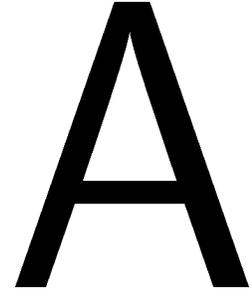


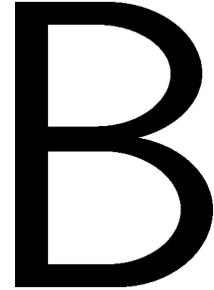
Part V
Appendices

Abbreviation Table



BP	Blood pressure		of carbon dioxide
CVP	Central venous pressure	Peri-op	Peri-operative
DL	Decision ladder	PER	A perfusionist
DR	The anaesthesiologist	Post-op	Post-operative
ECG	Electrocardiogram	Pre-op	Pre-operative
ESF	Event-state flow	PRP	Peer review protocols
EPR	event \rightarrow mental process \rightarrow response	PT	Patient
ETT	Endotracheal tube	RE	A resident
HR	heart rate	RL	A reliever
i.v.	Intravenous	RPD	Recognition primed decision
MD	Medical doctor	SG	Swan-Ganz catheter
NC	A technician	S-R	Stimulus-Response
NUR	A nurse	SUR	A surgeon
OR	Operating room	TOTE	Test-Operate-Test-Exit
PA	Pulmonary artery	X	The observer
P _{co2}	Partial pressure		

Information sheet for anaesthetologists



Decisionmaking in Anæsthesiology: An overview of the study

Objectives

Anæsthesiologists make a large number of decisions in the management of surgical patients, as in

- selecting anæsthetic techniques,
- titrating drug dosage,
- interpreting clinical observations, and
- determining proper interventions.

In this research we will try to understand these decision processes, using real operating rooms (ORs) as study “laboratories” and collecting behavioural data while anæsthesiologists are doing their job.

The ultimate goals are to provide basic information for improvement of training of anæsthesia personnel and design of anæsthesia systems.

Data Collection Procedure

Most decisions are made with little overt indications. Apart from recording the events happening in the OR, verbalisation of anæsthesiologist’s thinking process is needed in inferring the decision process. In particular, we are interested in

- when a decision is needed;
- what decision is made, and what considerations are involved;
- what hypotheses are considered, maintained, and excluded;
- what critical information is sought; and
- what intention is behind the current action.

During the case, anæsthesiologist will be asked to think aloud whenever a decision is needed or made or an intervention made. Probing questions will be asked when information from voluntary thinking aloud is not adequate. Note that only the knowledge and information consciously involved are relevant.

Other non-on-line questions will be asked related to general knowledge of the surgery procedure and pre-operative assessment. Along with the recording of verbal information, events occurring in the OR will be recorded by pencil-and-paper method. A follow-up questionnaire will be conducted after the review of recordings.

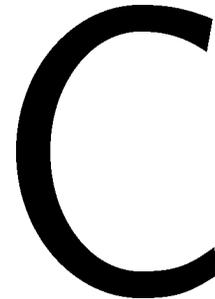
Data Processing

Episodes from a case are selected and event-flow diagrams constructed, correlating activities, intentions, and observed events.

Data anonymity

Anonymity will be maintained throughout the study. All names (of anaesthesiologist, surgeons, nurses, patients) will not appear in any written reports (including transcripts from recorded tapes). Efforts will also be made to ensure no person will be identifiable via indirect reference (*e.g.*, no date and location information will be disclosed). The recorded tapes will be used strictly for research purpose and will be destroyed or returned upon request.

Instruction for data collection



A Field Study of Problem Solving in Anaesthesiology: Data Collection Procedures¹

The overview of the study

As a step towards better design of devices and training systems, a field study was started to obtain some general characteristics of how anaesthesiologists solve problems in real life. By using real operating rooms (ORs) as “laboratories”, behavioural data are collected while anaesthesiologists are doing their jobs. Several cases have been recorded with the help of audio taping. These data showed some central features of problem solving in anaesthesia (preliminary reports are available upon request). Further studies are planned to substantiate the findings.

Data Collection Procedure

Three kinds of data are sought:

- Case report: prior to the start of a case, the anaesthesiologist gives a description of the case.
- On-line protocols: during the anaesthetic procedure, the anaesthesiologist reports actions and thinking process.
- Case summary: after the above information is processed by the analyst, the anaesthesiologist is asked to comment on the analysis done so far, and to correct errors in the data and analysis.

Detailed procedure for collecting these three kinds of data is described below.

Pre-operative phase

Receiving the assignment list marks the beginning of the anaesthesiologist’s preparation. After reading medical records and visiting the patient, many decisions have been made (such

¹ This research is a collaborative effort of Department of Industrial Engineering at University of Toronto, and Department of Anaesthesiology of The Toronto Hospital, under the direction of Dr. D.J. Doyle and Prof. P. Milgram. Contact for this study is Yan Xiao, Department of Industrial Engineering, University of Toronto, Toronto, M5S 1A4; Tel.: 978-3776; Fax: 971-1373

as the choice of the anaesthetic technique). A brief interview will be conducted to extract information regarding the anaesthesiologist's preparation up to this point. Questionnaire for the interview:

- Give me a short description of the case as if you were to present it to your peers, including significant findings and outstanding surgical procedures.
- What are the major concerns that *have actually gone* through your mind?
- What are those items that you think are unique to this case?
- What have you planned for the case beyond the general routines?
- What are the specific actions that you have listed for yourself to do prior, during, and after the case?

Other general questions will also be asked:

- What are the concerns that you might have asked a resident to consider?
- What do you expect a resident to have prepared up to this point?
- What is the expected surgical course?

Peri-operative phase

Apart from recording anaesthetic and surgical events, a wireless remote microphone is attached to the anaesthesiologist during the case to record verbal information. The anaesthesiologist is invited to think aloud whenever possible to describe mental activities, including:

- What you are doing and what are you trying to do (such as interventions and information seeking activities)?
- Indicate when a special effort is made in interpreting monitoring information, in making a choice, and in carrying out a procedure?

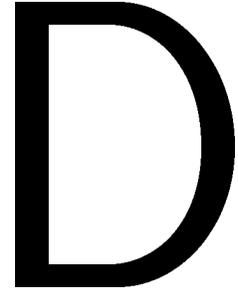
During non-critical times, some probing questions will also be asked:

- Suppose you want to leave now and give the job to a reliever with the same experience, what would you tell him/her?
- What are the expected problems, both in short term and long term?
- What is your current assessment of the patient status?
- How would you summarise the case so far?
- Are there any specific scenarios that you are trying to, or you have been trying to, avoid?
- Do you have any specific goals/patient status that you are trying to achieve?

Post-operative phase

The audio tapes made are to be transcribed, and potential confidential information (*i.e.*, reference to names, ages, dates, locations and specific surgery names) removed from the transcripts. With a brief analysis of the transcripts and other notes, a follow-up questionnaire will be conducted (usually after about a day or two). Interesting highlight episodes are brought forward to discuss with the anaesthesiologist. At the same time, the anaesthesiologist can correct errors made in the transcription, and slips-of-the-tongue, and the interpretation of the transcripts.

Case List for the Protocol Study



A valvular regrant

A male, 79, admitted into the hospital 6 weeks ago, was diagnosed to have a prosthetic valve stenosis (which was placed about 18 years ago), and an incompetent/rocking valve. Medical records and physical examination showed anemia, coagulation problem, and deteriorated renal functions. He has infection after a cystoscopy and is on antibiotic, which may partly contribute to the renal condition. Venous access looks challenging due to recent numerous i.v.'s. He seems not to have coronary artery disease, and his daughter's recent operations have been without complications from anaesthesia.

The subject (AL) was an attending anaesthesiologist with more than 30 years of practice experience. A senior resident was with him. The case lasted 5 hours.

A by-pass-valvular-replacement

A 35 year old, 85 kg, female with a stormy medical history was under operation for aortic arch stenosis, aortic and mitrial valve replacement, two aortic coronary bypasses, and two crafted carotid arch bypasses.

The patient had two previous cancer procedures: a hysterectomy and a lobectomy.

The subject (AL) was an attending anaesthesiologist with more than 30 years of practice experience. A junior (second year) resident was with him. The case lasted 6 hours 10 minutes.

A bone marrow harvest

A young, otherwise healthy, male was for a bone marrow harvest to get ready for chemotherapy. The patient was not admitted into the hospital until the day of operation.

The anaesthesiologist was a staff with about 5 years of attending experience. The case lasted two hours.

A pancreatectomy

A 61 years old, 60kg, female had a pancreatic mass and an exploratory pancreatectomy was planned with a possibility of a Whipple procedure (to treat pancreatic cancer). The patient had originally been scheduled to have the surgery in the second case of the day, but the first case was somehow delayed, which would have been a very difficult and troublesome case as anaesthesia was concerned.

Apart from the anaesthesiologist, a clinical clerk (a fourth year medical student) and a technician (who was testing and demonstrating a new, non-invasive, continuous arterial blood pressure measurement device) were also present during part of the case.

The subject (JD) had six (6) years of attending experience. The case lasted 7 hours.

An esophagoscopy

A 69 year old male was for a salivary stent esophagoscopy. He came to the hospital three months ago for a major GI bleed. At that time he had a cancer at the junction between his esophagus and stomach. The esophagus was removed and a tube installed upto his neck, but the tube falled apart at the end. The surgeon is to put a stent to keep it open. The patient has come back several times for the same procedure.

The subject (NM) was a fourth year resident. A staff anaesthesiologist was at her assistance, but only for two brief periods (both less than five minutes). The case lasted 1 hour 10 minutes.

A lobectomy

A female, 65 years old, 60 kilograms, underwent a right upper lobectomy. She was a heavy smoker and quited a month before the surgery. She was fairly obese, hypertensive. Epidural anaesthesia was considered for post-operative pain management but was rejected because of the technical difficulty due to obeseness and language barrier to obtain proper consent.

The subject (NM) was a fourth year resident. A staff anaesthesiologist was at her assistance, but only for two brief periods. So She did the case essentially on her own. The case lasted 3 hours.

An abdominal-aortic-aneurysm

A 71 years old healthy woman, 57 kg, underwent an AAA (*Abdominal-Aortic-Aneurysm*) procedure. Pre-operational visit did not show any significant findings. She had only one kidney. The chosen technique was to use epidural anaesthesia plus general anaesthesia.

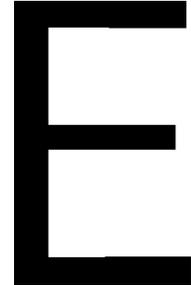
The subject (JS) was a fourth-year senior resident under the supervision of an attending physician, who was not present at the case. The case lasted 2 hours 30 minutes.

A cholecystectomy

A 35 years old, well built, healthy man, 67 kg, underwent a laparoscopy for cholecystectomy. It was one of the first laparoscopic cholecystectomies for the surgeon.

The subject (JS) was a fourth-year senior resident under the supervision of an attending physician, who was not present at the case. The case lasted 2 hours 20 minutes (considerable longer than such kinds case done by experience surgeons).

An example of the protocol data



The case

A femael of 65 years old and 60 kg underwent a right upper lobectomy to treat lung cancer. She was a heavy smoker but quited a month before the surgery. She was fairly obese and hypertensive. Epidural anaesthesia was considered for post-operative pain management but was rejected due to her English skill and technical difficulties involved due to obeseness.

Protocols

LEGEND

PA	Patient
DR	The anaesthesiologist (the subject)
NUR	A nurse
SUR	A surgeon
SV	A supervisor
X	The observer
XXX	A doctor
<...>	A summary or an abbreviation of a speech
{...}	A description of action or situations
[...]	An added comment by the transcriber

```
Time | Counter |
09:38:45|004 DR: Checking the cuffs on my double lumen tubes
        |         | {NUR was positioning PA}
09:39:38|012 DR: She is not going to have an epidural [to SUR]
        |         | I talked to Dr. XXX and he decided to give a PCA.
09:39:51|014 {DR was positioning PA}
09:40:36|021 DR: <instruct PA and get ready for iv cannul>
09:40:43|022 DR: Now, has anybody tried to start a big intravenous on you? [to PA]
        |         | Looks like they did.
09:41:02|025 DR: I have to start an intravenous because she doesn't have one.
09:41:09|026 {Another SV came in}
        |         | SV: I am here all day [to cover you]
09:41:28|029 DR: I tried to find an intravenous. It looks like that they poked
        |         | other side a few times for me.
        |         | See if we can ...Good. Good enough for a starting.
09:42:00|034 DR: Can you make a fist [to PA]
09:42:57|043 DR: She may not get in an 14 but an 16.
09:43:10|045 DR: Now some pinch now, a little slizzing going in [to PA]
09:43:42|050 DR: This patient doesn't have great veins. That's for sure.
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09:44:13|055 DR: Here we go. [Finding veins]
09:44:26|057 DR: Sometimes it is a bit tricky to get them in when you get a
twist little vein there.
09:45:09|064 DR: Well, my dear, what we're going to do is to put another needle
on this side, too [to PA]
09:45:15|065 DR: We want to keep patients dry during a thoracic surgery. So we
don't want to give too much fluid
09:45:34|068 DR: The colleague doesn't show up.
09:45:46|070 DR: Just relax you arm [to PA].
09:46:05|073 DR: What did I do with my freezing?
09:46:29|077 DR: A little pinch. I am sorry for that. There is a little more
freezing going in. [to PA]
{Observing the patient was nervous}
09:46:48|080 DR: Did they come and wake you up and give you a pill? [to PA]
09:47:12|084 DR: I noticed that I was going to put the art-line and the iv on the opposit side
from what I ... from the way it set up. [to NUR?]
09:47:55|091 DR: Just relax. We already have the freezing in so this is not going to
hurt you [to PA].
09:48:07|093 DR: Some people don't put this in steril but I always do.
09:49:01|102 DR: This is just to check <...>
This is so because sometime when you go for the skin you get a plug
of tissue in your angio [angiocatheter] So it is easier to ...
09:49:36|108 DR: Don't move, just relax [to PA]
09:49:42|109 DR: Just to see if we can get a flush.
09:50:00|112 DR: It's a more difficult network. I try not to go through the
artery. I just like to slide that in. It gives you the
opportunity that if by chance you don't get like that, and
sometimes you don't. It is just a matter of feel and experience.
The reason I like to put on a syringe is that I have all the
opportunities to watch the blood comes up the syringe. If the
blood still comes up you know that the tip is still in the artery.
I slowly rotate it off and try it up and most of the time it
works.
{Arterial cathether was in}
09:51:39|129 DR: You are going to go to sleep soon [to PA]
09:51:51|131 DR: Now I get rid of my sharps so that nobody ...
09:52:08|134 DR: Now I just make sure that this is zeroed
09:52:26|137 DR: Looks like it is more difficult to intubate [to SV]
{SV gives description of his experience with airway judgment}
09:53:11|145 DR: This is a little probe on you finger, measuring the oxygen in your
blood. [to PA]
09:53:28|148 DR: There is some oxygen for you to breath.
09:53:45|151 X: <what monitors you are going to use>
DR: Just the usual monitors.
09:54:47|162 DR: I am going to put an extra extension tubing so that I can
reach.
09:55:09|166 DR: Now we are starting to put in a little medication to make you
feel a little bit of sleepy. [to PA]
09:55:15|167 DR: Here is some curarine, 3 miligrams.
Now she is going to get heavy.
09:55:48|173 DR: They for sure to go ahead with a full thoracotomy? [NUR]
NUR: <...>
09:55:54|174 DR: Now we are waiting for that to come down.
Now the automatic cuff...
09:56:10|177 DR: I have some lidocaine drawn up. Blood pressure is little bit
along the high side. I thought it was going to be like that.
That's why I put the art-line before she went to sleep because
she is on the ...
09:56:37|182 DR: 250 of Fentanyl. [giving the patient]
09:56:43|183 SV: <asked about pre-medication>
DR: Yeah. I cut down the volume of pre-med. I don't always
pre-med with thoracotomy. But with her, ...
09:57:10|188 DR: Try to relax [to PA]
09:57:21|190 DR: Get another one of these ready because once she is asleep I
won't ...
{draw up Propofol}
09:57:32|192 DR: I don't like her blood pressure being so high.
09:57:42|194 DR: Feel a little sleepy? [to PA]
A little? [to PA]
09:58:25|202 DR: I gave her some lidocaine. It is because her blood pressure
is on the high side. I am trying to be responsive to.
09:58:57|208 DR: SUR, are you going to go ahead with the ...
SUR: <...bronchoscopy...>
09:59:08|210 DR: You may feel a little pain in your arm when you drift off to
sleep [to PA]

09:59:39|216 DR: Nice big breath [to PA]
10:00:10|222 DR: I feel a little bit of surprise that that didn't put her to sleep.
With Propofol sometimes it takes a while. [to ???]
10:01:38|239 DR: Now, hope it is not quite as difficult to do according to rules
You don't much room in your neck, my dear.
{Tube was in}
10:02:03|244 DR: I don't think I would got that 8 in it [size 8 tube].
10:02:38|251 DR: I don't think she is going to need any air in the cuff.
let's see. That's a pretty snug fit. [to NUR, deciding how
much air should be put into the tube cuff]
10:02:48|253 DR: SUR, this is a 7 and half [to SUR]
10:03:08|257 DR: Let's me tape the eyes.
10:03:13|258 DR: Okay. I have some propofol to keep her sleep with.
10:03:23|260 DR: They like to give this at sometime, too [indicate
antiseptic to SV]
10:04:32|274 {Work with SUR with bronchoscopy}
10:05:15|283 DR: I use vecuronium again, because she may end up with not giving
her a thoracotomy if her MED is positive. So I want to be
able to reverse her in about 45 minutes to an hour. [to X]
10:05:35|287 DR: Now, let's give her something to keep her asleep.
{giving some more propofol}
10:05:58|292 DR: I just give an <...> blood pressure and heart rate.
{Charting started}
10:06:13|295 DR: That's another reason I like the art-line if I can get quickly before
the patient goes to sleep, because all you are set. [to X]
10:07:32|312 DR: When I intubated the patient, the blood pressure was 115 and
and didn't change, which was good, because I was going to
use nitroglycerin. But I gave a fairly big dose of propofol to
try and block her down. I have the nitroglycerin ready but I
didn't use it.
Now I just use propofol to keep her asleep. You have just to
remember to give her every 3 or 4 minutes. I have to use my
hands to push it. [because no automatic pump]
10:09:39|340 DR: Are you doing a MED now? [to SUR]
Her neck does not have much space.
{Work with SUR, secure airway tube so that SUR won't pull it out
while pulling the bronchoscopy through the tube}
10:11:11|361 X: If you have an automatic pump, you may not need the art-line? [to DR]
DR: You do put it, because you need to draw blood gases one she
goes on one lung. And also I probably will use it anyway
because her blood pressure is quite high.
This is low now, almost on the lower side. But soon they are
going to stimulate her and meed is a very stimulating procedure.
10:12:48|384 DR: Did you see whether he [SV] gave her antiseptics? [to X]
X: <don't know>
DR: I'll wait though I think he has given to her.
10:12:52|385 DR: See, this is a little surgical stimulation [to X].
So I don't have to treat her low blood pressure. Because I
know that if I treat it, and they cut her, I'll be treating
the other way.
10:13:45|398 DR: She will get a Foley catheter. She doesn't have it yet but if
they decided to go ahead with the procedure she will get one.
[Foley catheter is a urinary catheter]
10:14:30|409 DR: She has a really large dose of fentanyl because her blood
pressure was high and I was trying to block that down.
Her mean blood pressure was 110 and now is 75.
The art-line is a little bit high and the transducer is a
little bit low so...
{adjusting transducer}
Now the two correlates better.
I am trying to ...
{Adjusting iv speed}
10:16:08|434 DR: You don't want this to run too fast, because if they decide to
go ahead with thoracotomy we would like to keep her on the
dry side. [to X]
10:16:31|440 DR: I haven't treated her blood pressure. I am waiting. I think
they are going to cut her. [to X]
10:17:04|449 DR: She needs a little surgical stimulation [to X] [commenting on
the low reading of blood pressure]
10:18:07|466 X: <commenting on the rising of the patient's blood pressure>
10:18:07|466 DR: Yeah, I think she is quite light. Probably quite light.
I know that as soon as they stimulate her her blood pressure
will go up.
10:18:39|475 DR: Now she is doing exactly what I thought she was going to do.
See how her blood pressure goes... [to X]

10:20:00|498 DR: Her probe came off finger [pulse oximeter probe came off and
DR went to fix it.]

10:24:11|008 DR: For this this procedure there is always a possibility
that they relocate the tube...
{Alarming sound}
DR: Did you extubate me? [to SUR]
SUR: <no>
DR: You just disconnected me.
It's okay. It is just disconnected.

10:24:38|012 DR: The endotracheal tube was just disconnected because it was
right beside the surgeon. [to X]

10:26:09|026 DR: He didn't give her antiseptic [He: SV. Her: PA] [After seeing
the bottle of antiseptic]

10:26:41|031 {DR preparing the antiseptic}
DR: Let's me see if she's got any allergies [see the chart]
{Inject the antiseptic, but hard to reach the inject point}

10:29:32|058 DR: Now I have to figure out how much drugs I have given.

10:30:09|064 DR: Hope I can get that tube in [the double lumen tube to be used
in the possible thoracotomy later on]. That's a big tube.
Her airway is small.

10:30:22|066 X: So you have predicted a difficult ...
DR: Airway? Well, she is short, fat, she's got the capped teeth
all along the front. Though nothing dramatic, but these
little things add up so I chose 7 and half tube, though for
bronchoscopy they like a bigger tube.
<discussion about the first case>

10:34:48|110 DR: As the case goes on it is not so stimulating, because they
already made the cut. I keep
turning down a little bit [the vapouriser].
She doesn't
need as much anaesthetic. Onece they have disect all the
planes it doesn't hurt the patient.
X: <did you correlates the observation of the surgical process
with monitoring?>
DR: The blood pressure came down a little bit. It tells me that the
patient's status is stable and the procedure is at its end.
At the end of the procedure I
keep the patient just asleep just in case we have to wake
her up.

10:39:47|162 DR: I am not going to draw any blood gas now. But if they tell me
that they are going to go ahead with thoracotomy then I'll
draw the blood. <I can get baseline value, also I want to
know how she responds to my ventilation, which is 50% oxygen.
And also how my endtidal co2 correlates with the test>
<A prolonged period of teaching by SV>

10:50:30|286 DR: Right now we're just waiting for surgerns to decide whether
they are going to go ahead with thoracotomy. If they decide
to go ahead, we are going to position her and I'll give her
some longer lasting relaxant pancuronium. [to X]
{The surgeon informed that they will go ahead}

10:53:18|322 {re-position the patient}

10:53:32|325 DR: I hope I can get that 35 in [35mm double lumen tube]

10:53:36|326 DR: I know that she is not the easiest patient to put a double
lumen in.

10:54:03|332 DR: Here is the tube. I checked the cuffs. [the bouble lumen tube]

10:55:05|346 DR: Let's take the tape off [remove previous tube]

10:57:02|373 DR: Actually I am gonna have to paralised her.

10:58:09|389 {Get the double lumen tube in}

11:00:52|430 SUR: Would it be possible to use a bigger tube?

11:00:56|431 DR: No. No way. I have to really push to get a 35 in.
Seven and half of an endo-tracheal tube doesn't need air in
the cuff.
{Trying to position the double-lumen tube properly}

11:12:08|013 DR: Now, where is that ephedrine?

11:13:13|023 DR: She is heavy. Is that a requirement to do thoracic surgery
that you have to be strong? [to SUR]
SUR: It helps.

11:16:50|057 DR: Just make sure that the intravenous works, because they moved
the patient.

11:17:08|060 DR: I am not going to be able to check this lady's brochis.
[because the particular positioning of the patient]

11:18:10|070 SV: Do you want a coffee or something?

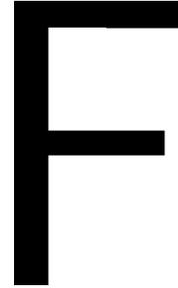
11:18:17|071 DR: I don't mind one. Let's get the chart upto date. I was
pretty much caught up with the positioning.

11:20:25|092 DR: Her airway pressue hasn't changed so we must be ventilating

very well. [to SV]
{Answering general questions from X}
12:10:16|118 DR: She may not be paralysed actually. I should put the nerve
stimulator on.
12:12:24|140 DR: She is partially paralysed, not totally. [after checking with
nerve stimulator]
12:13:15|149 DR: He's only given her 2 more vecuronium.
12:13:38|153 DR: I could have given pancuronium but vecuronium can last 45
minutes so I don't have to worry about it till after 1 o'clock.
And when you add these two drugs together, it lasts even
longer, like two hours.
So at the end of the case the patient is still paralysed and
you may not be able to reverse her.

{talking about choice of drugs}
12:20:38|231 DR: It takes a while to get used to a drug. At the first few
times, I tried to do what the instruction said. But it wasn't
that easy, because I didn't know how long it lasts before
they begin to move. I didn' know what's going to happen.
I took young and healthy patients to practice the drugs.
12:35:14|425 DR: Are you done? [to SUR]
SUR: <no, but asking about the dosage of adrenaline used internally>
12:42:55|558 DR: {inflate lung upon request of SUR}

Introduction to Annotated Protocols



F.1 About the protocols

Protocols from six cases, included in Appendices G to L, are annotated protocols, which were generated through repeated analyses of audio recordings, hand-written notes, and communications with domain experts. Due to the nature of field observations, the protocols presented here are only a *partial* recording of what had happened during the case. The recording alone do not give adequate data for the comprehension of events and activities which occurred. A knowledge of the domain and experience of being in operating rooms are certainly a necessity in bridging the gap and filling the missing information. As an observer and a protocol analyst, I had a privileged understanding of the protocols shown here.

Traditionally field studies (as well as laboratory experiments) do not provide the reader access to data at the level of detailed protocols (see criticism by Roth *et al.*, 1987). Protocols recorded in naturalistic settings are bound to be messy, incomplete, and inconsistent. They are loaded with domain language and context-dependent features. They lack the rigour and the precision that one would hope for.

Nevertheless, the detailed protocols are included here to let the reader have the chance of looking at how inferences were drawn and how cognitive issues were identified. It is the author's belief that the "raw data"—the protocols—provide a necessary context for understanding the task environment and cognitive activities. They allow the reader to judge the jumps that were made in the process of abstraction of detailed protocols.

One should certainly be reminded of the classic study by Newell and Simon (1972) when reading through these protocols. If compared with the protocols in Newell and Simon (1972), the protocols presented here are certainly more complex, in the sense that the operating room is a team environment and the anaesthesiologist is part of a multi-tasking work setting. Although the special vocabularies may also be an obstacle to the reader, I felt that such an obstacle is not fundamental and one can still understand the stream of behaviour without getting lost in the swamp of medical terms. It is worth noting that publication of the protocols here was not intended when the recordings were made.

F.2 About the annotation and the format

Protocols or *scriptised* transcripts¹ are on the left column; annotations are on the right column. The protocols are segmented into episodes, and each episode is identified by a time stamp (either a time since the start of the recording, or a clock time), and a counter. Not all episodes were annotated.

Three kinds of annotations were made to each episode: summary, note, and coding. The *summary* is to provide the reader an overview of major events and activities in an episode.

¹ See Section 5.2.2 for the procedure used in generating the protocols.

The *note* is to highlight interesting parts in the episode, to infer the cognitive activities that may have happened, and to provide additional information for understanding the episode. The *coding* is to present in a condensed format those activities that are relevant to this thesis. The detailed explanations of codings can be found in Chapter 5. Efforts were made to limit the number of coding categories, but there was no intention to develop a comprehensive coding strategy.

Legends to abbreviations can be found in the beginning of each case, or in the glossary on page 167.

Annotated Protocols from a Pancreatectomy



Case description

A 61 years old, 60kg, female had a pancreatic mass and an exploratory pancreatectomy was planned with a possibility of a Whipple procedure (to treat pancreatic cancer). The patient had originally been scheduled to have the surgery in the second case of the day, but the first case was somehow delayed, which would have been a very difficult and troublesome case as anaesthesia was concerned.

Apart from the anaesthesiologist, a clinical clerk (a fourth year medical student) and a technician (who was testing and demonstrating a new, non-invasive, continuous arterial blood pressure measurement device) were also present during part of the case.

The subject had six (6) years of attending experience. The observer did the transcription of the audio-tapes.

Legend

X	the observer
DR	the anaesthesiologist
CK	an clinical clerk
PT	the patient
NUR	a nurse
NC	a technician testing BP device
RL	the relief anaesthesiologist
SUR	a surgeon
< ... >	inaudible or omitted speech
< >	< abbreviated speech >
{ }	{ <i>Describing activities</i> }

Annotated protocols

EPISODE WP-1[08:00:13]

{Examining PT outside OR}

DR: I was going to see the patient.
 DR: Hi, DR.XXX. Remember me from yesterday? Sort of?
 PT: < ... >
 DR: Ok, sort of. Looks like SUR changed his mind.
 DR: So you got the first. That's good.
 DR: Thank you.
 DR: Yah. So I'll drag you in this morning and I figured out it might be nice.
 PT: Good.
 DR: So we have an eager, fresh team here.

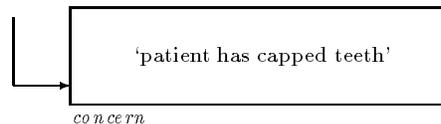
†SUMMARY: The anaesthesiologist met the patient outside the OR. He checked the patient's general status. He also communicated to the patient about the case switching.

EPISODE WP-2[08:00:46]

DR: Now, remember what I've said? We'll be very careful about your teeth. Ok? That promise still holds. [to PT]
 DR: Good. I am going to steal this and get the chart organised. [to PT]

†SUMMARY: The patient had expressed concerns during the pre-op visit about her capped teeth. While scanning, the anaesthesiologist comforted the patient.
 ‡NOTE: Post-case interviewed showed that the subject was reviewing the major concerns while checking the patient. A major concern is to be careful about the teeth during intubation and extubation.

Review



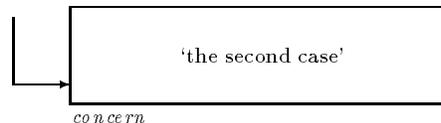
EPISODE WP-3[08:03:09]

{DR talking to X regarding the case inside OR}

DR: Now, our second case was originally scheduled to be the first case and she has very bad lungs. and I was really worried about her. So I was kind of pleased we're going to do this case instead, to start with [to X]
 X: Why? you have to do it anyway.
 DR: Not necessarily. If surgeon takes a long time in this case we won't get to the second one.

†SUMMARY: The anaesthesiologist informed the observer the switching of cases, expressed relief of his worry over the original case.
 ‡NOTE: The anaesthesiologist had probably cleared the plans for the troublesome case.

Alleviate



EPISODE WP-4[08:04:00]

{Talking about the new blood pressure machine}

DR: Where are we going to put this [NC's new blood pressure machine]
 DR: Are we going to have armboard for this case? [to NUR]
 NUR: I don't know. Probably.
 {Arranging the new machine}
 {Setting up the new BP machine with NC}

†SUMMARY: A company send NC to test a new non-invasive blood pressure machine which can give beep-to-beep arterial blood pressure.
 ‡NOTE: Because of the inserted task of testing the new blood pressure machine, the anaesthesiologist had to make special arrangement for his layout of measuring devices.

EPISODE WP-5[08:04:45]

NUR: < Informing tape allergic >

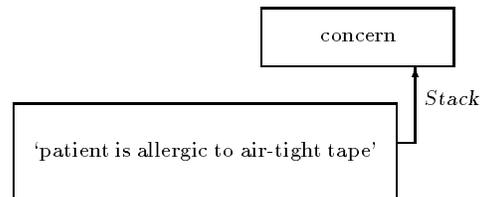
DR: What kind of tape?

NUR: She can use the pink the tape. But she can not the micro-tape, like the air-tight.

DR: Ok.

†SUMMARY: A nurse informed the anaesthesiologist about a tape allergy.

‡NOTE: The anaesthesiologist stacked a concern into the concern list. This concern would trigger changes in some parts of the routine procedures.



EPISODE WP-6[08:06:44]

DR: Ok, PT, we are just getting you in position. We will explain what we are doing as we go along, if you like, Ok?

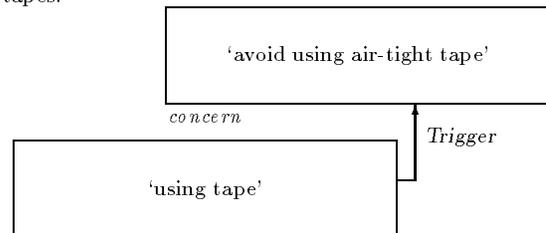
DR: I'm just taking this off.

DR: Ok. Now, PT, I am just going to take this down from here, because we are going to be putting a blood pressure cuff in that area.

DR: We are not going to use any elastic tape because I understand that you are allergic to it. So we have this kind of tape for you.

†SUMMARY: The anaesthesiologist is positioning the patient and tidying up areas on the arm to get ready for cannulation.

‡NOTE: Previous stacked concern had directed the usage of tapes.



EPISODE WP-7[08:07:58]

DR: What we will do, is to very discreetly tape this gown through, one arm at a time.

{Discussing problems with taping the existing i.v.}

†SUMMARY: The anaesthesiologist is re-organising tapes and an i.v. on the arm.

EPISODE WP-8[08:08:41]

NUR: < Asking about NC's new BP machine's cuff >

DR: I would like this cuff, on that side, and the new cuff, NC's, on the right.

†SUMMARY: The anaesthesiologist is arranging so that NC's cuff can be tested, but does not interfere with the patient monitoring.

EPISODE WP-9[08:08:47]

DR: I am just going to look to see if we have a good pulse here.

DR: I am just going to ...

{NUR and DR are putting on cuffs}

DR: Ok, I am just going to feel the pulse here, as well. I am going to feel the pulse here. Good!

DR: Mrs. PT, we are going to put a special monitor here to monitor your blood pressure, and another is going to be operational in just a moment.

{Directing people to put on cuff on the right arm}

†SUMMARY: The anaesthesiologist is setting up blood pressure monitoring devices.

EPISODE WP-10[08:10:00]

DR: Now I am going to bring your arm ... [interrupt]
Did you get shots or any thing to make you feel more comfortable before you came down?

PT: < Yes >

DR: Good. Ok.

DR: I am just going to get it set up to set the arterial line here.

DR: I just put in a little anaesthetic here.

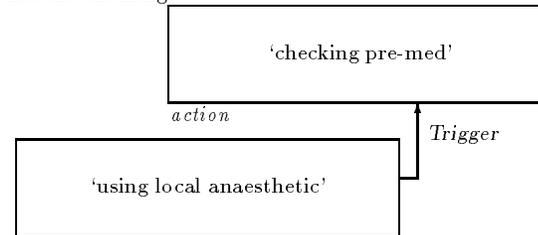
NUR: Do you want me to < ... > oxygen?

DR: No, we are going to start the arterial line.

DR: A little freezing going in.

†SUMMARY: The anaesthesiologist is setting up the invasive arterial blood pressure monitor's cannula (arterial-line). Before injecting a local anaesthetic, he checked the pre-medication order.

‡NOTE: The use of an anaesthetic triggered the check of pre-med order. The anaesthesiologist interrupted the procedure and did the checking.



EPISODE WP-11[08:11:11]

DR: I like a prep-tray and some eight gloves [to NU].

†SUMMARY: The anaesthesiologist is getting ready to cannulate for the arterial line.

EPISODE WP-12[08:11:41]

DR: Now while they are getting all that ready, I'll see if there is another i.v. here.

DR: I am tapping the veins to make them stand out a little bit, Mrs. PT.

{There is an i.v. line put in before. The size is 18 (usually too small to anaesthesia use).}

DR: I am going to put as much as I can in this arm, for you convenience. I am assuming that you are right-handed [to PT].

DR: A little more freezing go in here, Mrs. PT. Put in arterial line in? Yes, Please [to nurse]

{NUR is connecting the arterial line}

DR: OK, can you have this ready [referring arterial line]

DR: Would you make a fist, Mrs. PT? A fist with your...

DR: I am going to tap your vein to make them stand out, Mrs. PT.

DR: A raw needle...Ok
I am going to advance this a bit we will see how well that runs.

DR: I want it opened up [talking to nurse]

DR: The artery line will be...

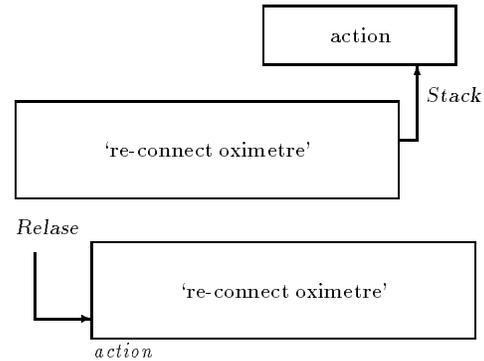
†SUMMARY: The anaesthesiologist is cannulating for the arterial line.

‡NOTE: Due to the task of testing the new blood pressure machine, the anaesthesiologist arranged his usual routine of monitoring.

EPISODE WP-13[08:13:49]

DR: Let's take the oximetry out, just for the moment.
 NUR: Do you want some more? [referring tapes]
 DR: We will put some more once the arterial line is in place.
 DR: Mrs. PT, this is just to make sure that your fingers are in right positions.
 DR: Put the oximetry back on. [Instruct others]

†SUMMARY: The anaesthesiologist removed the oximetry, and then put back on.
 ‡NOTE: Removing the oximeter out added a task of putting it back on. The anaesthesiologist utilising the resource opportunistically by asking the people available to do that task while proceeding to do other tasks.



EPISODE WP-14[08:14:41]

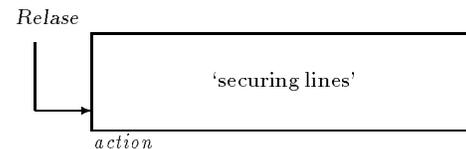
DR: Are we taking good care of you, Mrs. PT?
 PT: Excellent.
 DR: Excellent? Good.
 DR: Little needle going in.
 DR: Ok, the arterial line is elegantly placed
 DR: Ok, I can flush it now.

†SUMMARY: The anaesthesiologist relaxed after the arterial line is placed. He chatted with the patient.
 ‡NOTE: As a way of monitoring the patient's status, the anaesthesiologist chatted with the patient.

EPISODE WP-15[08:16:39]

DR: Good. Can I put you in charge of carefully securing the arterial line and two iv's we got there.[to NUR]
 DR: Get rid of the sharp.
 DR: Ok, this is no longer sterile. [Refer to the preparation tray.]

†SUMMARY: The anaesthesiologist downloaded the task to the nurse.
 ‡NOTE: The anaesthesiologist found the opportunity to download a task. He utilised the opportunity and switched to other tasks.



EPISODE WP-16[08:18:13]

{Scanning the workplace}
 DR: Now let's get the arterial line all zeroed.
 DR: We appreciate it if you can have the right arm left out. [to SUR]
 {talking to the surgeon about positioning the patient}
 SUR: You do what you have to do.
 {SUR came in and DR asked him about the new BP device on the right arm whether the surgeon is concerned.}

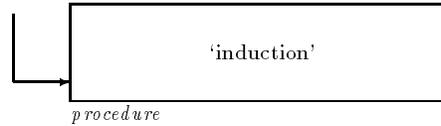
†SUMMARY: The surgeon entered the OR.

EPISODE WP-17 [08:19:40]

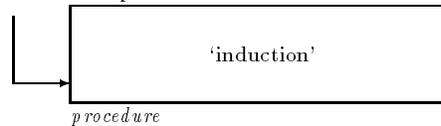
DR: How are you doing, Mrs. PT?
 {Injecting Fentanyl}
 DR: I am giving you some medicine to make you eyes feel heavy.
 DR: Ok. I will start the induction.
 DR: Now, this...
 {Injecting curare}

†SUMMARY: The anaesthesiologist started the induction sequence.
 ‡NOTE: The anaesthesiologist checked the patient status by chatting with the patient just before the induction. He scanned the drug cart as a way to make sure all pre-conditions were prepared.

Review



Review workplace



EPISODE WP-18 [08:20:43]

DR: Oh, Mrs. PT, I just have to get this around here.
 DR: You can breath through your mouth or nose, either one will be quite satisfactory, Mrs. PT.
 {Press automatic cuff to get reading}

†SUMMARY: The anaesthesiologist double checked the patient's status before the last induction drug. The anaesthesiologist used automatic cuff to double check the patient's blood pressure.

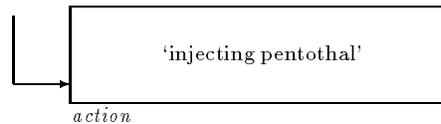
EPISODE WP-19 [08:21:36]

DR: Now, CK, I need to know how much her weighs. that'll be in the chart. 60 kg?
 {CK checks the patient's chart and confirm.}
 DR: Ok.

†SUMMARY: The anaesthesiologist obtained the patient's weight information.

‡NOTE: It is interesting that the anaesthesiologist is only concerned himself with the exact weight of the patient at this stage. Post-case interview indicated that the anaesthesiologist was rehearsing the next step: injecting Pentothal. The dosage of Pentothal does require accurate dosage.

Review



EPISODE WP-20 [08:21:51]

{X reminding DR to verbalise thinking.}

DR: Yes, I can comment on those things. Right now we have got all the monitor we're going to put prior to induction, and we got the baseline blood pressure measurement. We started with pre-oxygenation. We've given her some Fentanyl. We've given her some curare.

†SUMMARY: The observer requested the anaesthesiologist to give more verbal information. He gave a report on the patient's status.

‡NOTE: After giving patient a few drugs, the anaesthesiologist was waiting for the drugs to take effect, while scanning the workspace.

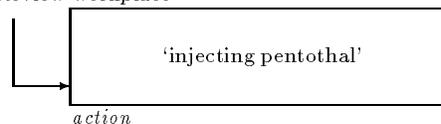
EPISODE WP-21 [08:22:17]

DR: I just ensure myself that the large-bore i.v. is running satisfactorily.
 DR: PT, I'm just going to... That's better.
 DR: You're going to go off to sleep now, PT.
 {Checking the syringe for pentothal}

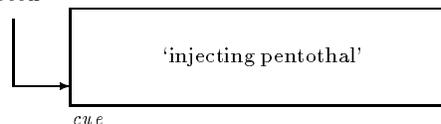
†SUMMARY: Scanning the workspace.

‡NOTE: The anaesthesiologist is checking the i.v. route so that Pentothal to be injected actually gets to the patient quickly and reliably. He was thinking about injecting the Pentothal.

Review workplace



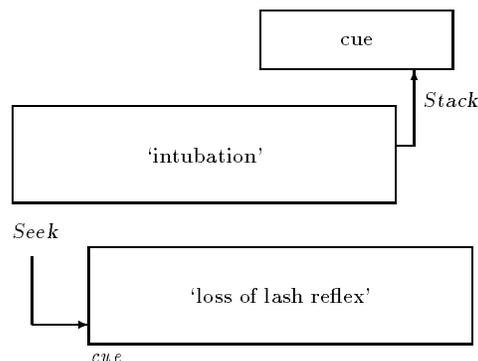
Seek



EPISODE WP-22 [08:23:04]

DR: That's the Pentothal going in, 250 mg
 DR: Getting sleepy, Mrs. (PT)

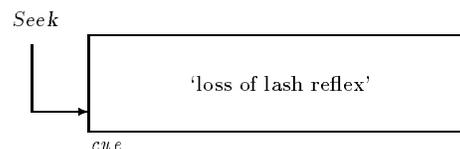
†SUMMARY: The anaesthesiologist injected Pentothal.
 ‡NOTE: After the injection, the anaesthesiologist anticipated that the patient would lose consciousness quickly. He was waiting for cues for the complete loss of consciousness so that he can intubation. The regular waiting time for this dose to take effect is about 30 seconds (or one arm-brain circulation time).



EPISODE WP-23 [08:23:14]

DR: Now she has a lot of caps on her teeth so I am going to do the intubation, because, you don't want to... [to CK]

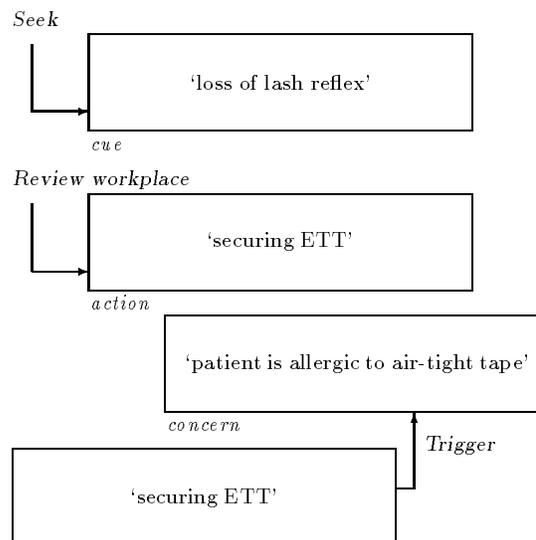
†NOTE: The clinical clerk (CK) was expecting to have a chance to do the intubation. Now the anaesthesiologist is explaining to the clerk the reason why he himself would do the intubation. The concern over the teeth directed this decision.



EPISODE WP-24 [08:23:39]

DR: So I checked for loss of lash reflex, and ...
 DR: I give her a positive pressure breath.
 NUR: Are you going to use a tie for this?
 DR: Yeah, one another tie. Because she is allergic to tapes and you never know...

†SUMMARY: The anaesthesiologist verbalised his actions
 ‡NOTE: The anaesthesiologist modified the regular practice of using tape to secure the endo-tracheal tube (ETT). Preparing for the extraordinary step while waiting for the patient to lose consciousness reduces the time of induction process.



EPISODE WP-25 [08:24:14]

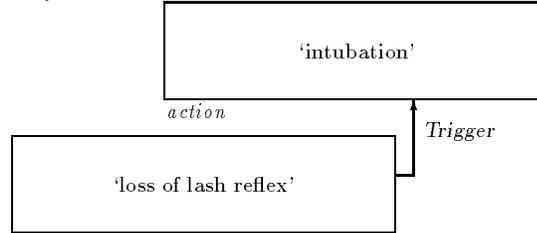
DR: I just make sure that it doesn't ruin my central venous line. [unclear what is 'it'. Probably the tie.]
 DR: So giving her some Pentothal and succinylecholine, she is quite asleep.

†SUMMARY: The anaesthesiologist is waiting for the proper moment to intubate.
 ‡NOTE: He is monitoring the patient for the moment of intubation.

EPISODE WP-26 [08:24:29]

DR: And I am about to intubate.
 DR: Ok, tube is in.

†SUMMARY: The anaesthesiologist has intubated the patient.
 ‡NOTE: The actual intubation process was actually quite short. But due to various contingencies, the anaesthesiologist had to be ready for them.



EPISODE WP-27 [08:25:09]

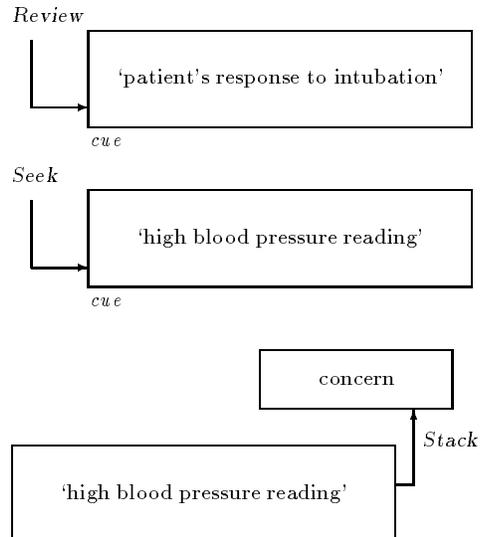
{NUR put 3ml of air into the sealing cuff of ETT}
 DR: Sounds like 3ml may not be enough for an adequate seal, let me just check the air entry [to NUR].
 {Using stethoscope to check on the patient's chest.}
 DR: It's a good air entry, so we put her on the ventilator.
 DR: Turn that on. Ok
 {Turning on the ventilator}

†SUMMARY: The anaesthesiologist finished up with intubation.
 ‡NOTE: Three ml's are the usual amount of air used to seal the ETT. Checking air entry would give definite answer if there is any question to that.

EPISODE WP-28 [08:25:49]

DR: You're reading 130 here which is a nice measurement [NC's new BP machine]. The arterial line reads 166 which I don't like at all so I am going to believe your machine. [to NC]
 DR: I can choose between numbers that I like. [to NC]

†SUMMARY: After intubation, the anaesthesiologist was checking the patient status.
 ‡NOTE: After intubation, the anaesthetics given before started to wear off. The patient may respond to the stimulus of intubation. The anaesthesiologist expected that the blood pressure may go higher.
 The anaesthesiologist has noticed an up-trend in the patient's blood pressure. He is await for the patient to settle down quickly so that he can start setting up the central venous pressure (CVP) monitor.



EPISODE WP-29[08:26:23]

NUR: < Asking: what size do you want? >

DR: Size 16 would be quite nice. Thank you.

EPISODE WP-30[08:26:32]

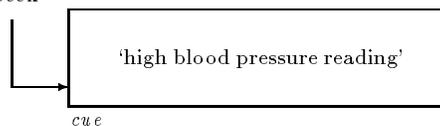
DR: It's interesting that she is 170 on the arterial line; and 112 on the NC' machine [the new non-invasive BP machine] and 150 on the automatic blood pressure.

NC: there are certain indications here that I need to see before I can start to trust this machine. [He is probably saying that the reading is less confident.] [MC explaining the new BP machine]
{Fixing the new BP cuff}

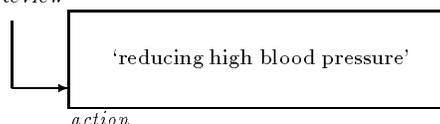
†SUMMARY: The anaesthesiologist had noticed the up trend in the patient's blood pressure, which was expected after the induction.

‡NOTE: The patient's blood pressure has risen up. But the anaesthesiologist received conflicting information. The new BP machine shows a rather low reading. The usually most accurate reading of BP from the arterial line, however, shows the highest.

Seek



Review



EPISODE WP-31[08:27:30]

DR: Can we... we are going to put the right arm on a armboard? [talking to nurse]

†SUMMARY: The anaesthesiologist is fixing the problem with the new BP machine.

EPISODE WP-32[08:27:49]

DR: That is a size 16 [talking to nurse]
{Talking about the prep-tray}

DR: That's not sterile any longer. No, Sorry.

DR: When I took the sharp off I had to sacrifice sterility for safety

†SUMMARY: The anaesthesiologist is preparing for CVP.

EPISODE WP-33[08:28:08]

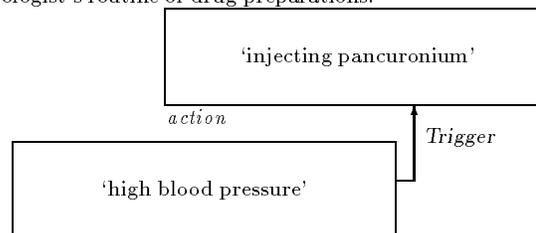
DR: I did not draw any pancuronium so that's the next thing that I want to do.

{Draw 6mg pancuronium.}

DR: That's 6 milligram of pancuronium.

†SUMMARY: The anaesthesiologist is checking the drug cart and is preparing for the drug.

‡NOTE: While waiting for the patient's blood pressure to settle down, the anaesthesiologist scanned the workspace and prepared for the long lasting muscle relaxant. The special arrangement to test the new blood pressure probably had offset the anaesthesiologist's routine of drug preparations.



EPISODE WP-34 [08:29:08]

DR: I just make some marks on the neck here to identify the dual sternocleidomastoid .

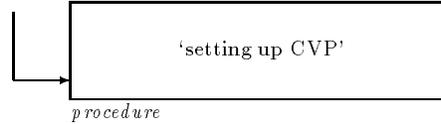
DR: Ok, I am going to wash my hands and I will be back.
{NUR inquires about the gown}

DR: CK is going to be in charge of anaesthetics in my absence, which will be brief.
{(DR) is washing his hands}

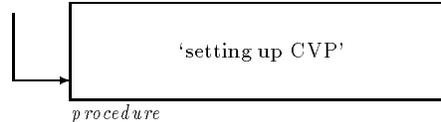
†SUMMARY: The anaesthesiologist is marking on the patient's neck for CVP catheter.

‡NOTE: The anaesthesiologist was getting ready for the CVP cannulation.

Review



Review workplace



EPISODE WP-35 [08:31:11]

{Talking with surgeons at sink}

DR: put in a line and it's all yours [to SUR]
{put on gown and gloves}

DR: So, I am going to put the central line here.

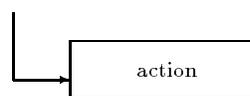
†SUMMARY: Chatting with the surgeon.

EPISODE WP-36 [08:33:13]

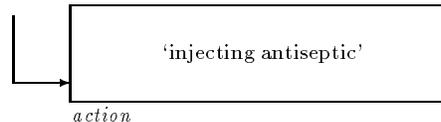
DR: Can I have some antiseptic? talking to nurse

‡NOTE: It was unclear why the anaesthesiologist requested the drug at the moment, even though antiseptic was given around incision time.

Scan



Review



EPISODE WP-37 [08:33:22]

SUR: I am not quite sure what we are going to do here. We don't have a diagnosis. She's got something bad in her pancreas and I think the chance of doing a whipple is very slim. In other words if it is cancer we are not going to be able to remove it. If it is benign, we may be able to cure her, which is not... Anyway we are not going to do anything exciting.

DR: She is hoping it is not a whipple as well.

†SUMMARY: The surgeon informed about the surgical plan specifically to the anaesthesiologist.

EPISODE WP-38 [08:34:29]

DR: I am just identifying the cleidoartery here and between the two heads of sternocleidmastoid and ...
{Starting to insert needle}

DR: I have the venous blood! This latest American invention.

DR: Pass this wire through.

DR: Isn't that neat? Those Yanks. I am only angry that I didn't invent it. The advantage of this technique is that you avoid use of two needles.
{Tying knots and securing the CVP.}
{Reading patient's status: HR=68 BP=92/47}

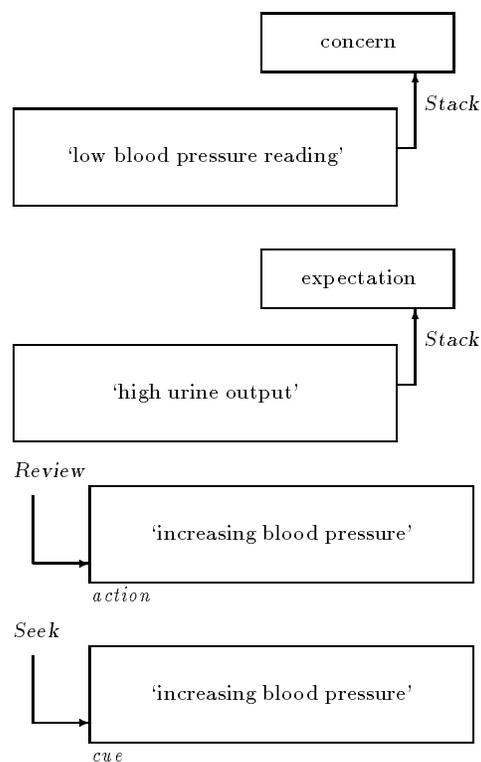
†SUMMARY: The anaesthesiologist is placing CVP catheter. At the same time he gave out a detailed verbalisation.

EPISODE WP-39[08:39:26]

{Press automatic BP to get reading}

- DR: Her pressure is about 87 here, about 100 and ...
I'm going to give her a little bit of epinephrine
and pump her pressure up to the region that I am
happy with.
- DR: She's got almost a litre of fluid so I don't think
she's got hypovolaemic.
- DR: She's probably going to put up a lot of pee for you
[to SUR]

†SUMMARY: The anaesthesiologist has noticed a down trend of blood pressure. He scanned the workplace while was thinking aloud. At the same time he noticed that the fluid bag was almost empty before his knowledge. In consequence he reasoned that the cause of low blood pressure reading was probably not because of low volume. ‡NOTE: The anaesthesiologist is not happy with the patient's status. Probing questions later showed that the anaesthesiologist assumed that the lack of surgical stimulus was the main cause of the drop in blood pressure. He excluded hypovolaemic basing on the fluid the patient has received so far. Large amount of fluid makes the anaesthesiologist to predict that the patient will have a large amount of urine output. Treating down trend blood pressure before surgical incision was almost always not favourable, as the surgical stimulations would drive up the blood pressure very quickly. Judged retrospectively, the incision time was 20 minutes later (see Episode Wp-50). It was clear that the anaesthesiologist was aware that the surgery would not commence in the next few minutes, and thus he treated the low blood pressure reading through drugs.



EPISODE WP-40[08:39:59]

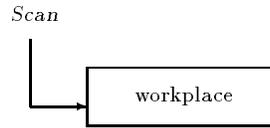
- DR: I just to get down... to enable you to cannulate
the bladder more easily.
- X: < Asking about epinephrine given earlier >
- DR: When the blood pressure was down? It was down low
enough that is tolerable, but I had felt more
comfortable when it was higher. Some people would
say that it was more to treat me to reduce my
anxiety than to treat the patient. But don't want
her blood pressure to drop below 100.
- X: < Why the blood pressure was down? >
- DR: There was a lack of surgical stimulation.

†NOTE: The anaesthesiologist explained his decision of giving the patient epinephrine. The urine monitor is just in place.

EPISODE WP-41 [08:40:38]

{Arrange anaesthesia cart and workplace}
 {arrange the lines on right arm}
 {Adjusting the ether screen}

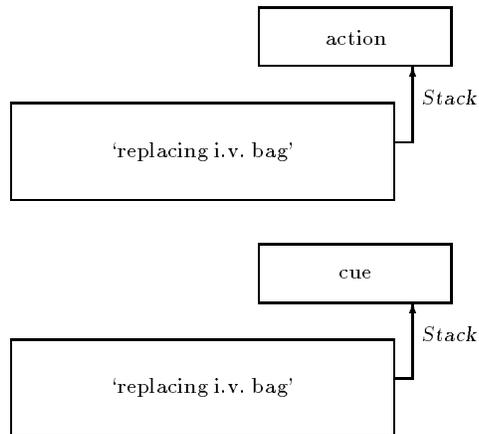
‡SUMMARY: The anaesthesiologist is re-organising the workspace after having set up all monitors and the patient has settled down for the surgery.



EPISODE WP-42 [08:42:55]

{Put on a new bag of i.v. and get ready to connect}

‡NOTE: The anaesthesiologist reviewed workspace and found the i.v. bag is almost gone, so he prepared another bag and got ready to connect. He also monitored the i.v. bag more often just before the bag was about to be empty.



EPISODE WP-43 [08:43:01]

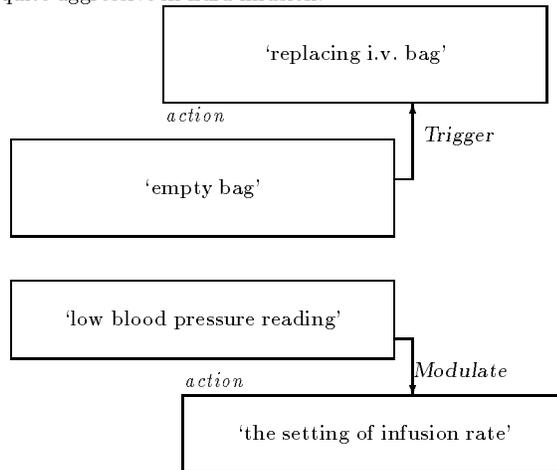
DR: There is no pressure on her right arm so that's good.

‡SUMMARY: The anaesthesiologist was checking the new blood pressure machine, which was mounted on the right arm.

EPISODE WP-44 [08:44:48]

DR: So this bag is empty...
 {change a new iv bag}

‡NOTE: The anaesthesiologist preferred to use fluid infusion as a way to drive up the blood pressure than via drugs. So he was quite aggressive in fluid infusion.



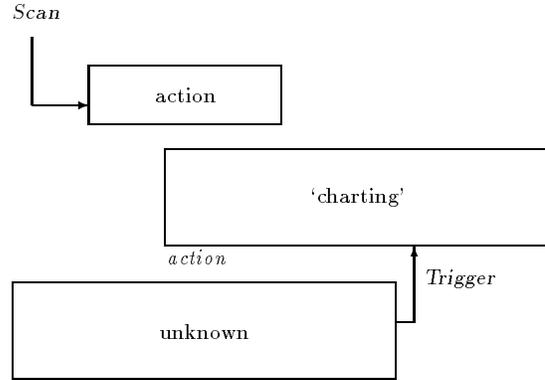
EPISODE WP-45 [08:45:07]

DR: Now we have a pretty good match among the three [BP monitors]

EPISODE WP-46 [08:49:45]

DR: Now I am going to do the charting up to date here.
 DR: Now, it is almost 9 o'clock.
 DR: I am just printing out the data, for my charting.
 DR: Ok, some more stuff here... [CVP is 3 cm H₂O]

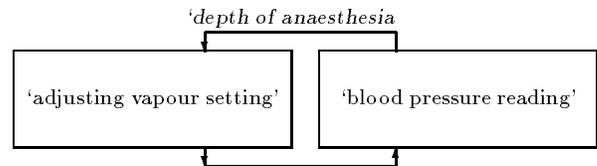
†SUMMARY: The anaesthesiologist started to chart.
 ‡NOTE: Charting usually indicates the start of a stable patient conditions. He appeared to be satisfied with the patient's general status.



EPISODE WP-47 [08:55:30]

{The patient's BP is 160}
 {Increasing vapour setting from 0.3% to 0.8%}

†SUMMARY: The anaesthesiologist started to treat the high blood pressure reading. He has monitored the reading for a while.
 ‡NOTE: In this instances and many others during this case, the anaesthesiologist adjusted the vapour setting, in accordance with the anticipation of surgical events, current vapour setting and the direction that the blood pressure reading should go. This behaviour can be looked as a local feedback/feedforward control loop to regulate the blood pressure. However, when the blood pressure needed to be lower whereas the vapour setting was high (e.g., > 1.5%), the local control loop was aborted and a new avenue was sought.



EPISODE WP-48 [08:56:23]

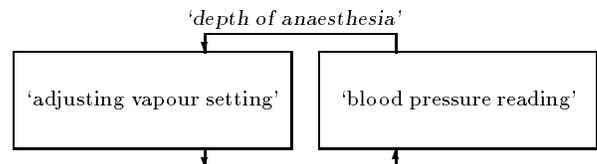
DR: Are you doing the second case as well? [to SUR]
 < Talking about the second case >
 DR: I am grateful for the switch. I heard that she's kind of problem. I asked for blood gas and hoped it would be ok. < Her pCO₂ is 60% >
 DR: The fact that you did the repeat gas [test] suggested that you weren't very happy with the first one. [to SUR]

†SUMMARY: Chatting with the surgeon.

EPISODE WP-49 [09:00:47]

{Decreasing vapour setting to 0.5%,BP 122, HR 66}
 DR: We got 114 on the arterial line and 115 on the sensor.
 DR: Do you know what that's going to do with my calibration?
 {Adjusting the table}
 DR: It's amazing that the CVP goes right up when you elevate the table.
 (BP=133 HR=66)

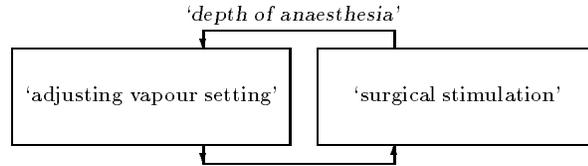
‡NOTE: The anaesthesiologist was monitoring the downward trend in the blood pressure. In the process he re-calibrated the arterial-line monitor by adjusting the table. He couldn't help noticing the CVP reading in the manometre on the bedside.



EPISODE WP-50 [09:03:22]

DR: So that's the incision so I'm just to make a mark [on the chart].
 {Increase vapour. HR=75, BP=135/72}

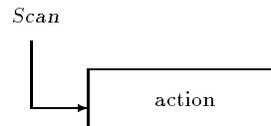
†SUMMARY: The anaesthesiologist noticed the incision, and increased the vapour setting.
 ‡NOTE: The anaesthesiologist used feedforward control: he anticipated higher surgical stimulation, thus giving more anaesthetic agent before actually seeing the response from the patient.



EPISODE WP-51 [09:13:57]

DR: I would like three units [to nurse] [blood transfusion] If we need more you can start cross match from there. Her starting haemoglobin is 139.

‡NOTE: The trigger for the act was not clear. Obtaining blood units was not a decision, but just a matter of timing.

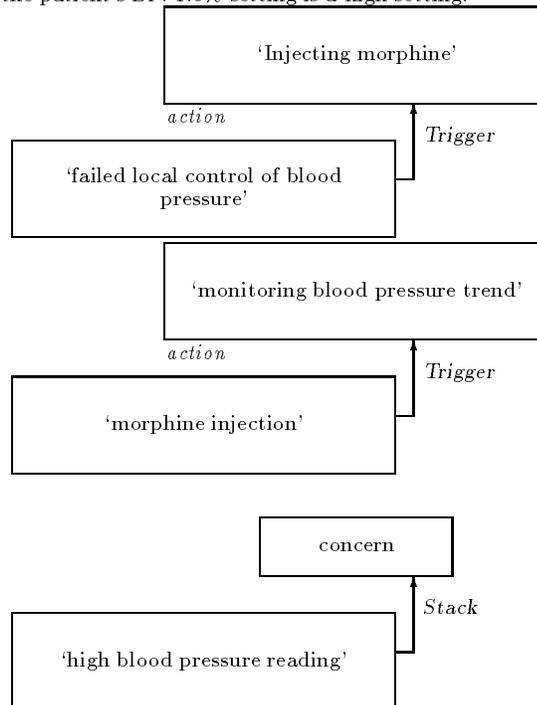


EPISODE WP-52 [09:15:48]

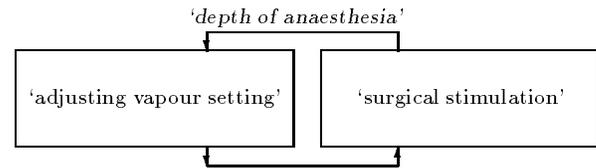
{Injecting Morphine}
 {vapour to 1.5%}

DR: I'm just giving a little bit of morphine.
 X: < Why? >
 DR: I noticed that her blood pressure crept up to 150 and surgical stimulation is still continuing. and I thought it is a good time to give some longer acting...
 DR: one, two, three, ... six milligrams. [count dosage just given]
 X: you certainly did not know how much before you gave it.
 DR: Well, I gave what I thought it was enough.
 X: So you gave half syringe.
 DR: A little under half.
 DR: It was just as reasonable to give 9 milligrams as to give 3, and ... to see what happened.

†SUMMARY: The anaesthesiologist changed a mode of intervention by giving intravenous drugs.
 ‡NOTE: Local feedback/feedforward mode of using vapourisor setting to regulate blood pressure reading ceases to work properly. The anaesthesiologist chooses a different mode of regulating the patient's BP. 1.5% setting is a high setting.



EPISODE WP-53[09:16:54]



DR: I just pump up the anaesthetic agent concentration for a bit.

{HR=72, BP=140/79}

EPISODE WP-54[09:17:31]

DR: I am dropping her end-tidal volume a little bit because her end-tidal CO₂ is kind of low 28 and I would like to get it around 34 or 35.

‡NOTE: Disturbances in patient status like this occur in not totally predictable manner. A local response to them often suffices.

X: Is this dangerous?

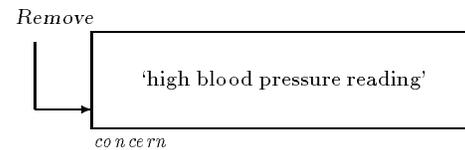
DR: In fact [this reading] is not dangerous but you can make it vary.

EPISODE WP-55[09:18:39]

DR: Well, patient settled in reasonably well.

{BP=150/76, HR=77. Vapour - Isoflurane 1.2%}

‡NOTE: The anaesthesiologist is happy with the patient's status.



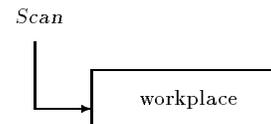
EPISODE WP-56[09:22:54]

{Checking CVP reading}

X: are you expecting a lot of fluid loss?

‡NOTE: A major function of putting up a CVP monitor is for fluid management. The anaesthesiologist examining the CVP reading repeatedly arose the observer's interest in his intention.

DR: Not an awful lot. Because we are not expecting a lot of chest fluid. It's about 6 now referring to CVP reading We changed the position before so...



X: This is not an absolute reading, right?

DR: Well if you do it exact right, the reading is absolute. Very often we put in CVP to help postoperatively. Because we're so good in putting them in.

DR: They are fun to do. One thing anaesthetists like to do is putting in lines.

EPISODE WP-57[09:47:28]

SUR: <request Nasogastric tube>

DR: Ok, nasogastric tube.

DR: They got bigger in size. That's 18 French [the NG tube]

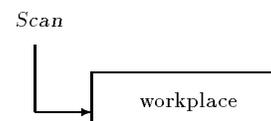
{Trying to put in the nasogastric tub}

{confirming with surgeon regarding the NG tube}

EPISODE WP-58[10:03:41]

DR: < Asked surgeon about the progress of the surgery >

‡NOTE: The anaesthesiologist felt that the surgery had gone into a reasonable length and should give indications about the expected length by now.



EPISODE WP-59[10:10:35]

X: You haven't draw any blood gas.

DR: No. I am not going to do any blood gas until there is fair amount of blood loss, when I need to do blood transfusion.

DR: So I am satisfied now. I have a reason to believe that she will not have a large amount of blood loss.

X: what would say to a reliever?

DR: I'd say be more careful about her teeth. Apart from that, everything is in the chart.

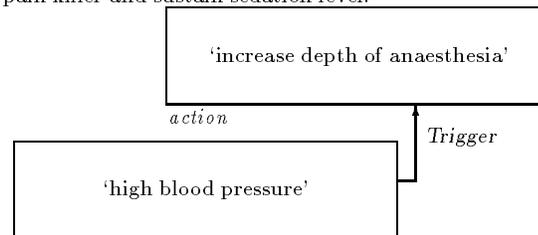
‡NOTE: After the patient settled down after the start of anaesthesia and surgery, the major concern for the anaesthesiologist remained to be the teeth.

EPISODE WP-60[10:14:59]

DR: I am going to pump up the anaesthetic agent.

DR: She is going to be here for a while That's another 6 milligrams [morphine].

‡NOTE: After observing the surgical field for a while, the anaesthesiologist decided to treat the high blood pressure with more pain killer and sustain sedation level.



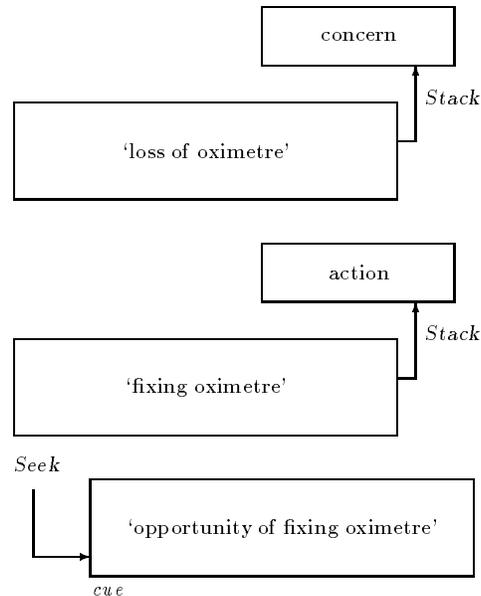
EPISODE WP-61[10:16:44]

DR: Now, pulse oximeter is coming off.

X: Can't imagine how people can manage the patient without it [oximeter]

DR: Well, I have a good reading all along so there isn't any reason that it is changed. When the surgeon is less involved what they are doing I'll go under to fix it.

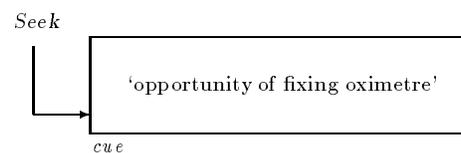
‡NOTE: Events like this are common in the operating room. The anaesthesiologist has to make do during these periods with less monitoring devices and rely on other channels of monitoring.



EPISODE WP-62[10:21:20]

DR: < Asking the surgeon to tell him if there is a good time to fix the oximeter >

SUR: < No >



EPISODE WP-63 [10:26:26]

{Decreasing vapour to 1.0% }

DR: That's another 3 milligram of morphine

X: why you do that?

DR: Well, her pressure is kind of high-ish, 150.

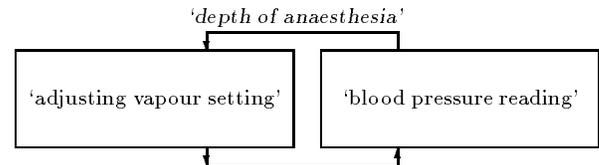
X: Is that the only way to treat that?

DR: No, no.

X: then why don't you use vapour?

DR: Yes, you can use that. But in balanced anaesthesia you use a little bit of everything.

‡NOTE: Post-case interview shows that the anaesthesiologist believed that the patient needed more pain remover.



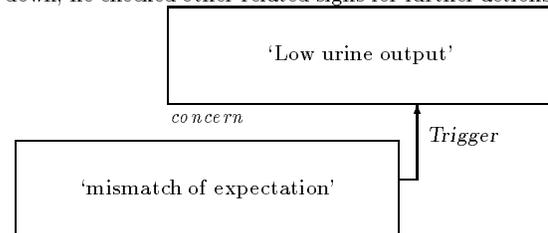
EPISODE WP-64 [10:29:28]

{Checking with urine output and CVP}

X: Urine output is correlated with CVP, right?

DR: If I don't have CVP, I'll go for urine output alone. The fact that CVP has gone down a bit. It provides more data to the hypothesis that it would be more beneficial to provide more fluid.

‡NOTE: After a period of high fluid input rate, the anaesthesiologist expected the CVP to go up. When CVP actually went down, he checked other related signs for further actions.



EPISODE WP-65 [10:30:57]

{Increasing oxygen ration to 34%}

X: < Why? >

DR: < No any good reason >

‡NOTE: Here it shows that the anaesthesiologist occasionally may not be able to verbalise his actions. Can we infer that his action is triggered by the concern over the loss of the pulse oximeter? It is a plausible explanation, yet was not confirmed by the subject.

EPISODE WP-66 [10:33:03]

{Noticing the higher trend in the BP, more than 160}

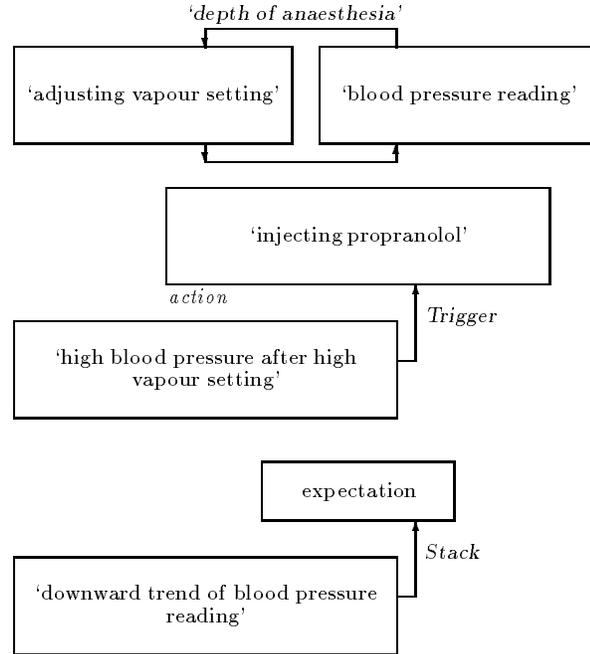
DR: It tells me that I should pump up the agent, despite my intervention

{Increasing vapour to 1.4%}

DR: < What I also need is a blocker. >

{Giving propranolol 1mg}

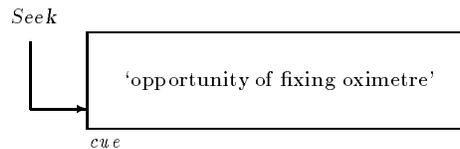
‡NOTE: Blood pressure is a joint indication of the patient's physiology. Here it is interpreted as a sign for the patient's response to surgical stimulation. The anaesthesiologist expected this, although his treatment of it is contingent on factors of (1) previous intervention (2) what is the status of previous intervention (3) the anticipation of future stimulation (4) the patient's response to previous treatment (5) current setting of the vapouriser. There are about three kinds of choices: blocker, pain killer, and anaesthetic agents. The anaesthesiologist was looking at environment for cues of which option is the most favourable, given the factors listed above.



EPISODE WP-67 [10:37:59]

DR: < Asking surgeon if can access the left-hand side of the patient to fix the oximeter >

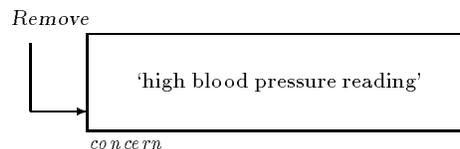
SUR: < we are in a dedicate procedure >



EPISODE WP-68 [10:38:28]

DR: Her pressure has settled down quite nicely.

‡NOTE: The anaesthesiologist had a concern over the blood pressure, which he believed was caused by surgical stimulation. Monitoring BP and controlling it became a short-term goal.



EPISODE WP-69 [10:40:35]

DR: The next thing is to get the oxygen probe on. The easiest thing for me to do is to draw up the blood gas and send it off. It is about the time that I would like to know the hematocrit is.

DR: Instead of bugging the surgeons, I will just go and.. So that's a decision.

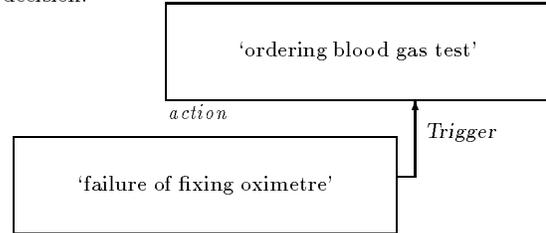
X: You have to do it anyway, right?

DR: Well, I would wait a little longer.

X: What is the cost of this test?

DR: My guess is about 5 dollars. As long as you can justify each time [to do the test]
{Drawing blood sample from arterial line}

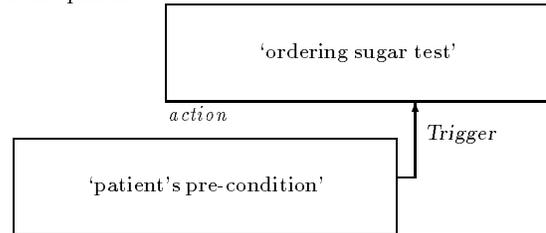
‡SUMMARY: The anaesthesiologist decided to do a blood gas test.
‡NOTE: While scanning the workplace, the anaesthesiologist was prompted with the option of doing a blood test. The option was favoured by the current concern over the oxygen probe. The cost of the test did not seem to have a strong role in this decision.



EPISODE WP-70 [10:43:13]

DR: Another example of decision is that ordinarily I would not order blood sugar, but because this patient has a history of pancreatitis, it would be more interesting to see that.
{Sending off the blood sample}

‡NOTE: While checking off which test to do, the anaesthesiologist saw the sugar test, which associated him with a pre-condition of the patient.



EPISODE WP-71 [10:50:03]

(Blood Gas test returned : pH=7.40 pCO2=40 pO2=204 TotCO2=26 BE=0.9 PCV=0.35 K+=3.1 NO=132 BS=13)

‡NOTE: The patient's status was good.

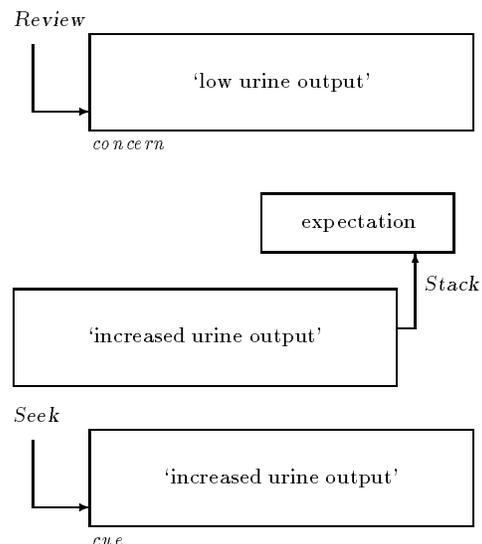
EPISODE WP-72 [10:51:30]

DR: So CVP is coming up with my fluids.

DR: I still have not had a lot of urine yet. So I'll keep providing fluids.
{Increase iv flow rate}

DR: < The patient's fluid should be about balanced >

‡NOTE: While managing the problem of blood pressure, another concern was brewed: the patient's low CVP reading and urine output. This concern existed even though the anaesthesiologist had been aggressive in fluid input.



EPISODE WP-73 [11:03:14]

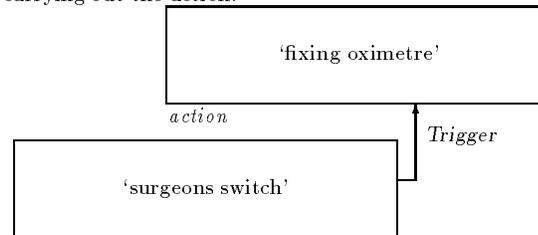
{Switching surgeons}

DR: Now, is that a good time for us to look at that...
[talking to surgeons about the displaced pulse oximeter]

SUR: Sure, it is a good time.

{Fixing the pulse oximeter with nurse}

‡NOTE: Pulse oximeter probe had been a concern for quite a while. The switching of the surgeon provided an opportunity for carrying out the action.

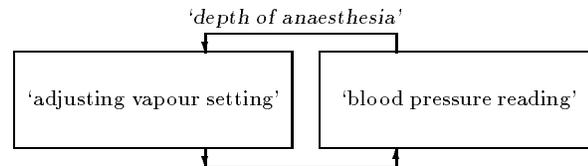


EPISODE WP-74 [11:05:26]

{Reducing vapour setting to 0.6%}

DR: < BP here is 108 >

‡NOTE: Another example of local control of patient status.



EPISODE WP-75 [11:06:02]

DR: Go ahead with the Whipple?

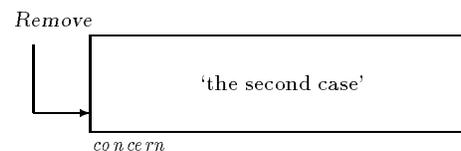
SUR: Whipple.

DR: Does that mean that we are not going to have the second case?

SUR: That's right.

DR: Good luck to the other anaesthetist. It will be enough just looking at the P_{co2} value. She is a real worry. She's got the worst lungs I've seen for years.

‡NOTE: Although anaesthesiologist did not know for sure that the second case would be cancelled, he had a strong expectation that first case would last long.



EPISODE WP-76 [11:07:13]

{Help Surgeon to check out the dimming lights}

EPISODE WP-77 [11:08:11]

Checking the urine output carefully

X: So is that true that your concern is the urine output now?

DR: She did not put much now

DR: The most common thing is that there might be a kink in the tube... but I just saw some drops coming in now.

DR: That's good. We'll just have to wait. There is a period of time between fluid goes in and the time the response occurs. [after checking urine line] So I just keep giving fluids

‡NOTE: While scanning the anaesthesia chart, the anaesthesiologist had realised that the patient did not generate adequate urine output. It had become a concern for him. Due to the large quantity of fluid input, he expected some urine output. In fact, at the beginning of the case (Episode Wp-39), the anaesthesiologist had anticipated large urine output. The mismatch between the observation and anticipation caused him to check abnormal spots. He verbalised his reasoning process in excluding problems in measurement. The concern was not resolved here.

EPISODE WP-78 [11:09:56]

DR: Now I'm just going to give some pancuronium [2mg]

X: For?

DR: Well, it has been for a while.

X: By seeing the chart?

DR: Basically yeah. Based on time. Also because I know that they are going to be here for a while, doing the operation.

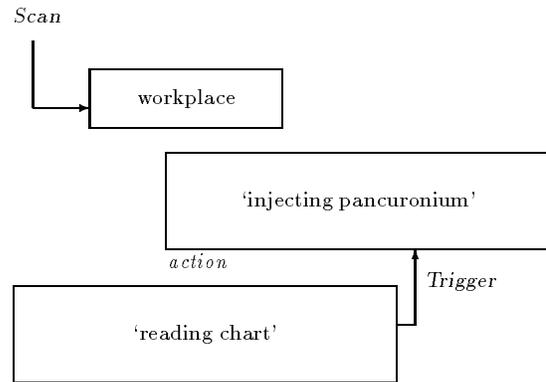
DR: Now, purists would say that I should use the nerve stimulator to check first.

SUR: Be careful---you're being recorded.

DR: Well, I am not too worried.

†SUMMARY: After checking the chart, the anaesthetologist gave some long-lasting muscle relaxant.

‡NOTE: Even though the anaesthetologist explained that he found out the need of pancuronium after seeing the chart, he could have thought of giving the drug before, and used the chart as a way to confirm this.



EPISODE WP-79 [11:13:19]

{Observing low BP, less than 100}

DR: I gave some Albumin. Albumin does a better job at restoring blood volume.

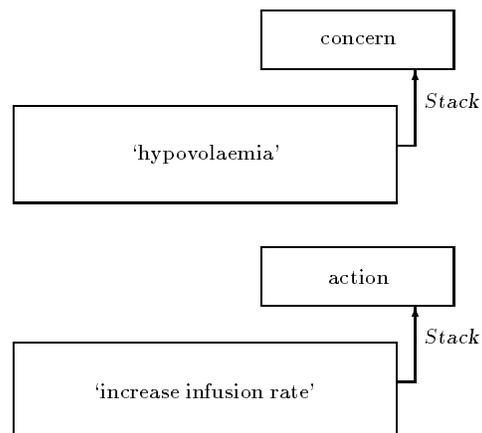
X: < Why? >

DR: I hadn't seen a lot of blood loss, but the blood pressure dropped suddenly, came back suddenly as well. It's probably related to diminished return of blood to the heart due to surgical manipulations. But, the manipulations were small, but the response was dramatic. That's the sign suggesting a hypovolaemia. So albumin would do a good job at restoring the blood volume.

DR: So low urine output, low-ish CVP, and a pressure drop in response to the decreased blood return to the heart, all of which indicate a hypovolaemia.

†SUMMARY: The patient's blood pressure had dropped. The anaesthetologist used more fluid infusion to counteract the low BP reading.

‡NOTE: By now the anaesthetologist had formed a strategy of increasing fluid input even more to restore CVP and urine output. Using fluid input also achieved the goal of increasing blood pressure. He could have used other means of increasing BP, but given that the surgery stimulation was continuing, using fluid method was judged to be a better solution.



EPISODE WP-80 [11:14:58]

NUR: if you need more albumin give me a notice as there is no more left in the cart.

DR: One more. To the nurse

EPISODE WP-81 [11:15:43]

DR: Another one for me? thank you [receiving a bottle of Albumin from nurse]

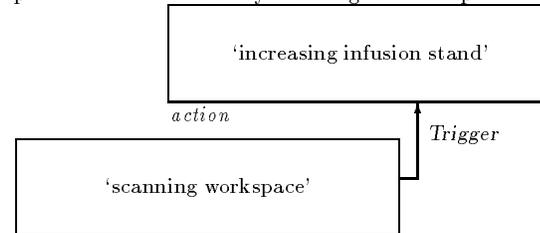
EPISODE WP-82 [11:16:40]

{Increasing iv stand}

X: < Why? >

DR: Well, I increase the stand height all the time.

‡NOTE: The concern was the patient's low blood pressure, low CVP, and low urine output. The anaesthesiologist used increased fluid input as a way to resolve that concern. To achieve that, he spotted another avenue by scanning the workspace.



EPISODE WP-83 [11:30:24]

DR: She is not making a lot of urine. I am just wondering whether the catheter has been kinked off or something. [to SUR]

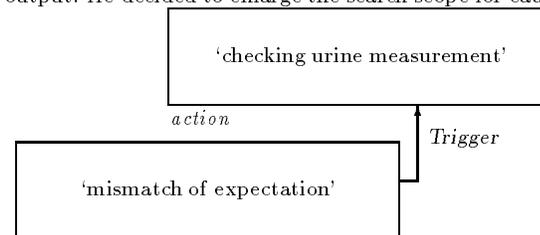
{Indicating a wish to check the urine line to SUR}

DR: I've got some albumin running. I've given 3 litres of crystalin.

{Urine line seemed to be okay}

‡SUMMARY: The anaesthesiologist asked the surgeon directly about other possible causes to the low urine output.

‡NOTE: After waiting for a while (see Episode Wp-77), the anaesthesiologist had not seen any significant increase in urine output. He decided to enlarge the search scope for causes.



EPISODE WP-84 [11:31:18]

{Mounting another bag of iv}

{Giving fluid bolus}

‡SUMMARY: The anaesthesiologist kept his strategy of aggressive fluid infusion.

EPISODE WP-85 [11:34:46]

DR: The CVP is about 8, going up.

DR: I can get it to go really up by pressing this. The time constant can be very short. And it seems to be short in this instance [referring the i.v. input].

‡NOTE: The anaesthesiologist is concentrating on high fluid infusion rate. He was also observing the correlation between the infusion pressure and the CVP reading.

EPISODE WP-86 [11:44:15]

X: What is your concern now?

DR: Right now the hypovolaemia is the major concern and that's why I am so aggressive with fluids.

EPISODE WP-87 [11:45:00]

SUR: what we got to do is to drink all this [refer to fluid?]

DR: Well, a lot of third spacing, eh?

SUR: very juicy

DR: Very juicy? well, I got her CVP up, and her pressure nice, but still she didn't pee a lot.

{Checking urine bag}

DR: Well, she's put 15cc so I cannot say she is not putting out any. I would like to see 100cc.

‡SUMMARY: The surgeon commented on his observation of fluid in the surgical site.

‡NOTE: The fluid in the surgical site provided the anaesthesiologist a possible explanation for the mismatch between massive fluid infusion and low urine output.

EPISODE WP-88 [11:50:18]

DR: This lady has a big bladder tube, doesn't she? [to SUR]
 SUR: < ... >
 DR: I admit it that it is better to blame you than me, right? [to SUR]
 DR: The other thing is that is it possible that the catheter is kinked? [to SUR]
 SUR: < ... >
 DR: No, no. Is the bladder felt extended?
 SUR: < No >
 You got to pull the bag. [to DR]
 DR: I just take a look under here [to check the urine line]
 SUR: No, the bladder is not extended.
 DR: Ok, I just keep giving fluid to keep CVP up.

‡NOTE: The anaesthesiologist was still puzzled by the fact that the magnitude of infusion was so big whereas the urine output was so low.

EPISODE WP-89 [11:53:59]

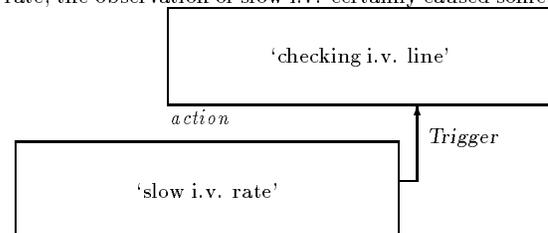
{Reading chart}
 {Draw morphine from ampoule}
 DR: Yeah, I think it is the time.
 {Injecting 6mg of morphine}
 X: Is that judgment of timing is purely time-based?
 DR: Yeah. [referring to give another dose of morphine]
 X: Why 6 mg? Because you are not worried about the patient not being waken up at the end of the case?
 DR: Well, I know that 6 mg will end before the case so I am not worried about that waking the patient up

‡NOTE: Reading the chart can be either a trigger for the act of injecting the drug, or a way to confirm that the patient was in need of pain killer.

EPISODE WP-90 [12:02:11]

DR: I am not too happy with urine department
 DR: Excuse me, SUR, I am just going check that her arms are ok. [to surgeon, in a strong tone]
 X: Any problem with iv?
 DR: Well it doesn't seem running very fast.
 {Re-arranging urine tube}
 DR: Now the iv seems to be running fine.

‡SUMMARY: The anaesthesiologist found that i.v. was not running smoothly and interrupted the surgeon to investigate the cause.
 ‡NOTE: While a local goal was to sustain a high fluid infusion rate, the observation of slow i.v. certainly caused some concern.



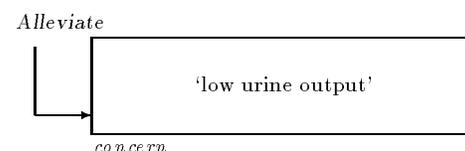
EPISODE WP-91 [12:08:47]

{Starting another bag of iv}

EPISODE WP-92 [12:20:38]

DR: She had a big bladder. She is actually making urine now.
 DR: Finally making urine.

‡NOTE: The concern over urine output alleviated somewhat. This was over 100 minutes of high fluid infusion (see Episode Wp-64 for the start of the concern over urine output). Still, the anaesthesiologist was not certain the exact cause of low urine output. Partly the problem was due to fluid shift to the surgical site, but there might be other causes.



EPISODE WP-93[12:30:26]

{*Ordering blood test*}

X: Any special reason to order this blood gas test?

DR: Well, I've given a lot of fluid I would like to know what the hematocrit is I want to know whether it is a good time to start transfusion but I suspect not.

‡NOTE: Post-case interview showed that the anaesthesiologist was thinking of transfusion. It was a common practice to get a baseline blood gas test before starting transfusion.

EPISODE WP-94[12:34:00]

SUR: < Request to give gentamycin >

{*Giving requested drugs*}

‡NOTE: Gentamycin is a routine drug to be given during operations to patients with inflammatory disease.

EPISODE WP-95[12:39:00]

[Blood test results are back: pH=7.32 pCO₂=42
pO₂=207 TotCO₂=23 BE=-3.5 PCV=0.27 K=3.1 W0=135
BS=9.8. CVP=14]

‡NOTE: Blood gas test indicates the P_{co2} increase from 40 to 42

EPISODE WP-96[12:43:46]

DR: So in response to the blood gases I am going to drop the CO₂ a bit by increasing the ventilation.

EPISODE WP-97[12:44:34]

{*Inject 3mg of morphine*}

EPISODE WP-98[12:46:46]

{*Adjusting ventilator rate from 8 to 12*}

X: You increased the rate, but not the volume?

DR: Not the volume.

EPISODE WP-99[12:48:01]

DR: And the potassium is down to 3.1, so I am going to add some potassium in the i.v.

{*adding potassium*}

EPISODE WP-100[12:49:35]

DR: < asking a nurse to check blood unit >

{*checking with nurse about packed cells, to be ready for blood transfusion*}

‡NOTE: The anaesthesiologist believed it was a good time to start blood infusion.

EPISODE WP-101[12:52:25]

{*Another anaesthesiologist came in to relieve DR*}

DR: This lady has a pancreatic mass. Oliguria is the problem of the moment. Now it is not because that I haven't given enough fluids. And the packed cell is just going up. And since it is < ... > not going to add too much to this. Or you'll get a sludge [interrupted]

DR: The other thing is that she hasn't much pancuronium for a while, but that shouldn't be a problem right away.

DR: She has a new fancy new non-invasive arterial line, hooked up to this manometre there.

DR: and from time to time the surgeons knock off the probe off the finger and you'll probably see that. I wouldn't worry about that.

DR: I just sent off for the blood gas. Ok

{DR left}

‡SUMMARY: The anaesthesiologist was relieved by another anaesthesiologist. He passed the case by giving an overview.

‡NOTE: Transferring duty was a good chance to see the things that the anaesthesiologist kept in his mind about the case. They include concerns, methods that were used but did not work well, pending activities, and special things unique to this case. It was also interesting to know he passed on the knowledge of how to treat the possible problem of displaced oximeter probe.

EPISODE WP-102[13:05:00]

{RL *checking tubes, lines, cannisters*}

{RL *asking size of i.v. catheters*}

{RL *gave 2mg pancuronium*}

‡NOTE: The reliever examining the whole workspace, in particular those areas associated with urine measurement.

EPISODE WP-103[13:10:00]

{RL observing breathing sign observed from capnography}
 {RL increases vapour to 1.5%}

EPISODE WP-104[13:19:00]

{DR came back}

EPISODE WP-105[13:19:13]

DR: I am going to give more morphine because
 X: Is she breathing?
 DR: The pressure has gone up a little bit. and she is
 on high level of ... [vapour]
 So I want to decrease that by giving more narcotics
 [BP dropped to 128]
 {Decreasing vapour to 1.1%}

‡NOTE: The anaesthesiologist did not agree with the approach
 of the reliever on how to balance between vapour and intravenous
 agent.

EPISODE WP-106[13:22:02]

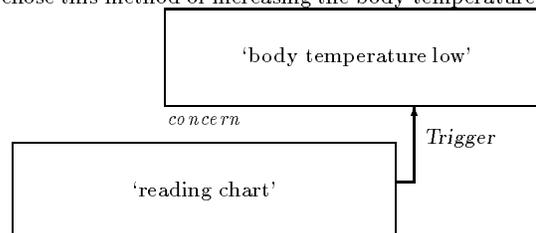
DR: Could you bring in another unit of 'red' stuff? [to
 nurse]
 {Checking with nurse the blood unit}

EPISODE WP-107[13:31:34]

DR: The patient is getting cold. It is long case but I
 am going to secretly increase the room temperature.
 Just to see how long it takes for them to comment
 how warm the room is.

‡SUMMARY: While charting, the anaesthesiologist noticed the tem-
 perature reading was low.

‡NOTE: It was interesting to note that the anaesthesiologist
 chose this method of increasing the body temperature.



EPISODE WP-108[13:33:47]

DR: CVP we have 18. [Indicating satisfaction]

EPISODE WP-109[13:36:02]

DR: Do I understand correctly that you've formulated a
 new plan or you revised it? [to surgeon]

SUR: < ... >

DR: There is a discussion about changing something. Not
 an anaesthetic concern. Well beyond my scope of
 interest. [to X]

EPISODE WP-110[13:54:43]

DR: well, we are getting urine...

EPISODE WP-111[13:56:06]

{Hanging up a new i.v. bag}

EPISODE WP-112[14:06:46]

DR: You see we are getting more urine

EPISODE WP-113[14:11:48]

SUR: I think she is cold [to DR, referring PT]

DR: We are hoping that we will warm the patient up but

SUR: That's what we figured.

DR: So far a blood warmer plus a catheter blanket is not
 proven to be adequate to the task. [to surgeon]

‡SUMMARY: The surgeon noticed that the patient's body temper-
 ature was low.

EPISODE WP-114[14:18:57]

{Acquiring of BP from automatic cuff}

X: Why didn't you get BP from arterial line?

DR: Oh, I just want to see what it was, as it looks kind of strange.

DR: Well, she needs pancuronium again. She is really taking a lot of it.

SUR: She is big.

‡NOTE: Using cuff to get blood pressure reading during the maintenance phase was not common. The automatic cuff was set to measure the blood pressure every 3 minutes. One can manually request a test any time. In the induction phase, because the rapid change in the patient's physiology, anaesthesiologists manually press the request button quite frequently. The anaesthesiologist used the redundancy in the system to ensure the reliability of measurement, in particular in those situations that do not follow expectation.

EPISODE WP-115[14:23:46]

{Taking blood sample from arterial line}

X: Why you do this blood test?

DR: Well, I've given a lot of fluid and I want to see what happened to that two units of packed cells.

EPISODE WP-116[14:25:02]

{Checking chart}

{Drawing some drug from ampoule}

X: is that also time-based?

DR: Yeah.

X: why didn't you use morphine?

DR: Because I don't have any left.

EPISODE WP-117[14:26:49]

{Starting reading game}

‡NOTE: The case had lasted over six hours, and the surgeon expect two more hours. They started a quiz to keep themselves aroused.

EPISODE WP-118[14:31:53]

{Finishing reading game}

EPISODE WP-119[14:33:11]

DR: That looks like that we're getting more urine now. Since two o'clock ...

{Checking CVP reading}

DR: Her CVP is well maintained.

X: What is the CVP now?

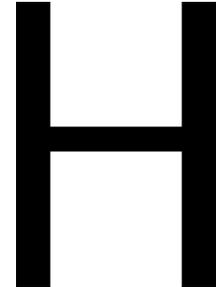
DR: Almost 21.

EPISODE WP-120[14:48:08]

DR: I was wondering she is getting puffy but not specially. I have given her ... 1 2.. 10 litres of fluid, plus albumin

‡NOTE: This anaesthesiologist used the trick of keeping all empty fluid bag hanging up on the stand, instead of throwing away. It gave a reliable way of recording keeping.

Annotated Protocols from a Valvular Regraft



Case description

A male, 79, admitted into the hospital 6 weeks ago, was diagnosed to have a prosthetic valve stenosis (which was placed about 18 years ago), and an incompetent/rocking valve. Medical records and physical examination showed anemia, coagulation problem, and deteriorated renal functions. He has infection after a cystoscopy and is on antibiotic, which may partly contribute to the renal condition. Venous access looks challenging due to recent numerous i.v.'s. He seems not to have coronary artery disease, and his daughter's recent operations have been without complications from anaesthesia.

The subject was an attending anaesthesiologist with more than 30 years of practice experience. A senior resident was with him. Considerable amount of verbal communications were between the anaesthesiologist and the resident.

The transcription was done by a professional transcriptionist.

Legend

X	the observer
DR	the anaesthesiologist
RE	the resident
PT	the patient
NUR	a nurse
PER	the perfusionist
SUR	a surgeon
< ... >	inaudible or omitted speech
< >	< abbreviated speech >
{ }	{ <i>Describing activities</i> }

Annotated protocols

EPISODE VAL-1 [Pre-op interview]

{The anaesthesiologist gave an overview of the case.}

†SUMMARY: There is not much special about this case in terms of anaesthetic plans.

Monitoring technique includes arterial blood pressure lines and Swan-Ganz catheter, which are routine for cardiac cases.

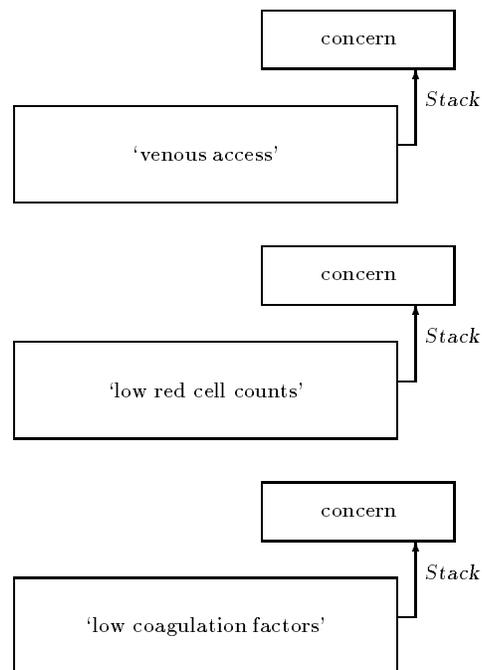
‡NOTE: Even though the anaesthesiologist expressed that the case is just one of the routine operations from the point of view of the anaesthesiologist, there are still a list of problems to be solved.

EPISODE VAL-2 [Pre-op interview]

{The anaesthesiologist gave summary of critical considerations.}

†SUMMARY: Venous access is an important concern, as the patient is likely to bleed, which is important as he starts with anemia. So it is almost certain that he will need red cells and coagulation factors.

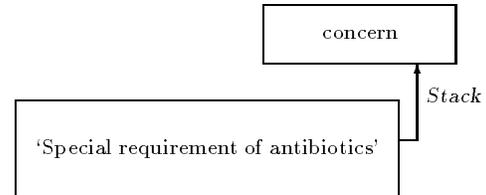
‡NOTE: Concerns such as venous access are rarely specific, and little separable activities can be associated with them. According to conversations with anaesthesiologists, these concerns will result in a more focused attention, detailed planning of steps, scheduling, more elaborate rehearsal of procedures and contingency measures.



EPISODE VAL-3 [Pre-op interview]

{The anaesthesiologist gave summary of critical considerations.}

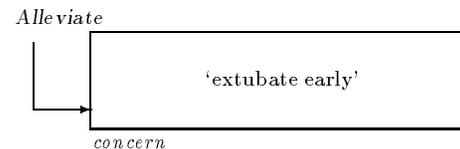
†SUMMARY: The second problem is the timing of antibiotics. The antibiotic the patient is on is eliminated through the kidneys, and partially toxic. You don't want to overload him, at the same time you don't want to miss a dose. The timing is 6 hours. So it is important to maintain the timing in this busy case. There is no better way but you have to remember the antibiotic.
 ‡NOTE: Injecting antibiotics is not an essential part of the anaesthesia procedure, but rather a separate task that has to be done by the anaesthesiologist. Because of this nature, it can be forgotten.



EPISODE VAL-4 [Pre-op interview]

{The anaesthesiologist gave summary of critical considerations.}

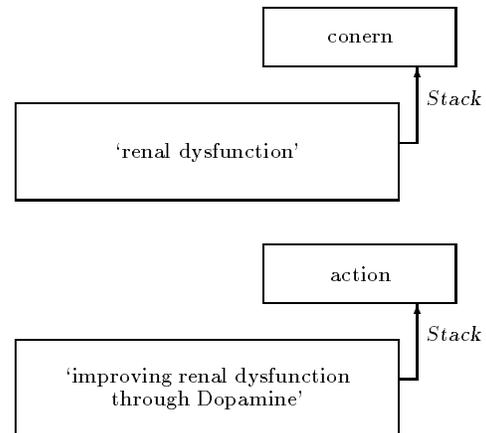
†SUMMARY: In this case the extubation will not be done in the operating room, and probably the patient will be intubated for the next two days. As the recent push from economic reasons, there is an increasing pressure for the anaesthesiologist to reduce ICU stay by extubating early. The anaesthesiologist will not even try to extubate him, and therefore there is no push to use vapour agent.
 ‡NOTE:



EPISODE VAL-5 [Pre-op interview]

{The anaesthesiologist gave summary of critical considerations.}

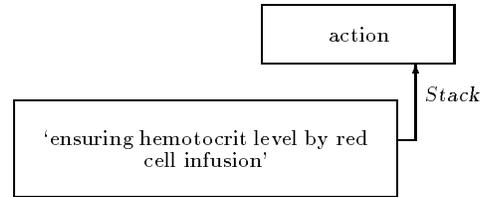
†SUMMARY: His renal dysfunction will delay his discharge from ICU. The reason is that the patient relies on kidney to deal with hemodilutions, which will be the result of the bypass. When somebody is started behind the game, one's goal is to correct the renal dysfunction as much as possible. So dopamine should be used.



EPISODE VAL-6 [Pre-op interview]

{The anaesthesiologist gave summary of critical considerations.}

†SUMMARY: The anemia indicates red cells from the start, the goal being to ensure the hemotocrit level to be at least the same as now when the case is done.



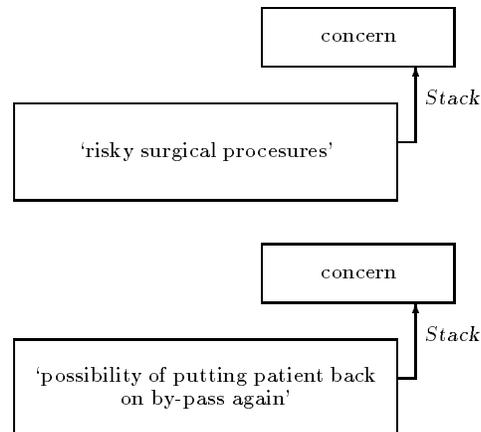
EPISODE VAL-7 [Pre-op interview]

{The anaesthesiologist gave summary of critical considerations.}

†SUMMARY: For emergency procedures, as the operation is a redo, scar tissue may complicate the case, and there is higher possibility that surgery will be challenging, and therefore the anaesthesiologist has to be more vigilant.

The surgical procedure is expected to be challenging. As there is an abscess in the root, and it is expected for surgeon to have difficulties in putting a new valve in, and therefore there is higher chance of massive bleeding, or even to put the patient back on by-pass again, which will complicate coagulopathy. The other problem with the second by-pass is the restart of hemodilution.

‡NOTE: Just like the anticipation of difficult venous access, the expectation of difficult and risk surgery does not generate specific activities.



EPISODE VAL-8[00:00:45]

{DR was preparing the case with a resident RE. The patient had not arrived yet.}

DR: Gentamicin is 70 mg. Gentamycin is on every third day by the looks of it and that is not due until tomorrow and that is because of his renal dysfunction I would imagine. 70 of Gentamicin. What else? And Ancef.

RE: Is there any rate that you would run Cyclon Haprin?

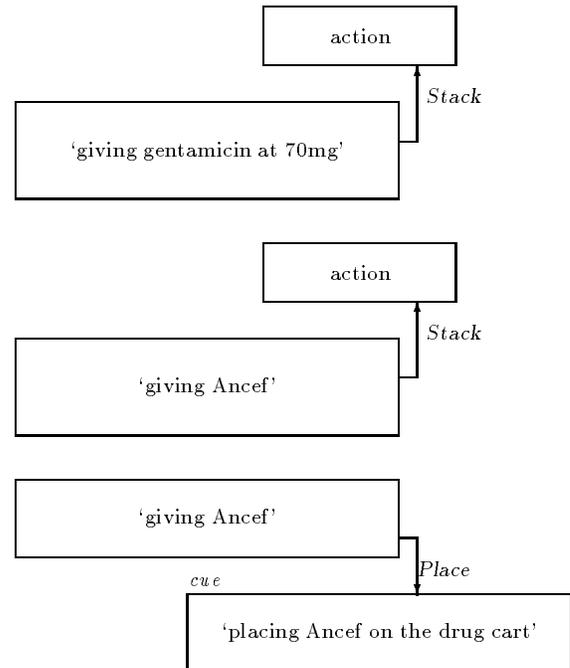
DR: It s not critical, if you run it over two hours it should be enough but if it goes in half an hour, it seems not to matter either.

RE: It is not necessary that you run the whole duration on the < ... >

DR: It is important that you start before you heparinize even from the beginning of the case.

†SUMMARY: DR is preparing syringes with R: reviewing antibiotics issues, and working out specific timing and dosage for antibiotics, which include other scheduled drugs Gentamycine.

‡NOTE: The anaesthesiologist and his assistant were concentrating on the unusual things, including drug names and dosage, and the reasons for which these drugs were given to the patient.



EPISODE VAL-9[00:02:35]

DR: We should get him in.

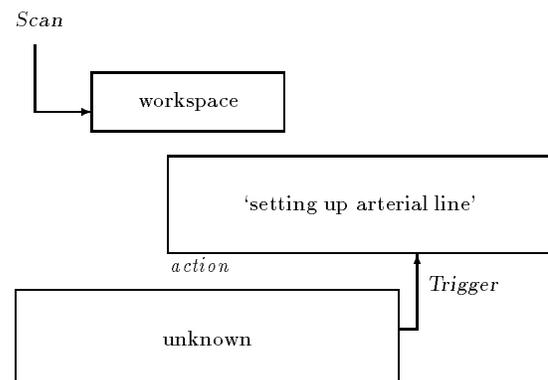
DR: Not a very good driver am I? [to NUR]. We don t have a cord for our bed, no, it's alright.

†SUMMARY: The patient was transported onto the operating table.

EPISODE VAL-10[00:04:00]

DR: Now the first thing we have to do is get an arterial line and ...

†SUMMARY: Reading the work environment and planning next move.



EPISODE VAL-11[00:04:16]

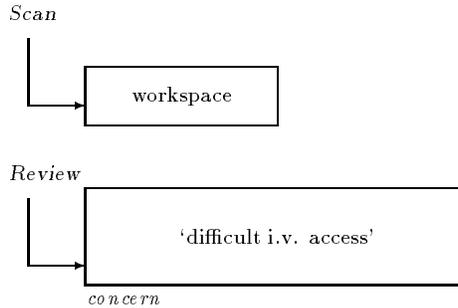
DR: Now the first thing we have to do is get an arterial line and

X: That's an i.v. line?

DR: No, we can't use that one, not for anything serious and we need an intravenous. That may be the most difficult thing we have to do, because his veins have been used and abused.

{Finding armboards}

†SUMMARY: DR and A are starting arterial pressure and intravenous infusion lines. They also gathering proper setups.



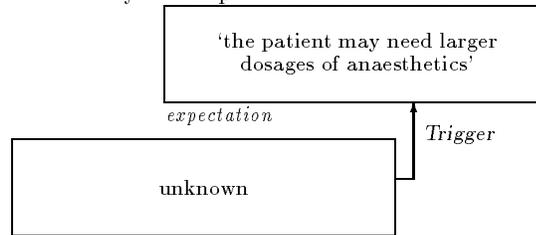
EPISODE VAL-12[00:05:24]

DR: Now to get ECG monitoring.

DR: He is not so sleepy from his pre-meds eh? He looks pretty chipper than a young guy, doesn't he?

†SUMMARY: Assessment: the patient is not so sleepy from the premedication.

†NOTE: In post-case interview: the anaesthesiologist believed that this may have impact on the doses used in induction.

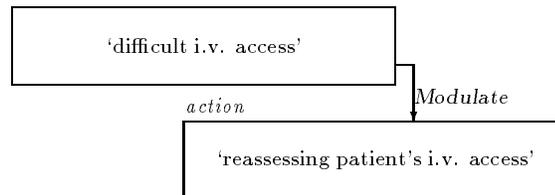


EPISODE VAL-13[00:06:24]

DR: Let's see what veins we have here. We are going to get just a little bit more sleeping here.

{Re-assess venous access by touching around PT's arm. Seems quite hard.}

†SUMMARY: Assessing patient's condition for iv cannulation.



EPISODE VAL-14[00:07:51]

{Securing arterial pressure line with R.}

DR: Is it going? [The arterial line]

RE: Yes it's going.

†SUMMARY: Arterial line was set. The anaesthesiologist waited till the resident finished the arterial line before he attempted the i.v. cannulation.

EPISODE VAL-15[00:09:00]

{Working on the veins}

DR: He has been in the hospital for a long time and he has had multiple intravenouses.

X: < Please verbalise while you're doing >

DR: Ok.

DR: Well you just have to be able to feel the veins and sometimes you can feel a vein and yet it is just a thrombosed cord you know.

DR: Have you got a tourniquet for this side? because I have to look at both sides.

{DR and R are working on each side in parallel to speed up}

RE: Are you getting a blood vein?

DR: Yes.

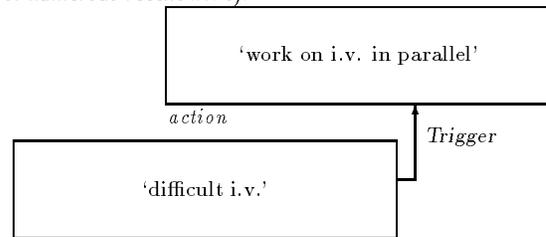
RE: What do you want now?

DR: I just want to wipe, give me a wipe there R.

RE: See if there is blood coming back in here.

DR: I haven t turned it on yet. There you are, that runs like a tap. I just need some tape. Oh there are two bonuses [tape].

†SUMMARY: DR and RE worked in parallele on iv to safe time. DR verbalised guidance (avoiding thrombos clot, which is hard because of numerous recent i.v.'s).



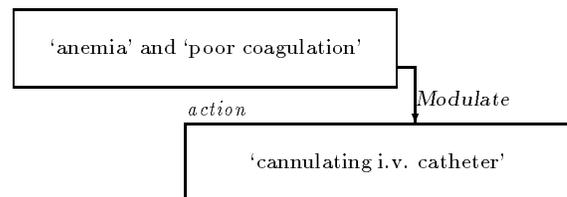
EPISODE VAL-16[00:12:07]

DR: We need a decent fairly central vein I think. Well I got my vein without too much trouble. We are going to try both sides because -- well it just saves time, if RE gets his in before I do then that's so much the better. I think I'm in.

RE: I can t see the vein at all.

DR: No, I know, it is like drilling for oil. It is difficult to tell whether it is a vein or a thrombosed vein.

†SUMMARY: i.v. cannulation was successful.



EPISODE VAL-17[00:13:11]

DR: Nothing worse like scratching around at 8:45 and still not have an intravenous in.

X: And the pressure when someone is watching you do it.

DR: Oh that dosen't make any difference to me. You have to get used to it.

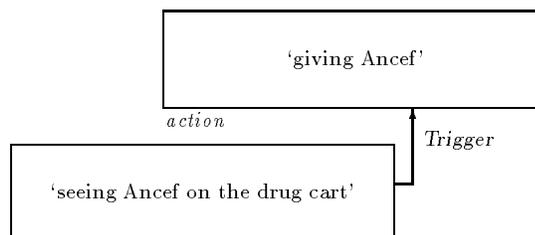
†SUMMARY: DR has placed in the i.v. and gives a goal/constraint.

EPISODE VAL-18[00:14:00]

DR: Now we have to get this oxygen. Let's get that off, debug the machine. All that made the difference to him. It is always better to under-sedate these guys that are clinical and them top them up once they get here.

DR: Now we have to get this oxygen. Let's get that off, debug the machine. All that made the difference to him. It is always better to under-sedate these guys than that are clinical and top them up once they get here.

EPISODE VAL-19[00:14:30]



DR: He can get Ancef can't he, he is not allergic to Penicillin. This is the antibiotic, prophylactic antibiotic that they all get and it prophylacts against Staphylococcus epidermis that grows in the skin and there is a cross-reactivity between this and Penicillin.

{Injecting Ancef}

EPISODE VAL-20[00:15:19]

{RE is rearranging lines around PT's pillow}

DR: Oh, don,t get it about, because you are going to take the pillows out in a minute and then that is another thing you have to fiddle around with.

†SUMMARY: The resident is rearranging lines around the patient's pillow, but the anaesthesiologist stopps him.

‡NOTE: The anaesthesiologist expects that the pillow will be withdrawn and thus attaching lines to it would be a bad idea.

EPISODE VAL-21 [00:15:33]

DR: He did not get his Lasix this morning, so we will probably give him Lasix. I am going to give him all this pain killer that he wants, I am going to give him 10, that is about 0.15 per kg.

RE: What is the medication dose that you gave him?

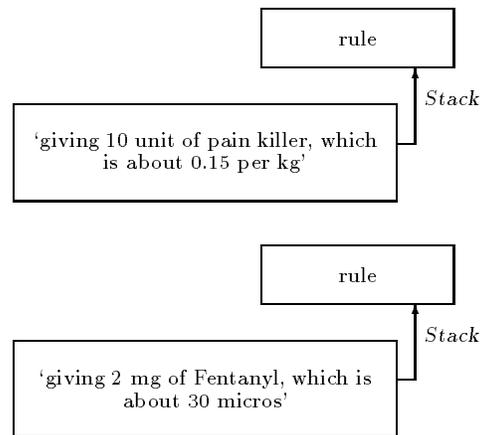
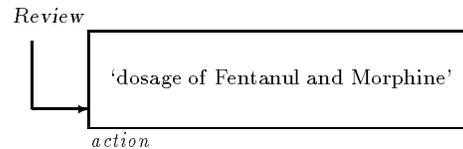
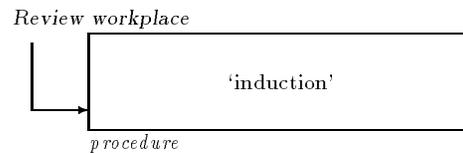
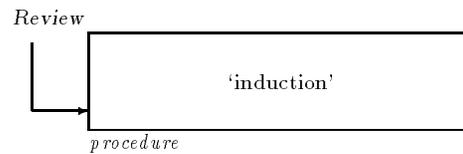
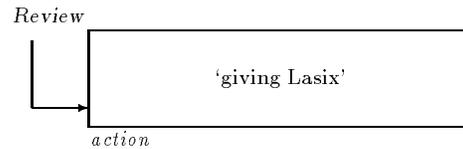
DR: He got 10 of intramuscular Morphine and 2.5 of Trilafon which for a 79 year old man is a fair dose, I think it is a reasonable dose, but it did not do anything much for him; probably did more than you think, but I would much rather undersedate patients like this than over-sedate them.

DR: It is really that you don't want them anxious at this stage, so they get tachycardic and hypertensive. [to X]

DR: I am going to give him 2 mg of Fentanyl, which for him is about 30 micros.

†SUMMARY: DR is reviewing premedication with RE, including the patient's response to the premedication. DR also planned induction dose after the review.

†SUMMARY: Similar to antibiotics, diuretics (Lasix) is an added drug to the anaesthesia procedure and can be forgotten during the busy period of induction. The anaesthesiologist rehearsed the task of injecting Lasix.



EPISODE VAL-22 [00:17:37]

{DR watching R intubating PT}

DR: Can you ventilate him?

RE: Yes.

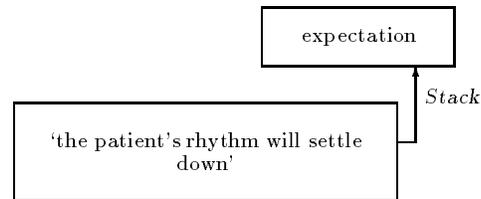
†SUMMARY: RE injected several drugs including pain killer and muscle relaxant.

EPISODE VAL-23[00:17:50]

DR: < Commenting on the rhythm on ECG > fibrillation so that's why it is a little bit fast. (120-130 beats/min)

DR: He is in chronic atrial fib, so that is what he is in, at least that s the rhythm that he is in now, he is a little fast [120-130 beats/min]. He is waiting for the muscle relaxant to take full effect so that we can intubate him unstressfully.

†SUMMARY: DR anticipates that when muscle relaxant takes full effect the patient's rhythm will be lower.

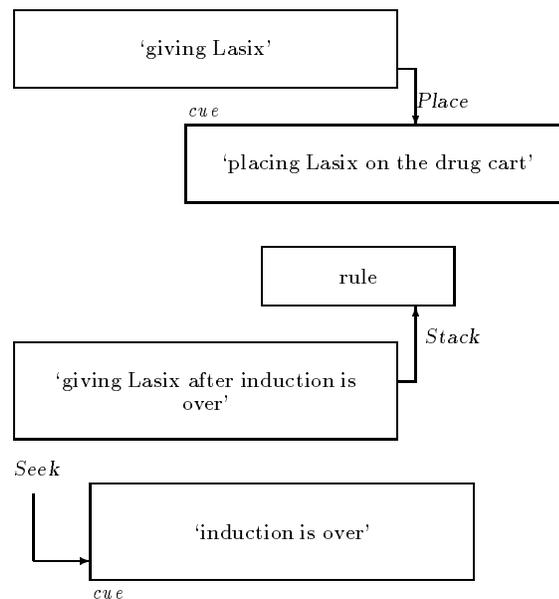


EPISODE VAL-24[00:18:22]

{Taking out Lasix and putting the drug on the drug cart}

DR: That is some Lasix which I am going to give him, I don't want to forget it.

†NOTE: While scanning the workplace, the anaesthesiologist took the opportunity and placed a reminder to himself. He would give the patient once the induction was over. The reason that he did not give to the patient right now is, according to post-case interview, that he did not want to compete with the induction for i.v. channel.



EPISODE VAL-25[00:18:59]

DR: Height divided by 10 plus 5 cm should put you in mid-trachea, but that is probably too far, there, how is that. That should be good. I put in 21cm or 22cm. He is a bit off the mattress too.

†NOTE: Stethoscopy can not tell if it is a little bit too far, which can be a danger when the patient is moved and the ETT tube may fall into bronchus.

EPISODE VAL-26[00:19:36]

{DR is verifying intubation with RE}

DR: You've got CO₂ trace [on capnography] and end-tidal CO₂ reading

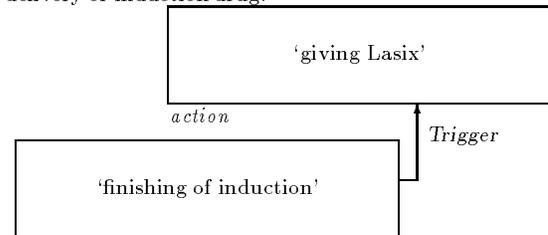
†SUMMARY: DR is supervising R's intubation

EPISODE VAL-27[00:20:40]

{DR was actually giving PT Lasix.}

DR: He did not his Lasix this morning so I want to give him now. That's 40 Lasix.

‡NOTE: From retrospective report: DR wants to give the drug after the induction phase, as he does not want to complicate the delivery of induction drug.



EPISODE VAL-28[00:22:20]

DR: Now I am just prepping him for his Swan-Ganz catheter and a central line. I always prep the both sides of the neck in case I have trouble on one side.

X: Do you anticipate this?

DR: < Previous operation may have changed the anatomy. This innominate vein is sometimes occluded. >

‡SUMMARY: DR is getting ready for Swan-Ganz catheterisation.

‡NOTE: Even though preparing both sides are the habit of DR but in this case there are more reasons to believe that he might have to try the other side than other cases.

EPISODE VAL-29[00:27:04]

{Commenting on RE's efforts trying to put Swan-Ganz catheter}

DR: trying to find cricoid and go from there. The thing you don't want to hit is the carotid artery

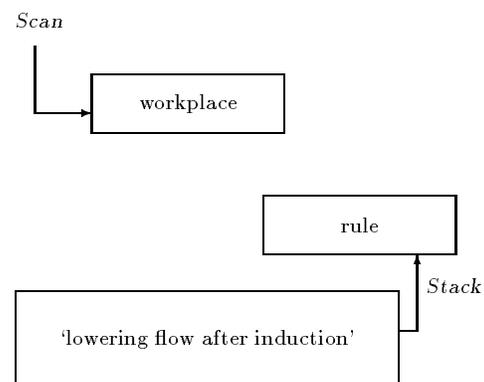
‡SUMMARY: The anaesthesiologist gave detailed instruction for putting in the S-G.

EPISODE VAL-30[00:29:58]

{Lowering the setting of vapouriser and ventilators.}

DR: The patient doesn't need high flow now.

‡NOTE: In retrospective report, DR mentioned that he usually starts with high flow to quickly saturate the agent, but usually lowers the flow after the induction is over. "You can forget to do that. But that's critical with elder patient."



EPISODE VAL-31[00:31:02]

{Turning alarm off for ECG}

DR: I did a very naughty thing of turning the alarms off, otherwise they constantly go off. These things are made for ICUs. It is painful in here when they constantly go off.

‡NOTE: From retrospective report: Because they end up doing nothing else but bouncing the damn thing. Or you set the alarm limit so far apart that it won't go off, which defeats the purpose.

EPISODE VAL-32[00:32:15]

{*Observing R having difficulties putting Swan-Ganz catheter in*} †SUMMARY: DR starts to work on the Swan-Ganz catheter.

DR: Oh Sarge you are going to make me put gloves on. All I am going to do, is locate the artery exactly and slide in beside it. That s all I am going to do, I m not going to do anything different. I can t imagine he needs to be any more deeply in the Trendelenburg position. I see you do run very naughty things, having found it, you take this hand off what you are doing and then all the stuff in the neck goes back, go on, keep going. That looks right. Do you know what I am saying? You should keep that hand there and just use your right hand to pick-up the finer needle and then pick-up the other one. Give me the scissors please. I will take this out and go right there. You don t know right where now, go on. Let me have a few. You found it. Did you set-up the needle I put out.

EPISODE VAL-33[00:34:46]

{*Teaching RE the exact manual technique of how to hold the needle to put Swan-Ganz in*}

DR: The syringe?

RE: Yes, do you want the syringe?

DR: Yes just give me a new one. I can t get from why is it not coming?

EPISODE VAL-34[00:37:26]

{*Allowing R to have a feel of the needle*}

†SUMMARY: Installing S-G

RE: Let me see if it is open or not. I see what you are doing, keep everything there.

DR: If you do any distortion with that hand at all, then you should keep it the same when you put that in subsequently. If they are putting a needle in, then I am distorting everything and then trying to find the track that it goes down. Is it wanting to go? It s going. You always need two strings to your bows, if you can t get he jugular in its relationship to the carotid, then you have to have some other way of finding it.

EPISODE VAL-35[00:40:48]

{*The Swan-Ganz catheter needle is in after DR's attempt.*}

EPISODE VAL-36[00:41:45]

{*RE is trying to thread the S-G catheter in.*}

DR: Now I need to straighten the table so our Swan has got some chance of going in. Have you got a long sheath or a second sheath? We may not be able to put it in.

DR: He has also got tricuspid regurgitation which makes it difficult to pass the Swan-Ganz through there. He has regurgitation through his tricuspid valve.

DR: What we are going to do, in case it won t go, in case we can t float it, we will have sufficient loops of sterile catheter that we can thread it in later in the case; sometimes they [the surgeon] can help us with this, feeling it and putting it through with your hands you see.

†SUMMARY: DR is commenting on the possible problems with floating un Swan-Ganz catheter.

†NOTE: Backup plan if Swan-Ganz will not flow in: asking surgeon to help after the heart chamber is open.

Review

'asking surgeon for help if failed'

option

EPISODE VAL-37[00:42:58]

{*Swan-Ganz has just floated in right ventricle.*}

EPISODE VAL-38[00:43:35]

{RE is trying to put Swan-Ganz into wedge position.}

DR: Now we are in the ventricle and now we are in the PT, that will just flow in. I am not sure I will try and wedge it; I would put it at about 50 and just leave it.

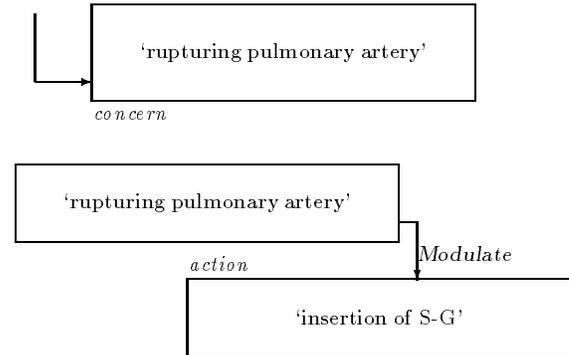
DR: One of the bad complications of S-G catheter is that you can rupture the pulmonary arteries. If the artery is old and not very elastic, you can rupture it, and that's a disastrous complication.

DR: If somebody has gross mitral regurgitation, or any mitral regurgitation, it can be difficult to tell when you are in a wedge position. You are tempted to keep threading more catheter in you see. You end up with a catheter as a balloon far too distally and distal means small pulmonary arteries and that is just when you rupture them and the people who rupture are old people usually.

†SUMMARY: DR was reporting guidelines for inserting S-G, and giving concerns involved.

‡NOTE: The anaesthesiologist explained some of the considerations involved in inserting S-G. Specific situations (*e.g.*, the patient was old) were integrated into general rules and guidance was generated that extra attention should be paid to stopping cues.

Review



DR: In old people you have to advance more slowly.

DR: Well once I am satisfied and I m in the PA, I work on PA and I won't be obsessive about getting a wedge. I can make inferences. It is defensive sort of practice. The other problem of putting a Swan in this man is that people who have bad aortic disease, and particularly stenotic disease, if they have an arrhythmia when you put the Swan in and sometimes it happens, you suddenly get ventricular fibrillation.

RE: The way of doing it, is that you have to turn the head away from ...

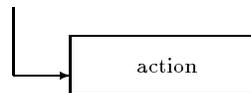
DR: Well you have to keep watching. If it happens, it is a bad complication because they are very difficult to resuscitate. I have to weigh in my head, is it worth exposing him to that small risk to have this thing in; in other words, am I going to benefit from the information I have and the answer to that for him is obviously yes.

EPISODE VAL-39[00:45:42]

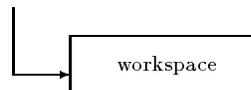
DR: We need to get the Cyklokapron started.

†SUMMARY: The anaesthesiologist reviewed the workspace and planned the next step.

Scan



Scan

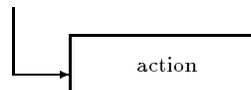


EPISODE VAL-40[00:45:52]

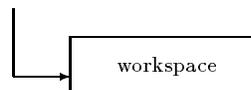
DR: As always, the most difficult thing is the nasogastric tube.

†SUMMARY: The anaesthesiologist reviewed the workspace and planned the next step.

Scan



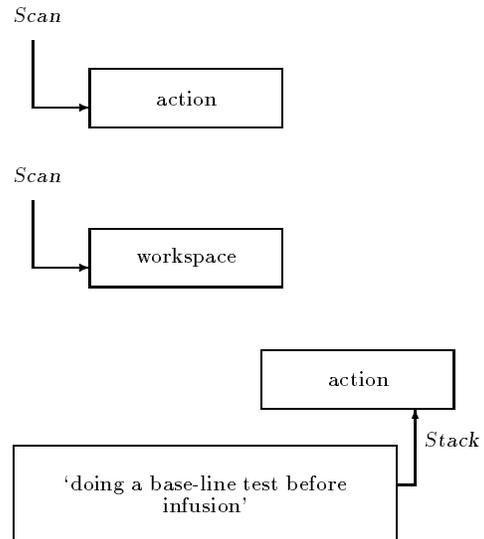
Scan



EPISODE VAL-41 [00:46:34]

DR: Now we have to take blood samples, one for clotting times and one for blood gases.
 RE: How much time apart?
 DR: Well we should do a baseline of these to start with and if they are normal, then I do not - if there is no clear abnormality, then I do not do another blood gas. We do another clotting time after we have given heparin and then they do them on the pump periodically.

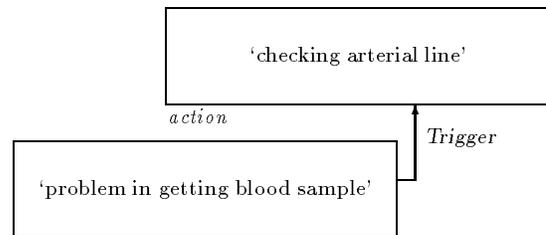
‡NOTE: DR is reading tasks from the workplace and gives justifications for the perceived tasks to RE.



EPISODE VAL-42 [00:47:19]

{ While drawing blood gas DR found that arterial line is not flowing well and asked RE to rectify the problem }

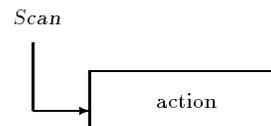
DR: RE, can you just go around and give that artline a bit of a -- put a rolled-up towel in his hand. It is not just that easy to withdraw. Just get a green towel and roll it up here.



EPISODE VAL-43 [00:50:00]

{ Getting ready to infuse blood unit }

‡NOTE: From retrospective reports indicated that getting ready for blood infusion is part of a routine procedures. What varies is the amount needed, and approximately timing.



EPISODE VAL-44[00:52:58]

DR: I am going to plug in the nitroglycerin and will not turn it on and plug in this dopamine and start that at 15 which will him will be about 3 mics per kg I think. I just started the dopamine.

RE: How many cc s?

DR: I have given him 15, you said 800 or 400?

RE: 800.

DR: 800 so, 15 is 3. We have just started a low dose dopamine to try and optimize his renal blood flow and that is there. That is normal.

X: < I saw you did the calculation. But why you have to do that? >

DR: Oh, we need to know what dose of dopamine we are giving. I know there is 800 micrograms in every cc, I know his weight and I have to come up with a dose per kg per minute.

X: But the dosage does not change much, does it?

DR: < Right > It usually works out somewhere between 10 and 20 and the 70 kg man comes in the middle that is why I start him at 15.

DR: You have to be able to do these things quickly and be able to get an approximate answer. I don t care whether it is 3.3 or 3.25 or 2.7; I want to know that it is 3 and not 4 and not 2.

†SUMMARY: Treat blood pressure problem and started dopamine to optimize the patient's renal blood flow.

EPISODE VAL-45[00:56:56]

DR: I am not concerned about that. With a mixed lesion it is difficult to know which one predominants you know. His initial blood pressure, you see his diastolic pressures are very low, which makes me think that his aortic regurg is the predominant lesion. It may not have been when he first came in.

RE: When he came in the ultrasound showed moderate aortic regurgitation and very minimal aortic stenosis < ... >

DR: But he originally came in I think with stenosis of his

RE: Do you think he was in failure? He came in with fever and all those things...

DR: I know, but at that time I think it was predominant stenosis that they found I may be wrong.

RE: I don t record a PE and it may be that he had aortic regurg unstable grounds.

DR: I think that developed at some time. I am sure now that his predominant lesion is aortic regurg. In fact, whenever you see diastolic like that, this low and there is no organic cause for it, you should always wonder whether it is real. You just read 0 there and see if things are all set, but they are not. It is not infrequently that you come in and take a case over, it has been going all day and we should start some <...> and you come in and you find that the diastolic blood pressure is 30 and it has not been that all day. People do not develop, there is almost no way you can get that without an organic lesion that is also like major incompetence. The treatment of that is very simple. You read 0 the equivalent because that is what is wrong.

†SUMMARY: Low reading from arterial blood pressure. DR and R are trying to find an explanation. DR thinks that the prodominant reason is regurgitation, which caused the low reading.
 ‡NOTE: Post-case interview: they tried to decide whether the low pressure should be treated.
 From this episode one can find that complicated reasoning processes do occur, and factors involved can be very large and extensive.

EPISODE VAL-46[00:58:27]

NUR: Didn't he have 3 units?

DR: Well we will get some more.

†SUMMARY: DR started red-cell infusion.

EPISODE VAL-47[01:00:31]

NUR: A couple of more units?
 DR: I would ask Lynn please.
 NUR: Regular or half-hour?
 DR: Regular, we won't need it in a hurry.

†SUMMARY: The anaesthesiologist gave instruction to nurse.

EPISODE VAL-48[01:02:21]

{Checking with blood bank about an abnormal overlaying labels on blood unit bag.}

EPISODE VAL-49[01:07:14]

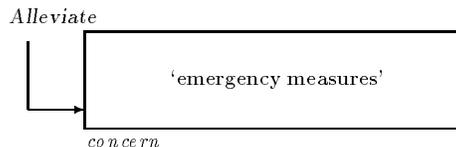
{DR was reporting on the surgical progress}
 DR: What they are doing now is isolating the femoral vessels and now will probably go on femoro-femoral bypass before they open the chest.
 X: Is that what you expected?
 DR: Yes it is, and it is not standard, sort of, all the cardiac surgeons do not do it, but SUR [this particular surgeon] does.

†SUMMARY: Self-reporting on the observation of surgical progress.

EPISODE VAL-50[01:08:00]

DR: I am glad they are doing that (get ready for femoral bypass). As it makes my job easier in case they have a major problem.

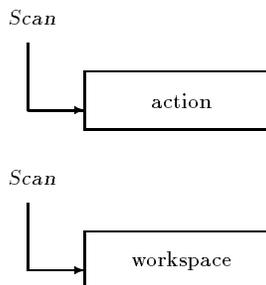
‡NOTE: DR assessing situations with regarding his concerns. He had worried about surgical emergencies and how he could deal with surgical incidents. In post-op interview he also revealed that the particular surgeon was known for using this procedure, and he was expecting this. Later on he was proven to be wrong at the assessment.



EPISODE VAL-51[01:08:45]

DR: Are you going to give more narcotic? He had 30, but I think you are probably going to have to give some, when he goes into bypass depending on what his status.
 RE: At this stage, no. I already gave 2 mg of Fentanyl.
 DR: I'll give him before he is on by-pass.

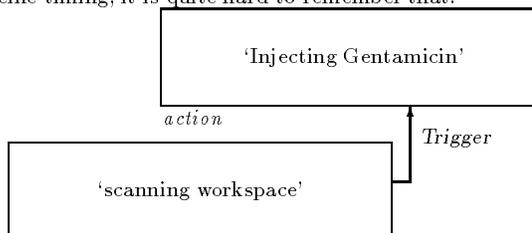
†SUMMARY: DR is reviewing patient's status (thinking more narcotics).



EPISODE VAL-52[01:09:58]

DR: [Suddenly recall gentamicin:] Now, gentamycine. There might be some in somewhere.

‡NOTE: From retrospective report: Because the requested specific timing, it is quite hard to remember that.



EPISODE VAL-53[01:14:06]

DR: You want to get red cells into him, but it is difficult for him to accommodate that volume without throwing him into hypothermia.

RE: So you are doing that while you are watching the monitor.

DR: We watch the coronary artery patients.

RE: After one good <...> that Swan-Ganz ...

DR: Well that is one good reason to have it in.

RE: How many units of blood do they get?

DR: They usually get, I will probably give him 2 I think if I can get it in before we go on bypass. It is coming out drip, drip, drip. This is going in, drip, drip, drip.

X: The renal function is pretty good?

DR: Well, he is making urine, that does not mean his renal function is good, we can almost make anyone pass urine with this.

X: It s a good sign at least.

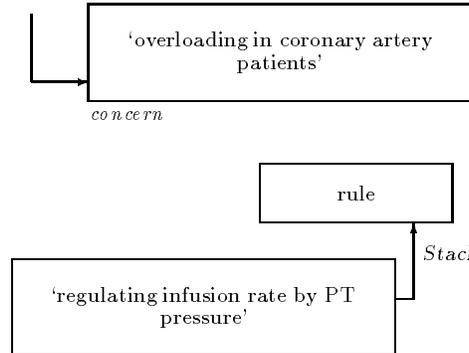
DR: Oh yes.

X: I have seen a case where the patient did not produce urine at all, like 25 mg.

DR: Well, that s not very good.

†SUMMARY: DR is increasing red cell infusion rate, and give guiding rules: trying not to overload the patient too much, by using pulmonary artery pressure as an indicator.
DR is happily watching the smooth infusion rate of blood cells and good urine output.

Review



EPISODE VAL-54[01:16:18]

DR: Did you get some? Remind me to get it from the ICU.

DR: I think you are going to start in the recovery room.

DR: They have it because they use it frequently I think.

†SUMMARY: RE said can not find gentamycin. DR suggested to look in ICU.

EPISODE VAL-55[01:19:53]

PER: We are avoiding vapor with this kind ..

DR: Well we are now actually giving him vapor.

PER: I have got E.tray. I can give it?

DR: That s fine. I think it might be a little while before we get on anyway.

†SUMMARY: The perfusionist asked for directions. He had assumed to avoid vapor.

EPISODE VAL-56[01:23:06]

DR: RE, why don't you try to get that down a little bit. Either with that or some Nitroglycerin. You can leave that on, it is a reciprocating saw. It s those structures, the right side of the heart can get up against the thing. I would give some Nitroglycerin. You are much better to do this with a decompressed power than with one that is cord. Get it down. One of the worst things about this saw is that it sprays everything with blood, little drops of blood. As you can see from the lateral x-ray, we got that much of his right ventricle and the vein is jammed-up fairly close to his - there is a loosened space behind it, but it is fairly closely applied and even his vessels, you see his PT comes up here, there is not much <...> recently between the vessel in the scan and then the PT.

RE: This could be due to scarring or this could be due to increased blood ...

DR: It does not matter what it is due to you see if it is sitting there, you can hit it and the beauty of femoral bypass, the thing that it does, is that it decompresses the heart

†SUMMARY: DR instructed RE to get the blood pressure down a little bit. (SUR was sawing to open the chest)
DR explained the reason to the resident: a decompressed heart will be easier for the surgeon to do the job. Also use the chest X-ray to illustrate the position of pulmonary arteries.
‡NOTE: Even though the surgeon did not ask for a lower pressure, the anaesthesiologist perceived the goal from what the surgeon was doing. This is one reason why there are little communications among the team members.

EPISODE VAL-57[01:24:54]

DR: We have a wonderful new system. You do what some reassurance that everything seems to be along okay, what your final output is, if you have reasonable output, even there you have got .. His blood pressure is 85 to 95, its effect on perfusion of vital organs. You have to strike a balance to what they have to do with x-rays and that will allow ... post upward it is 5.6 which is higher than it was before and that is 3.8.

RE: The diastolic pressure is because he is bleeding.

DR: Because he can't keep the blood in his arterial system because back flow is <...>.

RE: What is going to complicate his artery, perfusion and things.

DR: The principal thing that diastolic determines for the heart is coronary blood flow the lower that gets, the less his coronary blood flow is going to be ..

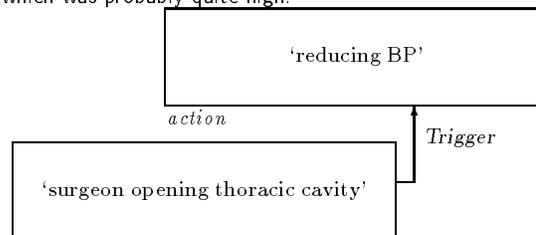
RE: The heart does not get as much oxygen.

DR: Yes, but I mean there is no evidence that we can see it is having a bad effect on him.

RE: Do you know the number yesterday?

DR: No. I knew it was low and I knew it would be low. How is he doing Sarge.

†SUMMARY: DR instructed RE to take cardiac output measurement DR read readings of cardiac output. The last reading is 5.4, which was probably quite high.



EPISODE VAL-58[01:28:16]

SUR: It does make the re-opening a little more difficult. But then again it might mean 75 or 72 whatever you have done, nobody anticipated it.

†SUMMARY: SUR reports the challenge of fixing the valves due to previous operation on the heart.

EPISODE VAL-59[01:29:34]

DR: I am at the back of the sternum.

DR: : No it will be at least an hour or maybe 1 1/2 hours throughout.

DR: What we are doing we get a sense where we are, and I would imagine we would change the doses and to accommodate and in this case they have to

EPISODE VAL-60[01:30:15]

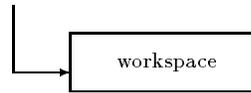
DR: Not really, the next thing we are going to have to do is give him, the next thing I want is heparin, but we still have a fair amount of resection around the heart to do, to free-up things so that they can cannulate them.

X: You have enough warning to do this.

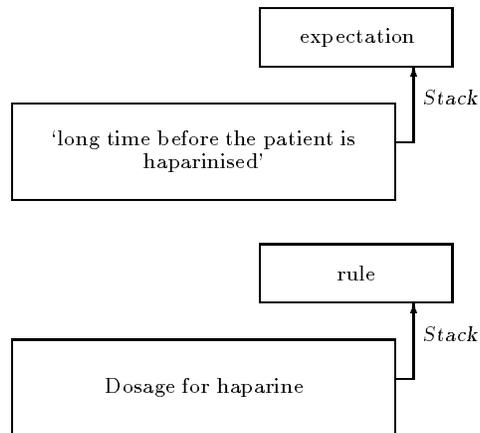
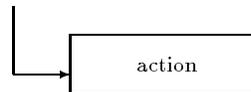
DR: How much heparin are we going to give him, RE?
 RE: Give him 7 kg and will give him 25 cc's.

‡NOTE: In post-case interview, DR mentioned that he usually does this calculation for every case, even though he knows the final dosage is between 300-400.

Scan



Scan



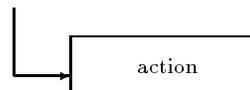
EPISODE VAL-61 [01:30:51]

- DR: If you are hear working on your own, you can't be in a reactive mode. You say we want to heparinize and you say oh yes, now I have to get it drawn-up you see. They may ask you to heparinize because there is an acute problem and you have to give it smartly, so you need to have it drawn and you nee to be prepared.
- X: Suppose that it did not draw up and when asked to give it then it is drawn up, would the nurse would judge him negatively?
- DR: Well yes, but that would only be one -- that would be the time of the whole way in which that case is approached. I won't draw up anything until I need it and then everything is a big scramble, you can't take cases over for people who do that and things are a mess. There is nothing anticipated or planned ahead of time, do you know what I mean? You get here and you draw up two syringes; you draw up a syringe for fentanyl and a syringe for pancuronium and you start. If you need a vasopressor then you have to stop and dilute his -- I mean it is just not the way to work. You have to be an anticipator and not a reactor.
- X: Are you ahead of your schedule?
- DR: No. I always tell these residents if they are standing here not doing anything, then they have forgotten to do something and it is not a bad way to operate, if you are standing here not doing anything and you say, What s the next thing I am going to have to do? and they say what I have to do is I have to give heparin and then I have to do a blood sample and this time I am going to say I am going to do a blood gas as well.
- †SUMMARY: Probing questions and answers with regarding the preparation of drugs, while the surgeon was opening up the heart.

EPISODE VAL-62 [01:32:32]

{ I am going to do a clotting time and send a blood gas so I have some sense of what his hematocrit is. }

Scan



EPISODE VAL-63[01:33:22]

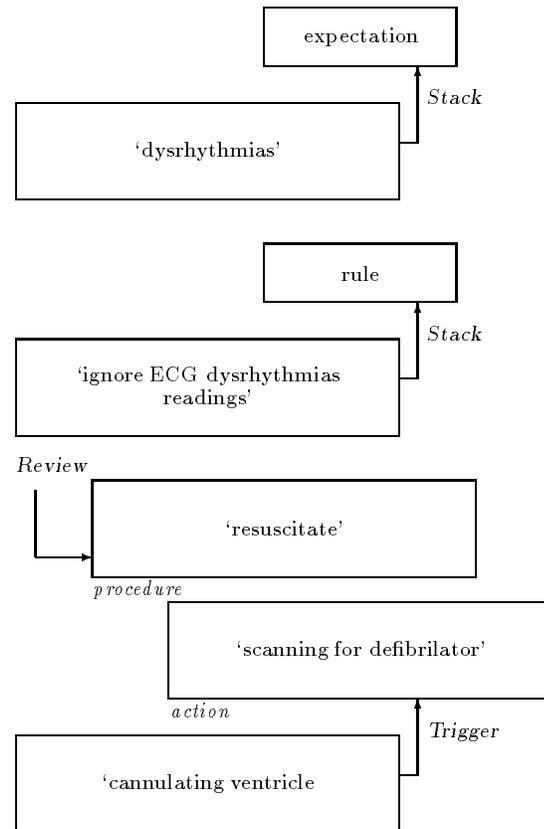
DR: The next thing is that if they are picking around the ventricle, he might develop some dysrhythmias. Now those you lastly have to live with because they have to do what they are doing.

X: You have to correlate that observing the patient is what they are doing, if it is arrhythmia ...

DR: I don't have to know exactly what they are doing, but I have some sense of where they are in the evolution of their procedure, and I know what phase they are at and it is important to know what effect that might have on what you are doing.

†SUMMARY: The anaesthesiologist gave a short self-reports

†NOTE: The anaesthesiologist expected the surgeon to cannulate on the heart, which could fibrillate due to the stimulation. In postcase interview, DR explained that such expectation had caused him to examine whether things like defibrillator is setup to use or not.



EPISODE VAL-64[01:34:17]

RE: It took quite a bit of time?

DR: I have to free enough of the atrium so that they can get a cannula in, so that involves some ...

DR: Are you going to open wider?

SUR: I will send one over when we do an ACT, normally I wouldn't but I will. You are going to be in good shape I think especially. That is probably you see how they are holding pericardially, probably from that.

SUR: You start an i.v. that you know about.

DR: I knew that and where I expected. I expect it when they have to retract even a little bit on the A-track without doing anything, but they are.

†NOTE: This is another example of cooperation without verbal communications between the surgeon and the anaesthesiologist.

EPISODE VAL-65[01:34:26]

RE: < Reported that pressure is sliding down. >

DR: < Explain that the surgeon is holding something that might have caused this. >

EPISODE VAL-66[01:35:12]

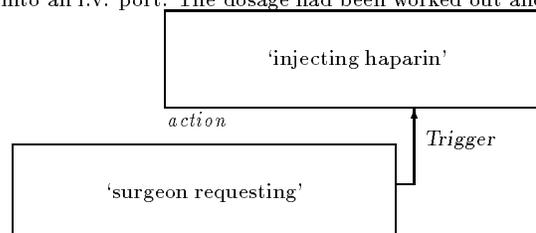
DR: < Giving treatment plan for the sliding pressure: you can choose one of the two: either turn the vapor down, or turn down the nitroglycerin. >

‡NOTE: The anaesthesiologist recalled solutions to the problem (decreased blood pressure) very quickly. By looking at the workspace and scanning the mental picture of the situation, he did not need to go through a complicated reasoning process.

EPISODE VAL-67[01:39:42]

SUR: < Asking to give heparin. >

‡NOTE: When the surgeon actually requested heparin, the anaesthesiologist triggered the action and injected the syringe into an i.v. port. The dosage had been worked out and verified.



EPISODE VAL-68[01:44:17]

DR: They have a tube when the artery exits to the aorta here and we have venous access to the pump from the femoral. He is having a mixture of things.

‡SUMMARY: The anaesthesiologist reported his observations of surgical technique: arterial from arterial arch, and vein from femoral vein, a mixture of things.

‡NOTE: later on they were proven not to be the case.

EPISODE VAL-69[01:46:52]

{DR instruct PER to use ultra-filtering, to deal with low hemotocrits, as the patient kidney is not functioning properly.}

(In post-case interview, DR estimates that about 75 of the case he uses ultrafiltering. For this case, DR told PER about using ultra-filtering prior to the start of the case)

EPISODE VAL-70[01:48:47]

DR: I think you are going to have a lot of fluid somehow.

‡SUMMARY: The anaesthesiologist instruct the perfusionist to start ultra-filtering, and explained to the observer.

PER: So do I.

DR: Why don't you---do you want to start that ultra-filtering as soon as you can?

{Explaining the use of ultra-filtering}

DR: What happens to people who have had a degree of left ventricular failure for very long is that the volume of blood in the body is increased so that when you go on bypass, you get a tremendous amount of blood out of them and when we are struggling with low hematocrits and what I have asked them to do is to alter filtrate this stuff so that they can get out some of the clear fluid.

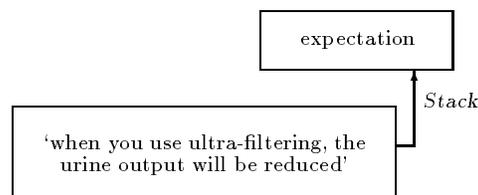
RE: I thought that the sodium in the body would help get rid of the ...

DR: If you have got good kidneys you can maybe do that, but without them, it is difficult.

EPISODE VAL-71[01:49:00]

DR: So blood will come through and come out the other side and will be clear fluid and that will help to increase his hematocrit, but still need to give him a 1/3 unit of blood. Otherwise, at the end we will have big volumes of stuff, his own blood that is all going to dilute, which we cannot get back into him. Now one of the things that happens when you do that is that you take off a lot of fluid here, you cannot get as much urine. All we can do is maintain good conditions for urine output and see that we get some urine.

‡SUMMARY: The anaesthesiologist reported his expectation of urine output as a result of using ultra-filtering.



EPISODE VAL-72[01:49:33]

X: So if you make the decision to use that, the filtering ...

DR: I asked her to put that in this morning.

X: How do you know that his blood volume is high?

DR: I know that you have an abundance of fluid in these cases and that if you do not do something to get rid of fluid especially when they have poor renal function, you are left struggling with them for a week in the ICU trying to get the wet fluid off and it has a nasty habit of accumulating their own.

†SUMMARY: The anaesthesiologist explained when to use ultra-filtering: because he knows from experience that these sorts of patients have large blood volume in their body but a low hemotocrit counting due to their kidney dysfunctioning.

EPISODE VAL-73[01:50:32]

DR: I would like to if I can come out normally, you come out of these things with fluid balance of somewhere between 3 to 5 liters. In him, it would be nicer if you could come out with a net balance of maybe nothing. It is really using the blood that he has got in his veins and getting rid of fluid and redistributing it. You cannot hope to do everything within the space of the time he is here, but I mean to retain fluid, it is a constant struggle trying to get them diuresced.

†SUMMARY: The anaesthesiologist explained the impact of ultra-filtering and fluid management plan for this case: in normal patients you'd expect a fluid balance of 4-6 litres, but with this patient, we want a fluid balance of zero. Essentially we want to get rid of the fluid in the blood.

EPISODE VAL-74[01:52:58]

DR: That is his clotting time which is 8.9 which is 8 seconds, 819 seconds to clot normal is 130 or something like that; so we need to have it somewhere between 450 and 500 before we go on bypass. We will do another one.

X: You have to do it constantly?

DR: He [the perfusionist] will do it every 20 minutes or so.

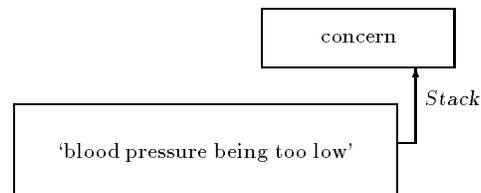
†SUMMARY: The anaesthesiologist is reading clotting time: 891sec. (baseline: 130)

EPISODE VAL-75[01:57:01]

{The patient blood pressure dropped too low.}

{DR instructed RE to turn up topamine to 5 mics.}

‡NOTE: In post-case interview the anaesthesiologist explained that Neosnephine has not worked well, therefore another drug is used that would increase blood pressure in different manner.



EPISODE VAL-76[02:02:03]

DR: Have you got any Levophed (phenylephrine) here? My drawers are empty. I am going to take the Levophed if I... Well this is the Nitroglycerin, this is absorption and this is expanded absorption. Was he able to keep his pressure up any better here?

DR: It s better than before.

RE: 25.

DR: 25? He is having a little trouble keeping his blood pressure up and he is not responding well to the usual doses of phenylephrine, so I am going to make up some phenylephrine and give him that and he can run that. In the meantime I have turned over Dopamine to 5 mg/kg which is on that pump. That may be all we have to do. We may not have to use this.

X: He is not responding to the regular dosage of

DR: He is not responding to the normal alpha-agonist drug that we use, phenylephrine so I will just give him this. This is a little more of a potent drug. The problem when you use these drugs, is that they produce arterial constriction. That is not good for renal tension and it is not good for radial arteries if you are trying to measure blood pressures from the, because there will be a considerable gradient between what you measure here and what you measure up in the aorta. That can be a problem when you come off bypass because you will have a damped trace that is hypotensive and you don t know whether you are treating someone who is really hypotensive or not.

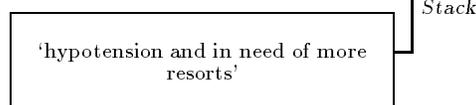
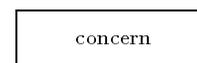
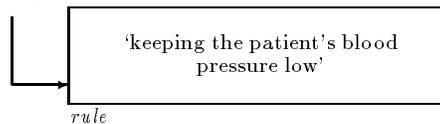
X: This is kind of a resort which you use ..

DR: I would rather not have to use it and I don't like to see them having to use a lot of phenylephrine either.

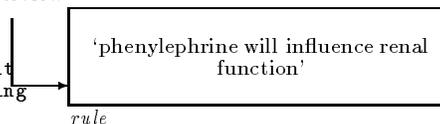
†SUMMARY: The anaesthesiologist was preparing for some phenylephrine. He intentionally kept the patient blood pressure low, thus the chance of having to increase the blood pressure was high. Thus he prepared some vaso-constricting drugs.

‡NOTE: The anaesthesiologist prepared vaso-constricting drugs but hoped that he did not have to use it. It proved that later he had to use it.

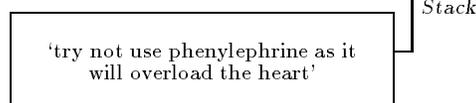
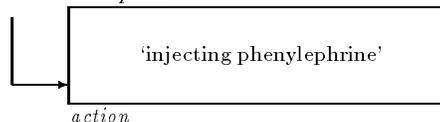
Review



Review



Review workplace



EPISODE VAL-77[02:04:50]

{Blood gas test results were just in.}

DR: 20 eh? Hit the button. So, it's 20 on bypass.
That is after your unit? Oh, it's not there. This is with 2 units of blood.

X: That was 24 before [regarding hemoglobin test results]

DR: Yes I know, but we have diluted him with all the fluid that was in there.

X: So there is a difference.

DR: If he can ultra-filter, then we can get that up without having to give him more blood, because he has good gas exchange on pump.

X: When you do that, do you offset these balance well when you feature the fluid it out.

DR: Or well you will lose some potassium but that is all for the good because we will have too much anyway. You will lose sodium and that doesn't matter and this does not have any effect on these.

X: How about the acidosis?

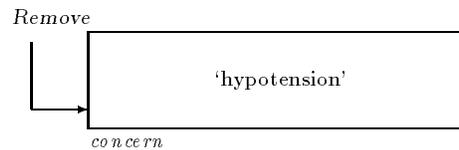
DR: Oh it won't have any effect on that either. Do you want me to put this on an infusion or not?

†SUMMARY: Probing questions around maintaining balance with ultra-filters.

EPISODE VAL-78[02:08:50]

DR: We still have his Dopamine going at 5 mic s and maybe we could gauge off on that - so we can get that down to 3. I am going to try to get that Dopamine down a bit, if we can get it down to 4 or even back to 3.

†SUMMARY: The anaesthesiologist instructed the resident to ease up the dosage dopamine to 4, or even back to 3.
‡NOTE: The anaesthesiologist had been watching for the concern of hypotension. He was waiting for the concern to resolve before he could take a break.



EPISODE VAL-79[02:09:00]

{DR took a break about 20 minutes.}

EPISODE VAL-80[02:30:49]

DR: You see we are still making urine, not a massive diuresis but we have taken off...

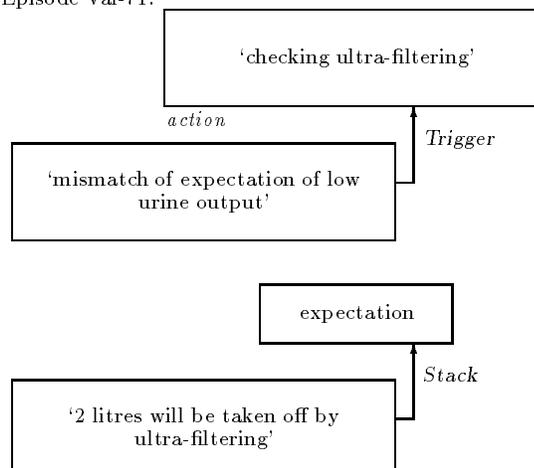
DR: how much have you taken off altogether? [asking the perfusionist]

DR: you have got 600 fluid you see in that bag over here, that is what was ultra-filtered.

X: Amazing, it is very fast.

DR: He probably will take off about 2 liters in the time that we are here.

‡NOTE: The anaesthesiologist was a little surprised to see large amount of urine accumulated. His expectation of low urine output due to the use of ultra-filtering was not confirmed. See Episode Val-71.



EPISODE VAL-81 [02:31:35]

{DR was reading the recent blood gas test results.}

DR: Now the next thing we have to watch are these---his potassium and his sugars and this will as time goes on, will go up as they give more and more solution to stop the heart and keep it stopped.

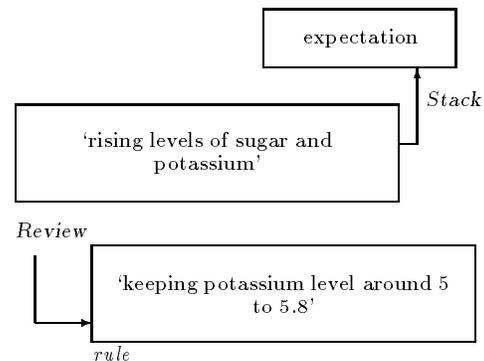
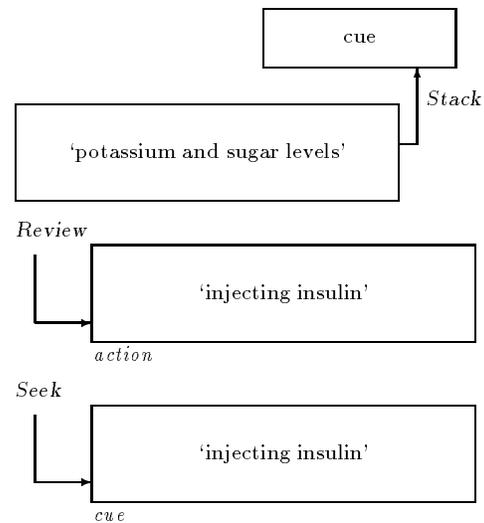
X: What about the future, will it lose some of it.

DR: Well it will lose some and he will get a load of sugar from his cardioplegia too, so these two things we can both treat if this -- we have to come out at the end with him, it would be nice if we could have him beating on his own without having to pace him - we want to have his potassium somewhere between about 5 and 5.8 or something like that when we come off bypass. Now we can manipulate it, as this goes up, we can drive that potassium back into their cells by giving him some Insulin so I will see what the next one is.

DR: I know that his potassium is going to go up and it is often very difficult to guess.

DR: < The surgar reading will go over 25 (now 19). I would start treat this but his potassium level is not that high. >

‡NOTE: The experience has led the anaesthesiologist to believe that the sugar value will be high. He responded the blood test feedforwardly in regulating the patient's sugar value.



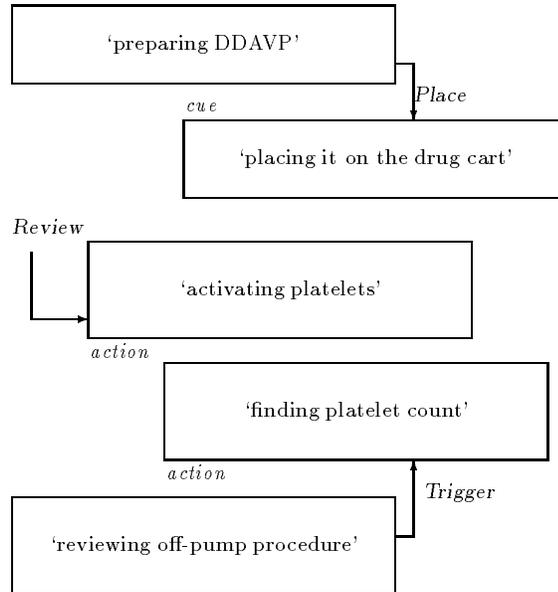
EPISODE VAL-82[02:44:42]

DR: Would you like to get me some DDAVP please and could you get me a platelet count, what's that in the binder?

NUR: The binder?, yes.

{DR is preparing DDAVP (a antidiuretic drug that also improves platelet function)}

‡NOTE: The anaesthesiologist found the drug from drug cabinet and placed it on the drug cart.



EPISODE VAL-83[02:48:49]

{*Reviewing patient record with a nurse.*}

DR: This is his hemoglobin from February xx. We need the one that is more recent than that and unfortunately you see there will delete the charts. Here we are, it is running towards 7.

NUR: Is that a direct number.

DR: It is not extremely accurate, it is a fairly crude measurement. I don't think it will make a difference to what you do.

NUR: It will probably run off in decimals. Does it tell you how the potassium is doing.

DR: It is still not hugely accurate. Have you got the WCB?

NUR: Yes.

DR: This is a drug that we use to improve platelet function. Platelets are the little bodies that initiate coagulation [to X].

X: Do you want to increase the number of platelets?

DR: Not the number, it increased their function. I am going to send this off to get a ... [blood test to get platelet count]

DR: Can you get some Dopamine.

{*calling for help to get platelet count*} I didn't realize that I did not have a platelet count recent, I could not find one. The chart must have been deleted I think. I need that ... Just a chart review that's all you need.

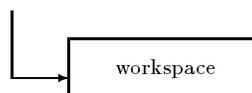
DR: Sometimes it gets busy in the hematology labs.

DR: CBC 171. I have got some DDAVP we will give later. No I won't do that because I found the result from yesterday in the computer.

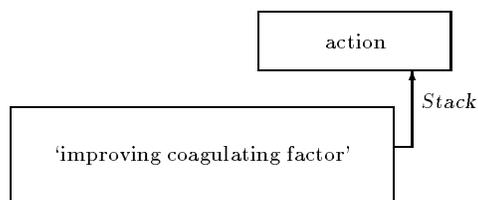
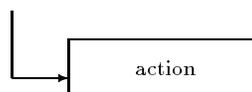
†SUMMARY: The anaesthesiologist was thinking of injecting platelet and DDAVP. To decide whether to do that, he needed a count of recent platelet test.

‡NOTE: Post-case interview showed that the anaesthesiologist was scanning the workspace and was thinking of things and steps needed for coming off bypass.

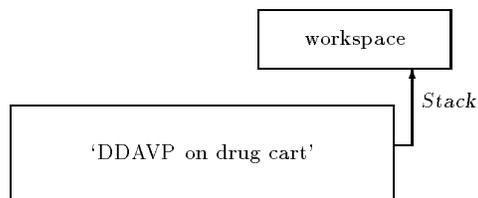
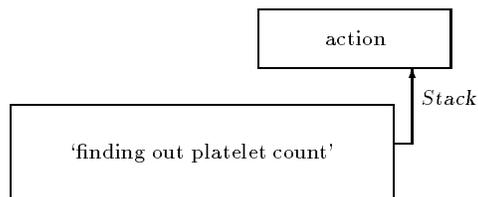
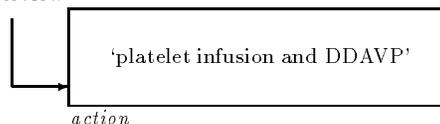
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Scan



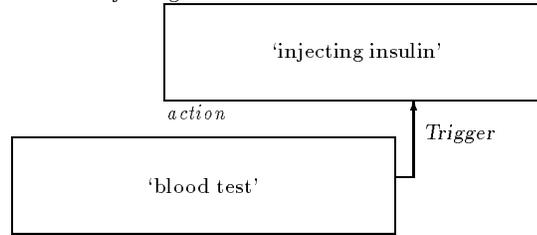
Review



EPISODE VAL-84[03:07:17]

{New blood test arrived}
 {DR told the resident to give the patient some insulin.}
 DR: [Sugar may not be as high because of the
 ultr-filtering.]

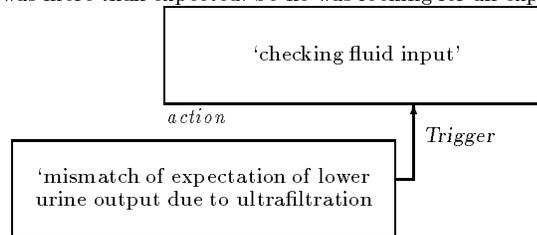
‡NOTE: As the anaesthesiologist was ready for the use of insulin, and in fact he was waiting for this blood test result to trigger the action of injecting insulin.



EPISODE VAL-85[03:10:08]

DR: < How much fluid has been filtered out? >
 PER: < nearly two litres >
 DR: < How much plegia did you use so far? >
 PER: < A lot >

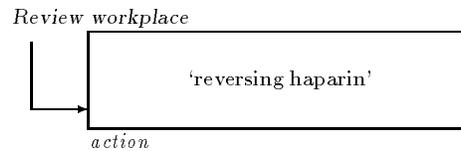
‡NOTE: Post-case interview showed that the anaesthesiologist found out the continuing large urine output and was wondering about the patient's fluid balance. The amount of fluid filtered out was more than expected. So he was looking for an explanation.



EPISODE VAL-86[03:20:00]

{DR was preparing Cyklokapron to get ready to reverse haparin. Cyklokapron was stored in very small ampoules and about 12 of them were used in the preparation.}

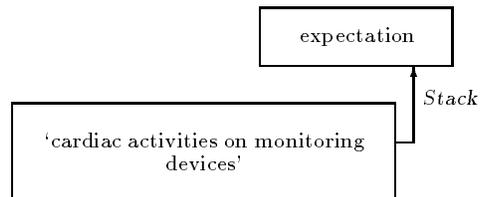
‡NOTE: The use of Cyklokapron was not until about half an hour later.



EPISODE VAL-87[03:31:20]

{The perfusionist gradually provided coronary artery some warm blood. ECG showed some patterns.}

‡NOTE: ECG was a response to lower potassium level.



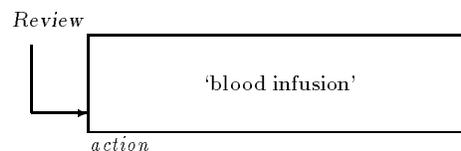
EPISODE VAL-88[03:32:01]

{DR checked urine output. Slow, but positive flow. Ask PER about the amount of ultrafiltering. All together: 1800ml in total.}

EPISODE VAL-89[03:38:39]

DR: I am going to get a unit of blood too, because I think we are going to need it. They have stopped off the filtering now. That is about 1800 he got off. You can correct by ventilating, you can correct his periods but you don t want to come off bypass with that.

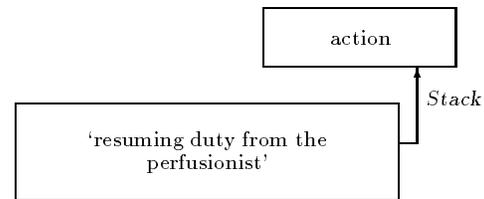
‡SUMMARY: The anaesthesiologist was planning for blood infusion.



EPISODE VAL-90[03:44:18]

{The patient was about to be off by-pass}

‡NOTE: The anaesthesiologist was scanning the workspace, and gathering syringes for off by-pass procedures.



EPISODE VAL-91[03:47:07]

DR: RE, how long since we gave any narcotic or midazolam? RE Last midazolam was about 9:30.

DR: Shouldn t we give something more? Because now that we have worn the vapors off you see.

DR: What is this here?

RE: That is pancuronium. Up until about 10 minutes ago, he has been getting a vapor so that and his lower..

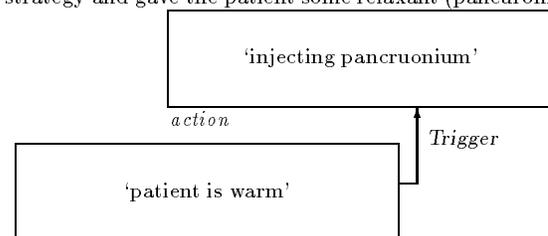
X: How did you decide to give another one?

DR: How did I decide? Just that now that he is warm, he mobilizes drugs very readily, because his liver works a bit better and I know that once we start to warm they turn this vapor off so there is actually none of it left in his heart to impair its function and then we come off. I know that if I do not do anything, the next thing he is going to tell me is that the saturations are going down and then he is behaving as though he is asleep you see.

X: You don't wait for that?

DR: So you pre-empt that and you head it off and I also know that during this period that some patients who have been aware this is one of the periods when they are aware.

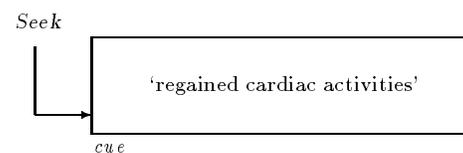
‡NOTE: The anaesthesiologist applied a feedforward control strategy and gave the patient some relaxant (pancuronium)



EPISODE VAL-92[03:53:45]

{DR and RE were waiting for signs of cardiac activity.}

‡NOTE: As the surgery progressed to the off by-pass stages, the attention was directed at how the newly re-grafted respond. Clearly it was one of the most critical moment in the operation. In post-case interview, the anaesthesiologist was looking for signs of trouble, and he already had internal pacemaker ready. Based on the awareness of the situation, they actively sought for cues.



EPISODE VAL-93[03:57:30]

{ Another blood gas test results are in. pH value is low. }

PER: < Oh I did not give bicarbonate. >

DR: [talk to X] I think I will pop a second one in. Some bicarbonate and we have decided after the last guess to give him some bicarbonate and we forgot to do it then. The last time it was -6 so it is not really very different.

X: When did you tell her to give him bicarbonate?

DR: After the last gas that was not too long ago, but he has been busy with him up there so. That is why they take them frequently.

X: So that is faster than you i.v. line.

DR: Well if I put it in my i.v. line, I have to give him more fluid, and I do not particularly want to whereas if he puts it in there, it is in the circulation without any extra fluid.

X: All you have to give is extra fluid to dilate him?

DR: If I give it, I have to give it in an intravenous somewhere and to get that in, I have to give 50 cc s of fluid and if I do that every time I give a drug, that adds up on top of which if he is running par, he needs to know the various drugs that are going in and when they go in so he can interpret the changes in blood pressures. If I am up here slipping drugs in, a little bit of this and a little bit of that and I don't tell him, he is left wondering what is happening.

‡NOTE: This question-and-answer segment shows that even though the decision used in giving the perfusionist bicarbonate may be simple, the anaesthesiologist was ready to expand the decision process to a wider scope by giving several reasons. In this particular case, a concern is the fluid in the patient due to the renal dysfunction. Extra fluid given will aggravate the concern.

EPISODE VAL-94[04:00:51]

{DR was preparing Amrinone, a visodialutor.}

X: Why are you putting this drug out?

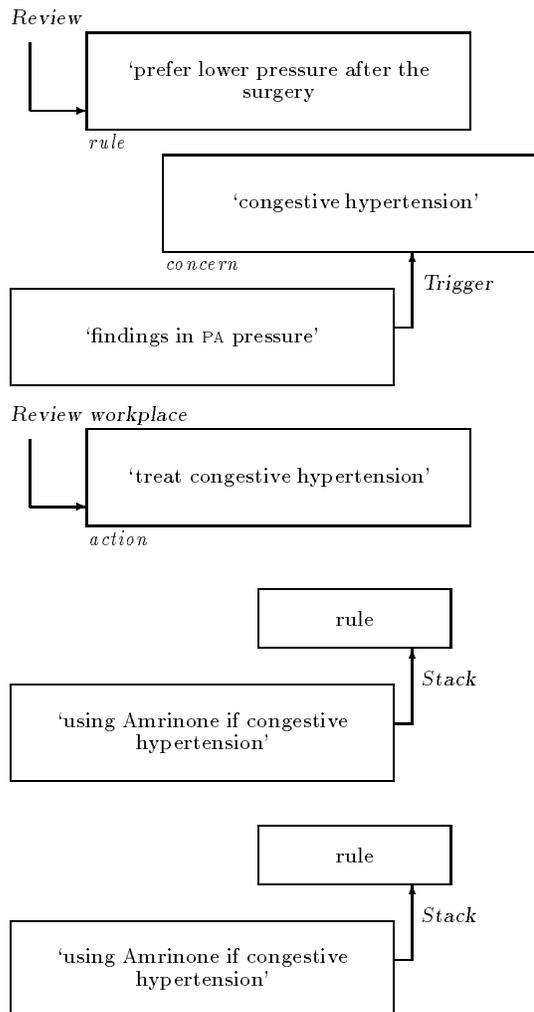
DR: Oh, because I think we are going to need it, it is a vasodilator and an inotropic.

X: Why do you need a vasodilator?

DR: I don't know that I will, but I think I will because I think I am going to have my pulmonary artery pressures. I am not sure why because I see them up there periodically and it may be that the Swan is just in too far. That is all, but it is just let's see what he looks like when he comes off. I am going to have to, because of all that repair, we are going to have to cut the blood pressure fairly carefully and not let it get much above 100. The alternative is to have it a little higher . . . [interrupted]

DR: Hypertension is a possibility not that I am worried we are going to have hypertension. Let's just see what becomes when he comes off.

‡NOTE: Readings from Swan-Ganz prompted the anaesthesiologist to think about a contingency situation of congestive hypertension. He prepared the drug for that situation. Post-case interview showed that such situation was not uncommon to the anaesthesiologist. The detailed rule of keeping blood pressure under 100 may not have been involved in the reasoning process, but keeping the blood pressure low about valvular regraft was a general rule.



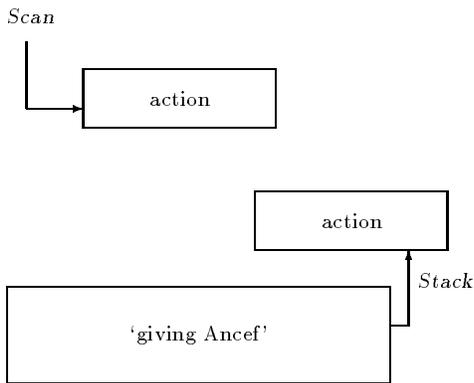
EPISODE VAL-95[04:02:59]

{Signs of sinus rhythms showed up in ECG and PA trace.}

‡NOTE: It was unclear to the observer what signs they were looking for at this stages.

EPISODE VAL-96[04:08:15]

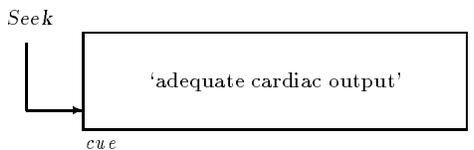
DR: < RE, get ready to give Ancef to the patient. >



EPISODE VAL-97[04:08:47]

{DRand RLwaited patiently for cardiac output to raise. Last measurement is 25.4, now is 48.5L/Min}

‡NOTE: Post-case interview indicated that one of the things to be done immediately after adequate cardiac output is DDAVP.



EPISODE VAL-98[04:09:33]

DR: DDAVP. Now we are going to activate his platelets. With this DDAVP we will jolt them into activity. This will just improve platelet function. Those platelets get bashed around and have are dysfunctional once they have been through the pump.

RE: So you always inject this before you ...

DR: No, we do not always use it. I don t get obsessed with getting a number out of that if it won t give it to you RE, I wonder if I could put it in over here. You didn't use any of that? [with regarding to a visodialutor]

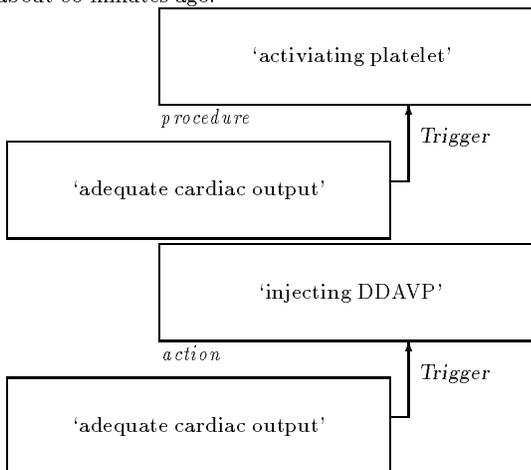
PER: Yes I did, I was using it right to the end for about 50 minutes.

DR: RE I think I am going to put this up. You have got the thing of that have you?

RE: Yes I do.

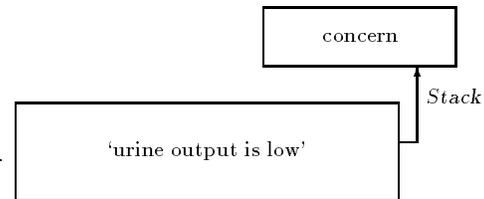
‡SUMMARY: DRinstruct RE to give DDAVP (an antidiuretic) to the patient

‡NOTE: The drug DDAVP was prepared at Episode Val-82, about 90 minutes ago.



EPISODE VAL-99[04:09:51]

DR: I think by this stage the effects of the team begin showing, you are doing one case <...> It is high isn't it. Let us go now back on this. This is Dopamine, let s just go back to 15. We have a high output, you see this 7 or 8 liters a minute, which is high. It is unnecessarily high especially as we are giving him a little more -- he was getting 4 mic s of dopamine, so we can afford to cut that back and maintain an effect on his urine output. I turned that back to 3 now and we will probably get that back to 2 maybe and at this stage, we will just see -- I have just given him Protamine and DDAVP, SUR. Does he not look nice or --



SUR: Not when we opened him.

DR: Oh well he had been on heparin.

SUR: What his volume?

DR: I am not sure what has done that. That is a high so his SVO s must nearly nothing. Easy with that Protamine.

SUR: If he is not <...> maybe we can give him another dose of Lasix.

DR: Yes. It looks like he is not making much urine so we have got good output and we have got good filling.

DR: That was about a half-an-hour ago.

EPISODE VAL-100[04:11:50]

{PER gave back an unused infusion bag prepared by DR (a visodilutor). He used something else for that purpose.}

EPISODE VAL-101[04:13:35]

{ RE finished a new test of cardiac output and the measurement is a little highish (7.8L/min). DR suggested to get back on the previous lower setting of Dopamine infusion. Suggested dosage was 15 (which is about 3 mics).}

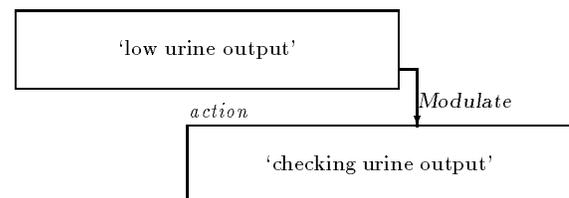
EPISODE VAL-102[04:16:02]

{ DRnoticed cardiac output was lower and decided to give more Dopamine.}

EPISODE VAL-103[04:16:20]

{ DR discussed with RE about the low-ish urine output: the patient had good cardiac output, and good filling pressure, and Dopamine was running. Urine tube has positive running of urine, so the problem should be the low urine output, not with the tubing.}

‡NOTE: Urine output is a good indicator for renal function.



EPISODE VAL-104[04:17:10]

{ DR is going to use 80 Lasix to treat the low urine output.}

‡NOTE: The anaesthesiologist examined various aspects with the problem of low urine output. He then decided to give Lasix to treat the problem directly.

EPISODE VAL-105 [04:17:42]

{ DR is giving another dose of Uncef to boost the antibiotic level. }

DR: Urine output. I am going to boost his antibiotic level and now that we are off, because all those D-strokes get diluted. I will push a little more fluid into him. I think I will give him a little more digoxin.

RE: Do you think it is a good idea to give him more dig?

DR: I think so.

RE: there is some nor-epinephrine in that -- no up on top, there dilute it in that infusion if you want to use that. That is 4 mg.

X: He is too low?

DR: Well his blood pressure is high, I think he is a little empty too. It could be a little fuller. Just hold your horses a bit RE, don't go plowing it in yet and we will get this off.

†NOTE: The anaesthesiologist was reviewing the drug cart and was prompted by the ampul of Uncef. In post-case interview he mentioned that the reason to give the drug was because of the massive fluid infusion, which could have put the antibiotics inject earlier to a sub-therapeutic level.

EPISODE VAL-106 [04:19:37]

{ DR found down trend in blood pressure. RE tried to decided what to do. }

DR: < there is some diluted epinephrine that DR prepared but had not been used by either PER or himself. >

DR: Hold the hose down a little bit, RE.

EPISODE VAL-107 [04:20:36]

DR: How long has that run?

PER: A little over 3 hours.

DR: I am getting a little volume into him but the red stuff did the right thing at the right time.

†SUMMARY: The anaesthesiologist asked the perfusionist how long he ran cardiac plegia. The perfusionist answered three hours.

EPISODE VAL-108 [04:22:26]

DR: < ... > his heart rate is going down a bit eh? I would give him 125 I think or a 1/4 at the most. I think what I might do, is I am going to get some more Cyklokapron I think. It is that drug we gave him at the beginning to prevent the dissolution of fibrin.

X: What problem will this correct?

DR: It will help him to maintain the fibrin clot he has got. Normally if you make fibrin, there are mechanisms called into play which dissolve it. I will put this in and I think you might need Protamine too, so that is coming in. What is it 140?

RE: What are you looking for?

DR: Oh something similar to what it was when we started.

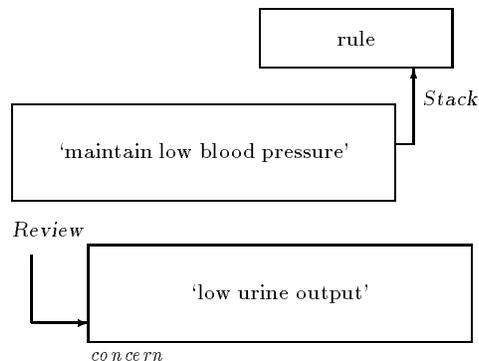
RE: Which gas?

DR: Well we don't want him to be hypertensive. Not much urine there actually.

RE: Are you still working on that problem?

DR: Yes. We may have to leave it to time and you can't cure everything in here you know. Is that you going off?

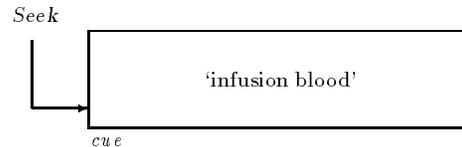
†SUMMARY: The anaesthesiologist mentioned that he is going to get some Citrate Caprane to maintain fibrin, which is dissolved by haprin.



EPISODE VAL-109[04:28:27]

DR: < asking RE about blood gas test results. >
 RE: The results are not back yet.

‡NOTE: Post-case interview showed that the anaesthesiologist was thinking of infusion blood. He looked for cues in the blood test to initiate the action.



EPISODE VAL-110[04:28:41]

{DR found some urine output upon examining the urine bag.}
 DR: < about 25ml since last observation > judge from that he [the patient] probably is alright.

‡NOTE: The anaesthesiologist assumed it was because of previous 80ml Lasix. It is just another example that whenever action is taken, an expectation is generated for directing future attention of monitoring.

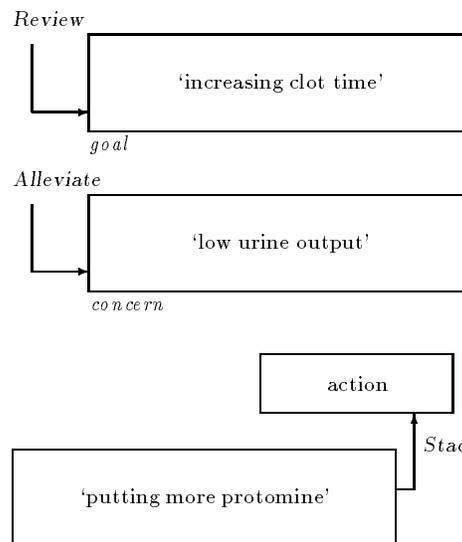
EPISODE VAL-111[04:29:26]

{RE got blood test results back. Hemotocrit is .27.}
 DR: That is all the pump blood in there. That is not bad for a 3 hour pump run.

EPISODE VAL-112[04:29:36]

DR: I am going to -- the DDAVP is in, that extra protamine is in and I am going to give a little more protamine actually. Do you put protamine up in the central line, that protamine, that extra protamine. That thing is on the ear isn't it.
 DR: I see some more urine and I am getting happier. If I saw a little more clot I would be hilariously happy.

‡SUMMARY: The anaesthesiologist is reviewing patient status by examining what's in the pipeline, i.e. the drugs that have been put in recently. He also verbalised the current major concern: the clot time, and a subdued concern: low urine output.



EPISODE VAL-113[04:30:35]

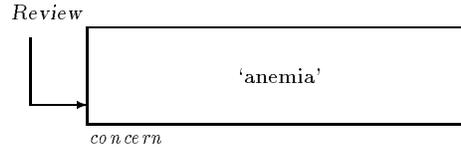
DR: I know, but the numbers can say that you cannot, but you look over there, this is likely <...> and I am going to level on it. Could you just put that up on the central line RE. 23 it is still.... all the pump blood is in now SUR and I am running more Cyklokapron he has had DDAVP and all these are on renal dose Dopamine now. Should we give another unit of blood? At [the age of] 83 he has not got a lot to lose. All these cells have not been coming together. We will probably have to give him more fluid. Before you get back to the ICU you will do it.

‡NOTE: DR was executing the plan of putting more protomine, and now try to find out which way to give to the patient, as one line is running Citrate Caprane, so he is looking for the central line.

EPISODE VAL-114 [04:31:35]

{DR is discussing with RE about whether to give the patient another unit of blood, as the patient's hemotocrit reading is good.}

‡NOTE: The anaesthesiologist had not really worried about the patient's hemotocrit counts, considering that one of the concerns that he had about the patient was anemia (see Episode Val-2). He had used a few ways to combat the concern: using ultra-filtering, starting red-cell infusion early in the case, and reduced fluid infusion. At this stage he was wondering whether he should give more blood to the patient.



EPISODE VAL-115 [04:32:02]

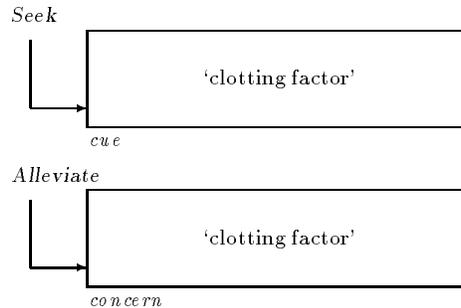
RE: < arguing that there is no harm to give the patient another unit of blood. >
 DR: < arguing that some more fluid has to be given to the patient if another unit of blood is to be given. >

EPISODE VAL-116 [04:39:49]

{DR was watching over the surgical site for direct information about the clotting factors in the blood.}

DR: He doesn't look too wet, doesn't he? [to SUR]
 SUR: No. He is fine. These are mainly bone marrows.

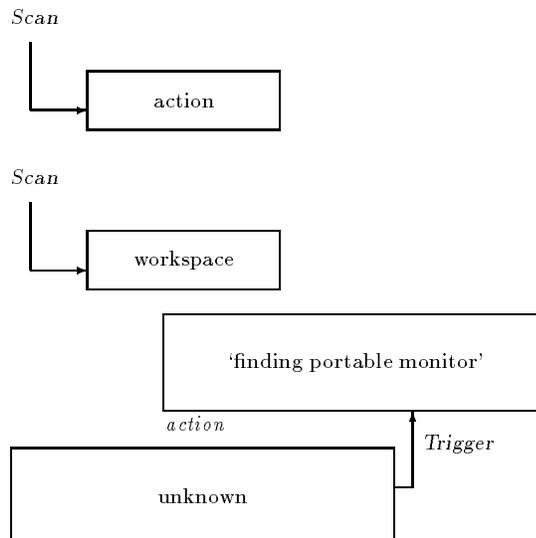
‡NOTE: The anaesthesiologist confirmed with the surgeon about the clotting situations.



EPISODE VAL-117 [04:39:53]

DR: I can't find the monitor. I think they have gone to look for one. Here it is. Just give it to me. Never mind the bed, we are not quite ready. Just put those right leads on.

‡SUMMARY: The anaesthesiologist was looking for the portable monitor so that they can get ready to transport the patient.
 ‡NOTE: The anaesthesiologist was looking for the next step: transporting the patient to ICU, even though the surgeon was still closing the wound.



EPISODE VAL-118 [04:48:53]

{DR and RE were transporting the patient to ICU.}

EPISODE VAL-119 [04:50:52]

{PT was in ICU.}

EPISODE VAL-120 [04:53:10]

{RE transferred duty to the ICU anaesthesiologist:
77 man, chronic ASV (aortic stenotic valve)... He is on
Dopamine at renal type dose, some additional Cyclone
Caprone, some additional protomain. Just let them go
through. He has high cardiac output, and low-ish refill. His
potassium is 5.2 but has received insulin. Run through Pro-
tomain in the stand. He received Lasix 40, 40 and 80 and had
considerable urine output. We used ultra-filtering, and fluid
balance is good. and nothing should be specially concerned.}

EPISODE VAL-121 [04:59:34]

DR: The case went as smooth as any body could hoped for.

Annotated Protocols from a Lobectomy



Case description

A female, 65 years old, 60 kilograms, underwent a right upper lobectomy. She was a heavy smoker and quit a month before the surgery. She was fairly obese, hypertensive. Epidural anaesthesia was considered for post-operative pain management but was rejected because of the technical difficulty due to obeseness and language barrier to obtain proper consent.

The subject was a fourth year resident. A staff anaesthesiologist was at her assistance, but only for two brief periods. So She did the case essentially on her own.

The transcription was done by the observer.

Legend

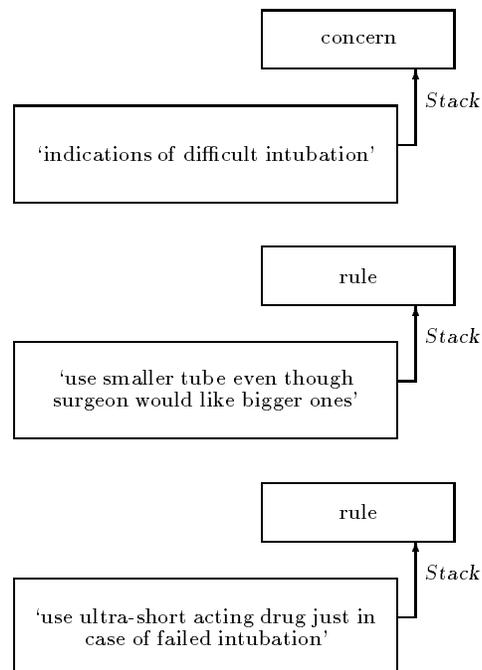
X	the observer
DR	the anaesthesiologist
PT	the patient
NUR	a nurse
SV	the supervisor
SUR	a surgeon
< ... >	inaudible or omitted speech
< >	< abbreviated speech >
{ }	{ <i>Describing activities</i> }

Annotated protocols

EPISODE LOB-1 [Pre-op]

{The anaesthesiologist was briefing the observer}

†SUMMARY: The patient looks difficult to be intubated. She is short and fat. She has small mouth and had capped teeth all along the front. Two decision were made to alleviate the concern over the possible difficult intubation. A small size endotracheal tube will be used, in spite the surgeon would like large size tube for bronchoscopy. The second is to use ultra-short acting muscle relaxant for intubation (*i.e.*, succinylcholine), so that if the attempt of intubation fails, the patient can be waken up easily to breath on her own.

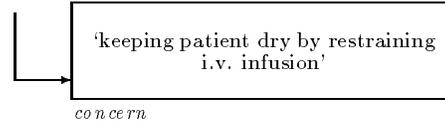


EPISODE LOB-2 [Pre-op]

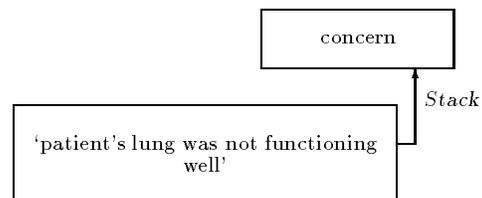
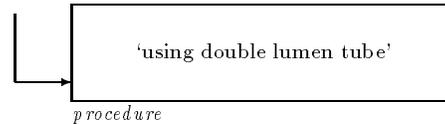
{The anaesthesiologist was briefing the observer}

†SUMMARY: In thoracotomy surgeons like the surgical field being dry. Thus iv infusion will be restrained. If the lobectomy is to be carried out, the case will be a long case. Double lumen tube will be used, which will also be difficult due to the patient's condition for intubation. The patient's lung is not functioning properly, thus iv anaesthesia will be used, instead of using nitrous oxide.

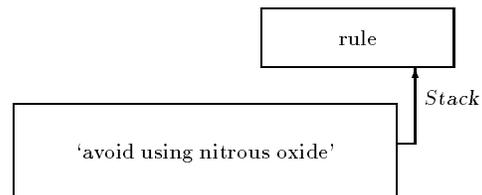
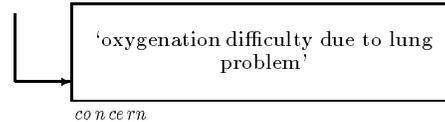
Review



Review



Review



EPISODE LOB-3 [Preop]

{The anaesthesiologist was briefing the observer}

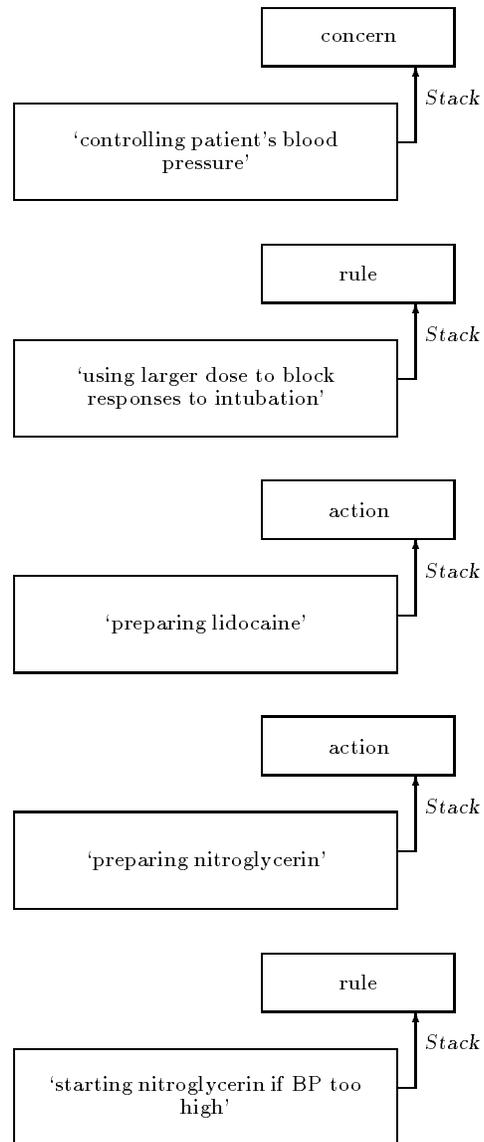
†SUMMARY: The patient is obese and will be difficult to do an epidural. Because the anticipated difficulties involved, it is important to have a good, clear consent from the patient. However, the patient does not speak good English. Thus other way of managing post-operative pain will be used.

EPISODE LOB-4 [Pre-op]

{The anaesthesiologist was briefing the observer}

†SUMMARY: The patient has an uncontrolled hypertension. Most of the time patients with uncontrolled hypertension will have episodes of high blood pressure during induction. The following ways were considered to deal with the high blood pressure problem:

- Using pre-medication.
- Using larger dose to block the response to intubation.
- Preparing lidocaine to intervene high blood pressure
- Preparing nitroglycerin infusion in case of dangerously high blood pressure.



EPISODE LOB-5[Preceding case]

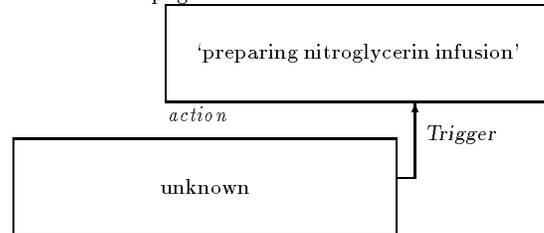
{The anaesthesiologist was preparing nitroglycerin infusion bag while in the preceding case.}

DR: Usually what I do is that during this case I am starting to get ready for the next case.

DR: I got this drug, nitroglycerin, drawn up for the next case, because she... her blood pressure is high on the floor, and she tells me that she's got high blood pressure and she doesn't take medication very often, just occasionally. Her blood pressure was a little bit high on the floor. Usually [stressed pronunciation] those patients are harder to control in the operating room. So I am expecting her blood pressure to bounce around a lot, up and down.

†SUMMARY: The anaesthesiologist prepared nitroglycerin infusion device while in the previous case.

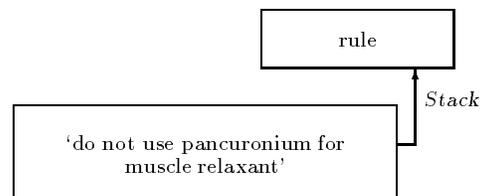
‡NOTE: This episode happened during the preceding case. See Episode Sal-28 on page 276



EPISODE LOB-6[Preceding case]

{The anaesthesiologist asked the surgeon whether the patient would have a MED.}

‡NOTE: This episode happened during the preceding case. See Episode Sal-33 on page 277. A MED procedure was done to determine the nature of the disease. Whether or not the lobectomy proceeds will depend on the result of the MED. If lobectomy is cancelled, the patient will be awakened up. The confirmation of the MED procedure would mean that the anaesthesiologist should use a short-acting muscle relaxant.



EPISODE LOB-7[09:38:45]

{The patient was just in}

DR: Checking the cuffs on my double lumen tubes.

{NUR was positioning PT}

†SUMMARY: DR was preparing tubes to be used during the possible lobectomy, while the patient was just brought into the OR.

EPISODE LOB-8[09:39:38]

DR: She is not going to have an epidural [to SUR] I talked to Dr. XXX and he decided to give a PCA.

{DR was positioning PT}

†SUMMARY: DR was communicating her decision of not using epidural to a member of the surgical team.

The patient was positioned and monitors were linked up.

EPISODE LOB-9[09:40:36]

DR: < instruct PT and get ready for iv cannula >

DR: Now, has anybody tried to start a big intravenous on you? Looks like they did. [to PT]

DR: I have to start an intravenous because she doesn't have one

†SUMMARY: The anaesthesiologist started to set up an iv line.

‡NOTE: Often the patient comes to the OR with an i.v. line. The anaesthesiologist then decides whether the line is adequate for the purpose of administering drugs, fluid, and blood in the particular case.

EPISODE LOB-10[09:41:09]

{A SV came in}

SV: I am here all day [to cover you]

EPISODE LOB-11[09:41:28]

DR: I tried to find an intravenous. It looks like that they poked other side a few times for me. See if we can ...Good. Good enough for a starting.

DR: Can you make a fist [to PT]

DR: She may not get in an 14 but an 16.

†SUMMARY: The anaesthesiologist was encountered with a difficult iv. She made the decision of using a smaller iv cannula. During the iv cannulation, she made a detailed verbalisation.

‡NOTE: The anaesthesiologist decided on the size of iv cannula at the time of catheterisation. Factors that influence the choice include: the need for large-bore catheter and the difficulty of putting in a large-bore catheter. The large the size, the more difficult and more traumatic to the patient. The first factor is assessed based on the judgment whether there is a potential for large fluid infusion (such as potentials of massive bleeding). The second factor is assessed during physical examination. Occasionally the difficulty is only known after a few trials of putting large bore needles in.

EPISODE LOB-12[09:43:10]

DR: Now some pinch now, a little slizzing going in [to PT]

DR: This patient doesn't have great veins. That's for sure. []

DR: Here we go. [Finding veins]

DR: Sometimes it is a bit tricky to get them in when you get a twist little vein there.

{ The iv was in at 09:44:26}

DR: Well, my dear, what we're going to do is to put another needle on this side, too [to PT] [This 'another' needle was for arterial blood pressure measurement]

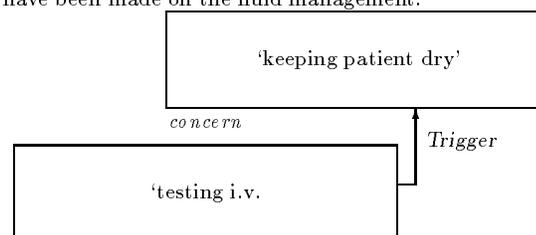
EPISODE LOB-13[09:45:15]

{DR Secured iv with nurse and tested iv}

DR: We want to keep patients dry during a thoracic surgery. So we don't want to give too much fluid.

†SUMMARY: The anaesthesiologist secured iv while recalled a strategy to be used in fluid management.

‡NOTE: While putting in the intravenous catheter, the anaesthesiologist rehearsed a guidance for the fluid management, *i.e.*, how much fluid should be given. There was no access to how the anaesthesiologist rehearsed, and what other decisions that may have been made on the fluid management.



EPISODE LOB-14[09:45:34]

DR: The colleague doesn't show up [indicating the surgeon]

DR: Just relax you arm [to PT].

DR: What did I do with my freezing?

DR: A little pinch. I am sorry for that. There is a little more freezing going in. [to PT]

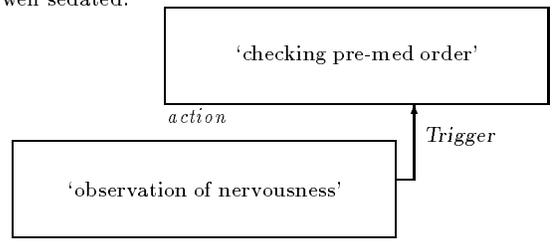
†SUMMARY: The anaesthesiologist was setting up a cannula for the invasive arterial blood pressure monitor.

EPISODE LOB-15[09:46:48]

{*bserving the patient was nervous*}

DR: Did they come and wake you up and give you a pill?
[to PT]

†SUMMARY: The anaesthesiologist checked with the patient about pre-medication order after seeing the patient anxious.
†NOTE: In the majority of cases observed, the anaesthesiologists were found to confirm, in various manners, whether the premedications orders had been followed. The anaesthesiologist here was triggered by the observation that the patient was not well sedated.



EPISODE LOB-16[09:47:12]

DR: I noticed that I was going to put the art-line and the iv on the opposite side from what I ... from the way it set up. [to NUR]

DR: Just relax. We already have the freezing in so this is not going to hurt you [to PT].

DR: Some people don't put this in sterile but I always do.

DR: This is just to check < ... > This is so because sometime when you go for the skin you get a plug of tissue in your angio [angiocatheter] So it is easier to [interrupted]

DR: Don't move, just relax [to PT]

DR: Just to see if we can get a flush.

DR: It's a more difficult network. I try not to go through the artery. I just like to slide that in. It gives you the opportunity that if by chance you don't get like that, and sometimes you don't. It is just a matter of feel and experience. The reason I like to put on a syringe is that I have all the opportunities to watch the blood comes up the syringe. If the blood still comes up you know that the tip is still in the artery. I slowly rotate it off and try it up and most of the time it works.

{*Arterial catheter was in*}

†SUMMARY: The anaesthesiologist was placing the arterial blood pressure cannula with detailed verbalisation.
†NOTE: This passage is a detailed verbalisation of the process of catheterisation. It describes the rules used plus general comments. It is rare to see this among more experienced staff.

EPISODE LOB-17[09:51:39]

DR: You are going to go to sleep soon [to PT]

DR: Now I get rid of my sharps so that nobody ...

DR: Now I just make sure that this is zeroed

DR: Looks like it is more difficult to intubate [to SV]
{*SV gives description of his experience with airway judgment*}

DR: This is a little probe on you finger, measuring the oxygen in your blood. [to PT]

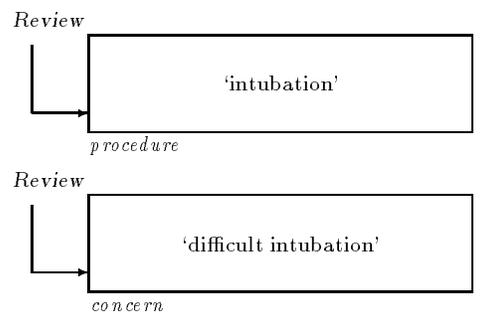
DR: There is some oxygen for you to breath.
X: < what monitors you are going to use >

DR: Just the usual monitors.

DR: I am going to put an extra extension tubing so that I can reach

DR: Now we are starting to put in a little medication to make you feel a little bit of sleepy. [to PT]

†SUMMARY: The anaesthesiologist was getting ready for a stressful period: intubation. She mounted important monitors, and reviewed the difficulties, and rehearsed maneuvers.
†NOTE: To use the arterial pressure monitor, the transducer has to be zeroed. It is the last step in setting up the arterial blood pressure line.



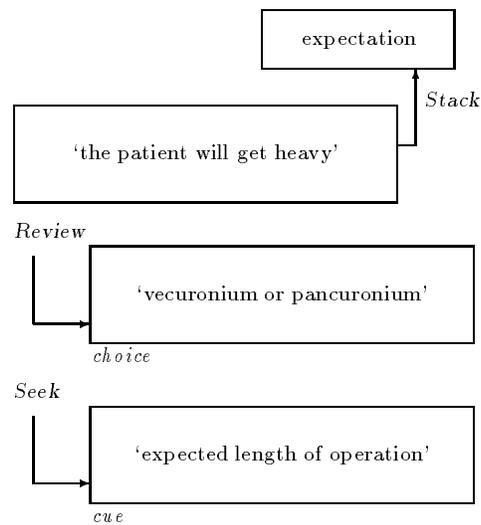
EPISODE LOB-18[09:55:15]

DR: Here is some curarine, 3 milligrams. Now she is going to get heavy.
 DR: They for sure to go ahead with a full thoracotomy? [NUR]
 NUR: < ... >

†SUMMARY: The anaesthesiologist started induction sequence by injecting curarine to facilitate intubation. In rehearsing following procedures, she was also thinking about whether to use vecuronium or pancuronium.

‡NOTE: At this moment the anaesthesiologist was going to give muscle relaxant for the surgery. The choice to be made here is whether to use a long-lasting one (pancuronium) or a short-lasting one (vecuronium). The choice is determined by the length of the surgical operation, which was not certain to the anaesthesiologist. But she knew that there were two possibilities: either a short, 45 minutes, biopsy procedure, or a full lobectomy that would last several hours. The anaesthesiologist was fortunistic in terms of information gathering, in that she was actively looking for cues for decision.

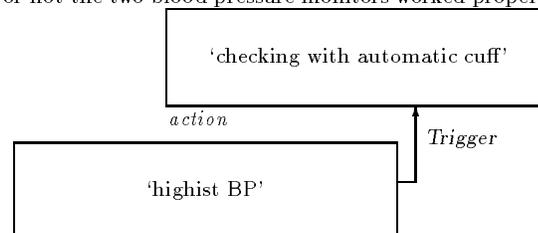
The action of injecting drugs induced anticipation that the patient would respond to the shortacting muscle relaxant for intubation. This anticipation in turn triggered a monitoring task.



EPISODE LOB-19[09:55:54]

DR: Now we are waiting for that to come down [that=blood pressure].
 DR: Now the automatic cuff... [using cuff to verify the blood pressure]

‡NOTE: Invasive arterial blood pressure monitor gives beep to beep readings, whereas the automatic manometer cuff gives reading every three minutes or upon request. Both methods of measuring blood pressure suffer various inaccuracies and errors. However, they are independent to each other. Using redundant channels to verify the observed trend (high blood pressure). It may also serve as a way to verify whether or not the two blood pressure monitors worked properly.



EPISODE LOB-20[09:56:10]

DR: I have some lidocaine drawn up. Blood pressure is little bit along the high side. I thought it was going to be like that. That's why I put the art-line before she went to sleep because she is on the ... [interrupted]

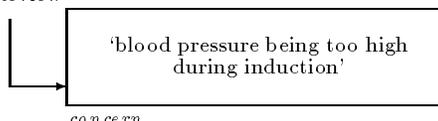
‡NOTE: The anaesthesiologist had known that the patient had high blood pressure before the operation. She made the prediction that the blood pressure would fluctuate to a large degree during the induction process. She had made her decision to use lidocaine if blood pressure were high, and had the drug drawn up. But she did not know exactly whether or when the drug would be needed.

She also had nitroglycerin infusion set up in case that the blood pressure was dangerously high. Not mentioning nitroglycerin indicates that the situation did not warrant more aggressive intervention.

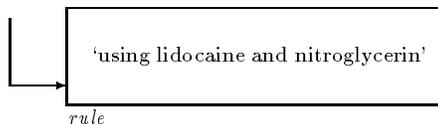
The fact that the anaesthesiologist mentioned the possible intervention method (using lidocaine) is an indication that she had assessed the blood pressure situations, and it was also likely that she was about to give the drug to reduce the blood pressure but felt that the blood pressure was not high enough.

The anaesthesiologist confirmed the prediction of a high blood pressure reading. High blood pressure reading triggered the recall of intended intervention: lidocaine.

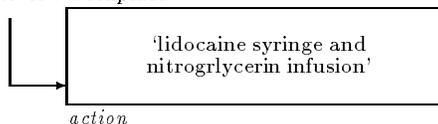
Review



Review



Review workplace



EPISODE LOB-21[09:56:37]

DR: 250 Fentanyl

{giving to the patient}

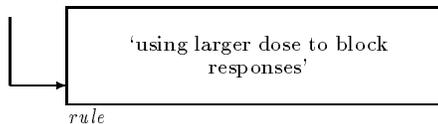
SV: < asked about pre-medication >

DR: Yeah. I cut down the volume of pre-med. I don't always pre-med with thoracotomy. But with her,...

DR: Try to relax [to PT]

‡NOTE: 250 micrograms of Fentanyl for a 60 kg was a fairly large dose. The anaesthesiologist used a large dose of Fentanyl. Retrospective reports indicated the intention of blocking the patient's response to induction.

Review



EPISODE LOB-22[09:57:21]

DR: Get another one of these ready because once she is asleep I won't . . .

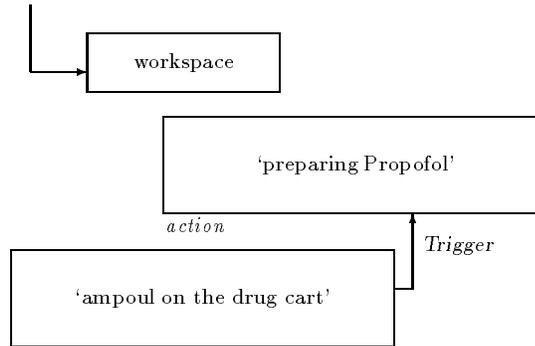
{drawing up Propofol}

†SUMMARY: The anaesthesiologist prepared a syringe of Propofol for later use during maintenance.

‡NOTE: Drawing up a syringe for later use during a busy period was unusual.

Drawn up syringes placed on the drug cart can be used as a reminder of using the drugs.

Scan



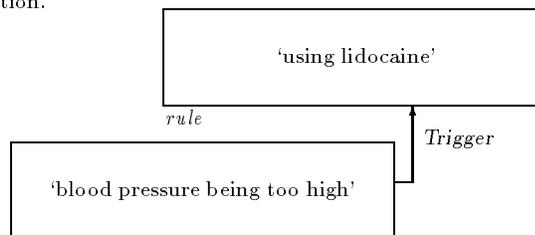
EPISODE LOB-23[09:57:32]

DR: I don't like her blood pressure being so high.

DR: Feel a little sleepy? A little? [to PT]

DR: I gave her some lidocaine. It is because her blood pressure is on the high side. I am trying to be responsive to. [to X]

‡NOTE: Continued high blood pressure triggered the act of injecting lidocaine. Although there were other means for reducing blood pressure (such as using nitroglycerin infusion), the anaesthesiologist did not give any indication that she entertained any decisionmaking, but rather, executing a preplanned choice. There was little indication that the mental effort was attempted of sorting through the factors and deciding on the best intervention.



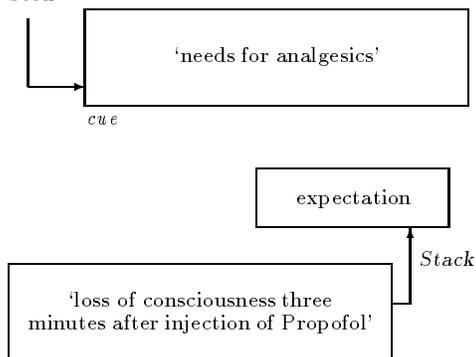
EPISODE LOB-24[09:58:57]

DR: SUR, are you going to go ahead with the ...
 SUR: < no bronchoscopy >
 DR: You may feel a little pain in your arm when you drift off to sleep [to PT]
 DR: Nice big breath [to PT]
 DR: I feel a little bit of surprise that that didn't put her to sleep. With Propofol sometimes it takes a while.

†NOTE: The anaesthesiologist confirmed with the surgeon on how the the biopsy would be carried out. This would impact on the use of analgesics.

The anaesthesiologist found out that the patient did not go to sleep according to her anticipation. This mismatch triggered a reassessment of her anticipation. In this case the anaesthesiologist attributed the mismatch to the overestimate of the drug effect. It reveals the importance of anticipation. Anticipation helped the anaesthesiologist to focus her attention in monitoring the patient. It also gave her hints as to how to revised her understanding of the drug actions if there was a mismatch. Three minutes after the injection of Propofol, the anaesthesiologist found that the patient did not go to sleep as anticipated. She attributed the mismatch between anticipation with observation to the overestimate of the drug effect.

Seek

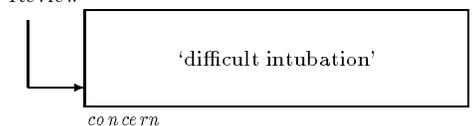


EPISODE LOB-25[10:01:38]

DR: Now, hope it is not quite as difficult to do according to rules You don't much room in your neck, my dear.
 {Tube was in}
 DR: I don't think I would got that 8 in it [size 8 tube].
 DR: I don't think she is going to need any air in the cuff. let's see. That's a pretty snugg fit. [to NUR, deciding ho much air should be put into the tube cuff]
 DR: SUR, this is a 7 and half [to SUR]

†SUMMARY: The endotracheal tube was placed. She also gave a retrospective assessment of her decision to use 7 and half sized tube.

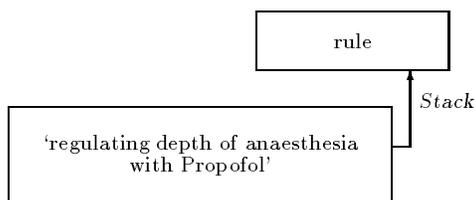
Review



EPISODE LOB-26[10:03:08]

DR: Let's me tape the eyes.
 DR: Okay. I have some Propofol to keep her sleep with.

†SUMMARY: The anaesthesiologist reviewed the situations, and rehearsed the guidance of using Propofol to achieve an important goal: keeping the patient unconscious.

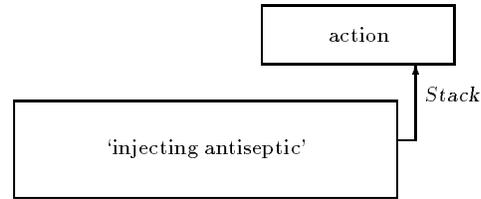


EPISODE LOB-27[10:03:23]

DR: They like to give this at sometime, too [indicate antiseptic to SV]

{Work with SUR with bronchoscopy}

†SUMMARY: The anaesthesiologist reviewed another action to be done: injecting antiseptic.



EPISODE LOB-28[10:05:15]

DR: I use vecuronium again, because she may end up with not giving her a thoracotomy if her MED is positive. So I want to be able to reverse her in about 45 minutes to an hour. [to X]

DR: Now, let's give her something to keep her asleep.

{giving some more Propofol}

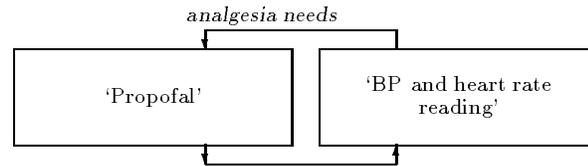
DR: I just give an < ... > blood pressure and heart rate.

{charting started}

†SUMMARY: Starting charting indicated that the anaesthesiologist was satisfied with the current status, and she did not predict any immediate changes in the patient status.

‡NOTE: Using a long lasting muscle relaxant (e.g., pancuronium) in a short procedure is a very embarrassing error for anaesthesiologists.

The anaesthesiologist gave the patient vecuronium (a short-acting muscle relaxant lasting about 40 minutes), a bolus of Propofol to keep the patient unconscious, and checked the patient's two vital signs: blood pressure and heart rate to regulate those two variables. The anaesthesiologist clearly used these two variables to assess the need for analgesics.



EPISODE LOB-29[10:06:13]

DR: That's another reason I like the art-line if I can get quickly before the patient goes to sleep, because all you are set. [to X]

DR: When I intubated the patient, the blood pressure was 115 and and didn't change, which was good, because I was going to use nitroglycerin. But I gave a fairly big dose of Propofol to try and block her down. I have the nitroglycerin ready but I didn't use it.

Now I just use Propofol to keep her asleep. You have just to remember to give her every 3 or 4 minutes. I have to use my hands to push it. [because no automatic pump]

†SUMMARY: The anaesthesiologist gave retrospective account of what had happened during the induction. She also reported a recurring task of injecting Propofol every 3 or 4 minutes.

EPISODE LOB-30[10:09:39]

DR: Are you doing a MED now? [to SUR] Her neck does not have much space.

{Working with SUR, securing airway tube so that SUR won't pull it out while pulling the bronchoscopy through the tube}

†SUMMARY: The surgeon was inserting through the endotracheal tube. The anaesthesiologist tried to avoid the tube being pulled out.

EPISODE LOB-31[10:11:11]

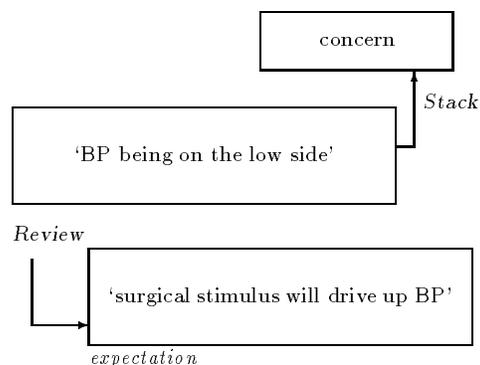
X: If you have an automatic pump, you may not need the art-line? [to DR]

DR: You do put it, because you need to draw blood gases once she goes on one lung. And also I probably will use it anyway because her blood pressure is quite high.

DR: This is low now, almost on the lower side. But soon they are going to stimulate her and MED is a very stimulating procedure.

‡SUMMARY: The anaesthesiologist detected that the blood pressure was low. But she was expecting the biopsy procedure was very stimulating and the patient blood pressure would increase as a response to that surgical maneuver.

‡NOTE: Blood pressure is an indication of anaesthesia depth, which determines the need for anaesthetics (in this case, Propofol and vapour agent). The low blood pressure was not treated here, but rather, the anaesthesiologist considered the anticipated future input (surgical stimulation) and decided not to treat the problem. See the explanation given at Episode Lob-33.



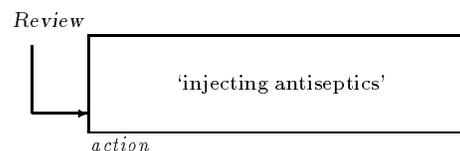
EPISODE LOB-32[10:12:48]

DR: Did you see whether he [SV] gave her antiseptics? [to X]

X: < don't know >

DR: I'll wait though I think he has given to her.

‡NOTE: The anaesthesiologist recalled a task to be done: injecting antiseptics. A missing communication link with SV put unknown on the status of this task.

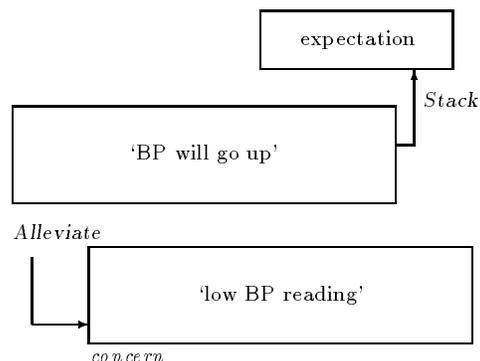


EPISODE LOB-33[10:12:52]

{Surgeon made cut }

DR: See, this is a little surgical stimulation [to X]. So I don't have to treat her low blood pressure. Because I know that if I treat it, and they cut her, I'll be treating the other way.

‡SUMMARY: The surgeon started cutting. The anaesthesiologist anticipated that the patient's blood pressure would rise due to the surgical stimulation.



EPISODE LOB-34[10:13:45]

DR: She will get a Foley catheter. She doesn't have it yet but if they decided to go ahead with the procedure she will get one.

‡NOTE: Foley catheter is a name for the urinary catheter. Thinking about the Foley catheter could be an indication that the anaesthesiologist was thinking of using increase iv rate as a way to raise blood pressure temporarily, which she so reported in the post-case interview.

In the present context, she was likely thinking about intervene the low blood pressure after seeing how much a surgical stimulation could do to raise the blood pressure.

EPISODE LOB-35[10:14:30]

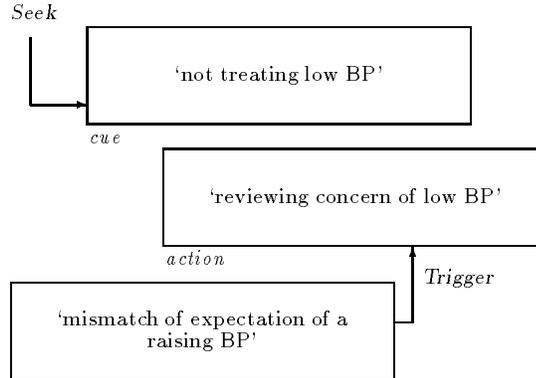
DR: She has a really large dose of fentanyl because her blood pressure was high and I was trying to block that down. Her mean blood pressure was 110 and now is 75. The art-line is a little bit high and the transducer is a little bit low so...

{Adjusting transducer}

DR: Now the two correlates better.

‡NOTE: The anaesthesiologist was reluctant to treat the low blood pressure. She was looking for reasons of not treating the low blood pressure by re-calibrating the transducer.

The anaesthesiologist was clearly not satisfied with the way the patient was settled down. Her concern over the low blood pressure reading was shown by her act of recalibrating the arterial line blood pressure reading, which she thought was lower than it should be. She attributed the low reading to the large dose of fentanyl, which she could justify.



EPISODE LOB-36[10:16:08]

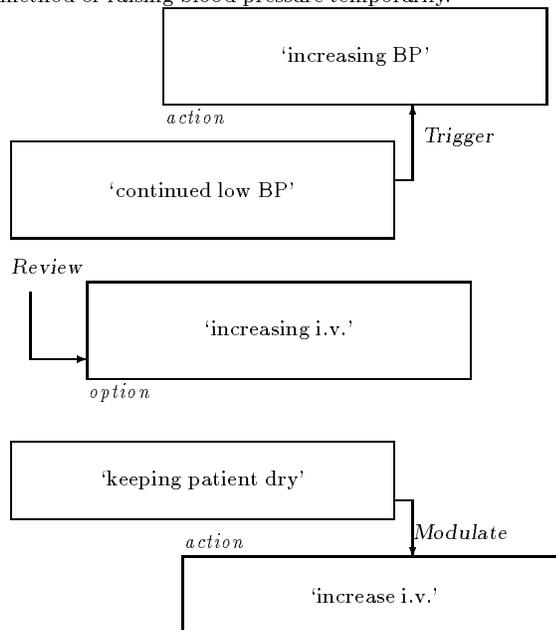
DR: I am trying to ...

{Adjusting iv speed}

DR: You don't want this to run too fast, because if they decide to go ahead with thoracotomy we would like to keep her on the dry side. [to X]

‡SUMMARY: The anaesthesiologist raised the iv rate in order to raise the blood pressure temporarily. She also reported the goal conflicts involved in using this method.

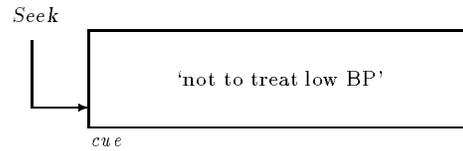
‡NOTE: The anaesthesiologist finally decided to use increased fluid infusion to combat the low blood pressure reading. The anaesthesiologist also reported the goal conflict involved in this method of raising blood pressure temporarily.



EPISODE LOB-37[10:16:31]

DR: I haven't treated her blood pressure. I am waiting. I think they are going to cut her. [to X]

‡NOTE: The anaesthesiologist waited for the surgeon's stimulation, but she could not control the pace of the surgeon.



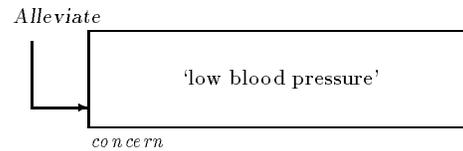
EPISODE LOB-38[10:17:04]

DR: She needs a little surgical stimulation [commenting on the low reading of blood pressure]

‡SUMMARY: The surgeon caused more stimulation than before. The patient's blood pressure rised. The anaesthesiologist's anticipation was confirmed.

{SUR starting to move the scope}

X: < commenting on the rising of the patient's blood pressure >



DR: Yeah, I think she is quite light. Probably quite light. I know that as soon as they stimulate her her blood pressure will go up.

DR: Now she is doing exactly what I thought she was going to do. See how her blood pressure goes...

EPISODE LOB-39[10:20:00]

DR: Her probe came off finger [pulse oximeter probe came off and DR went to fix it.]

‡SUMMARY: The pulse oximeter probe came off. The anaesthesiologist fixed it.

‡NOTE: This episode demonstrated the fact that anaesthesiologists work in a dynamic and changing environment.

EPISODE LOB-40[10:24:11]

{SUR was moving the bronchoscope in large swing}

‡SUMMARY: The anaesthesiologist watched as the surgeon was adjusting the bronchoscope and anticipated that problems could arise as a result of the surgeon's movement. She focused her attention in monitoring both the surgeon's action and the tube.

DR: For this procedure there is always a possibility that they relocate the tube...

{Alarming sound}

‡NOTE: This episode of disconnecting breathing tube is a good demonstration that how anticipation facilitate monitoring. At the very moment of verbalising the anticipation of a possible disconnection, a disconnect alarm went off.

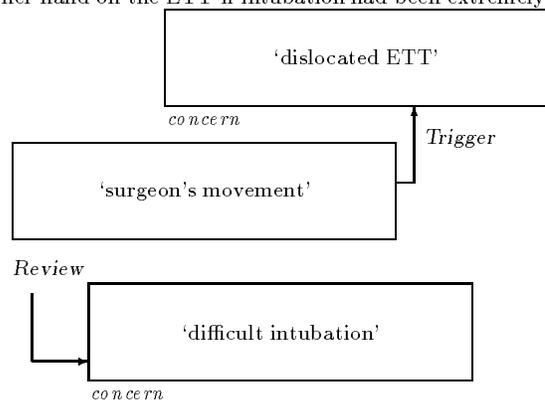
DR: Did you extubate me? [to SUR]

SUR: < no >

Post-case interview showed that the anaesthesiologist would put her hand on the ETT if intubation had been extremely difficult.

DR: You just disconnected me. It's okay. It is just disconnected.

DR: The endotracheal tube was just disconnected because it was right beside the surgeon. [to X]

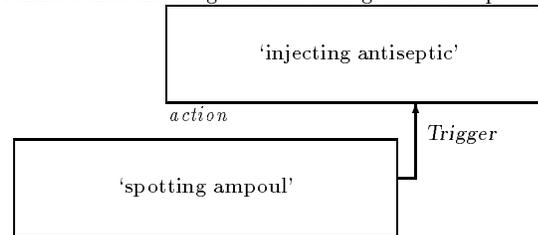


EPISODE LOB-41 [10:26:09]

DR: He didn't give her antiseptic [He: SV. Her: PT]
 [After seeing the ampoul of antiseptic]
 {DR preparing the antiseptic}
 DR: Let's me see if she's got any allergies [see the
 chart]
 {injecting the antiseptic, but hard to reach the inject point}

†SUMMARY: The presence of the ampul of antiseptic told the anaesthesiologist that the drug was not given to the patient. She gave the drug right away.

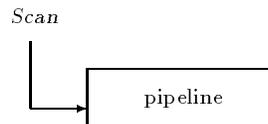
‡NOTE: The anaesthesiologist used the workspace as a way of registering task pipeline. By seeing the ampul of antiseptic, she realised that the drug had not been given to the patient.



EPISODE LOB-42 [10:29:32]

DR: Now I have to figure out how much drugs I have
 given.

‡NOTE: The injection of antiseptics was followed by the charting action, which triggered the review of the drugs given so far.

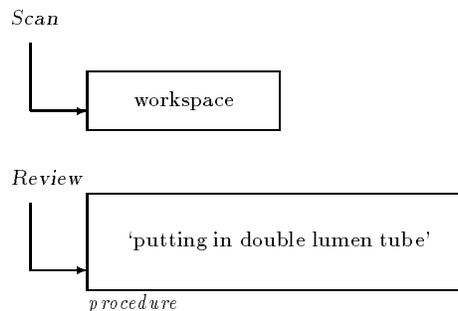


EPISODE LOB-43 [10:30:09]

DR: Hope I can get that tube in [the double lumen tube
 to be used in the possible thoracotomy later on].
 That's a big tube. Her airway is small.

†SUMMARY: The anaesthesiologist was checking the double lumen tube for later use. She anticipated that the task of insertion was not easy for this patient.

‡NOTE: Although the trigger was unknown, the anaesthesiologist was rehearsing and planning for the procedure of inserting a double lumen tube.



EPISODE LOB-44 [10:30:22]

X: So you have predicted a difficult ...

DR: Airway? Well, she is short, fat, she's got the
 capped teeth all along the front. Though nothing
 dramatic, but these little things add up so I chose
 7 and half tube, though for bronchoscopy they like a
 bigger tube.

†SUMMARY: Discussion about the first case

EPISODE LOB-45[10:34:48]

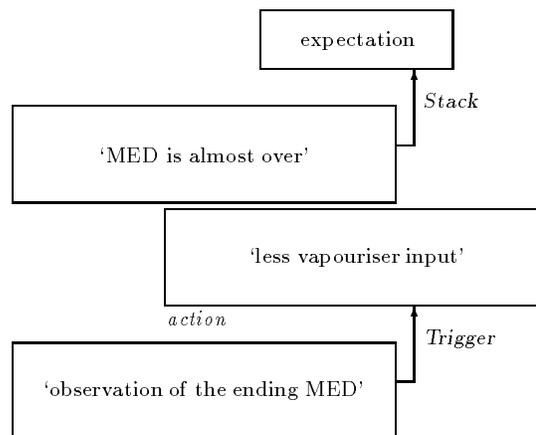
DR: As the case goes on it is not so stimulating, because they already made the cut. I keep turning down a little bit [the vapouriser]. She doesn't need as much anaesthetic. Once they have dissect all the planes it doesn't hurt the patient.

X: < did you correlate the observation of the surgical process with monitoring? >

DR: The blood pressure came down a little bit. It tells me that the patient's status is stable and the procedure is at its end. At the end of the procedure I keep the patient just asleep just in case we have to wake her up.

†SUMMARY: The anaesthesiologist's anticipation that the surgical stimulation was being reduced was coupled by the observation that the patient's blood pressure dropped. She turned down the vapouriser to reduce anaesthesia input.

‡NOTE: This episode is another example of feedforward control. The anticipation of less stimulation was confirmed by the observation of lower blood pressure. The anaesthesiologist also revealed her rule of giving anaesthetics.

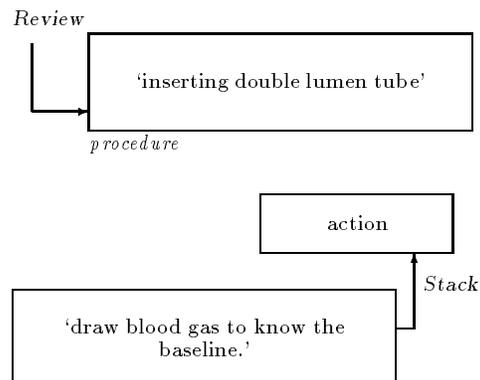


EPISODE LOB-46[10:39:47]

DR: I am not going to draw any blood gas now. But if they tell me that they are going to go ahead with thoracotomy then I'll draw the blood.

DR: < I can get baseline value, also I want to know how she responds to my ventilation, which is 50% oxygen. And also how my end-tidal CO₂ correlates with the test >

†SUMMARY: The anaesthesiologist reviewed her task list.



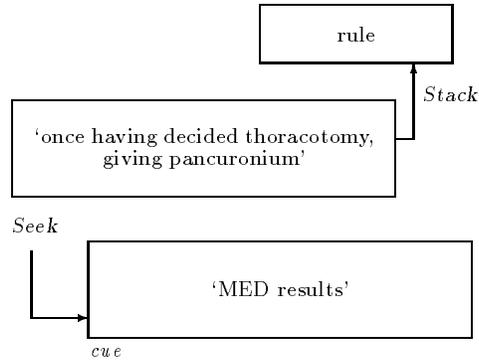
EPISODE LOB-47[10:40:10]

< A prolonged period of teaching by SV >

EPISODE LOB-48[10:50:30]

DR: Right now we're just waiting for surgeons to decide whether they are going to go ahead with thoracotomy. If they decide to go ahead, we are going to position her and I'll give her some longer lasting relaxant pancuronium. [to X]

The anaesthesiologist reviewed her next move basing on the likely future event. She may also be at the point of checking the patient's status in terms of muscle relaxation.

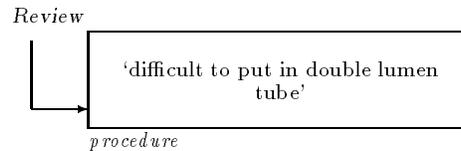


EPISODE LOB-49[10:53:18]

{The surgeon informed that they will go ahead with the lobectomy}
 {re-position the patient}

DR: I hope I can get that 35 in [35mm double lumen tube]
 DR: I know that she is not the easiest patient to put a double lumen in.
 DR: Here is the tube. I checked the cuffs. [the double lumen tube]

†SUMMARY: The patient was repositioned for the lobectomy. The anaesthesiologist attempted to put the required double lumen tube in.

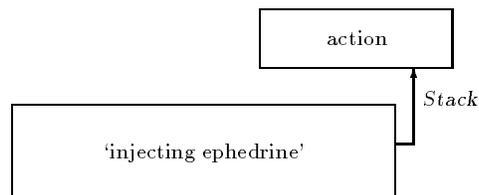
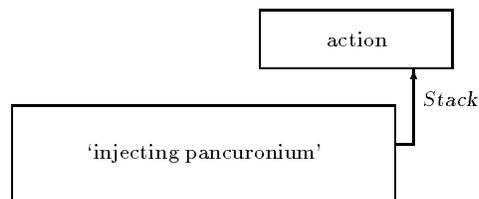
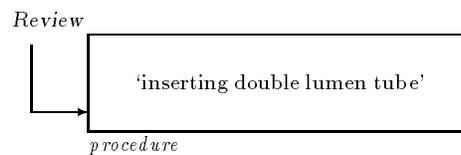


EPISODE LOB-50[10:55:05]

{The surgeon was ready to do the thoracotomy, which would require to turn the patient to the side.}

DR: Let's take the tape off [remove previous tube]
 DR: Actually I am gonna have to paralyse her.
 {Get the double lumen tube in}
 SUR: Would it be possible to use a bigger tube?
 DR: No. No way. I have to really push to get a 35 in. Seven and half of an endo-tracheal tube doesn't need air in the cuff.
 {Trying to position the double-lumen tube properly}
 DR: Now, where is that ephedrine?
 DR: She is heavy. Is that a requirement to do thoracic surgery that you have to be strong? [to SUR]
 SUR: It helps.

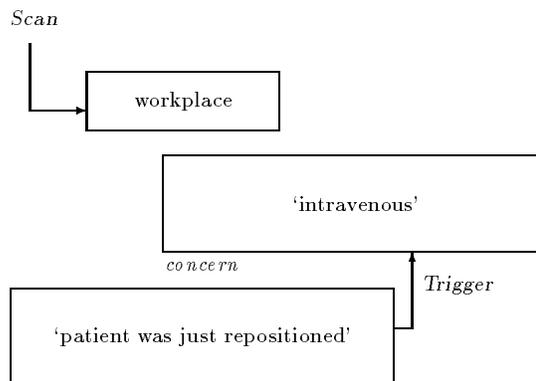
†SUMMARY: The anaesthesiologist inserted the double lumen tube with the help of a bronchoscope. Before the maneuver she realised that the patient was not paralysed, so she paralysed the patient. She also injected ephedrine to facilitate the insertion.



EPISODE LOB-51[11:16:50]

DR: Just make sure that the intravenous works, because they moved the patient.

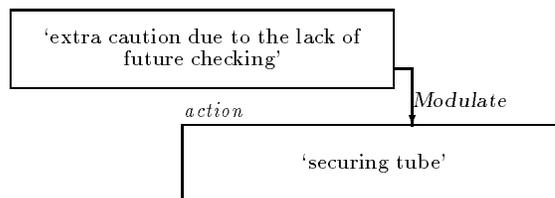
‡NOTE: Rechecking iv links after repositioning the patient is part of routine observed in almost every such case.



EPISODE LOB-52[11:17:08]

DR: I am not going to be able to check this lady's bronchus. [because the particular positioning of the patient]

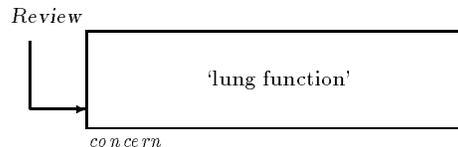
‡NOTE: By reviewing the situation, the anaesthesiologist realised that she had to take special precaution in inserting the double lumen tube. Ordinarily the anaesthesiologist could check the position to ensure that the surgeon did not displace the tube.



EPISODE LOB-53[11:18:10]

SV: Do you want a coffee or something?
 DR: I don't mind one. Let's get the chart upto date. I was pretty much caught up with the positioning.
 DR: Her airway pressure hasn't changed so we must be ventilating very well. [to SV]

‡SUMMARY: The anaesthesiologist was relieved by the supervising staff. While keeping up charting, she noticed that the patient's airway pressure had not changed.
 ‡NOTE: The anaesthesiologist was concerned about the function of the patient's lung (see Episode Lob-2). Her attention was directed by that concern.



EPISODE LOB-54[11:20:00]

{DR left the OR}

EPISODE LOB-55[12:05:00]

{DR came back to the OR}
 {Answering general questions from X}

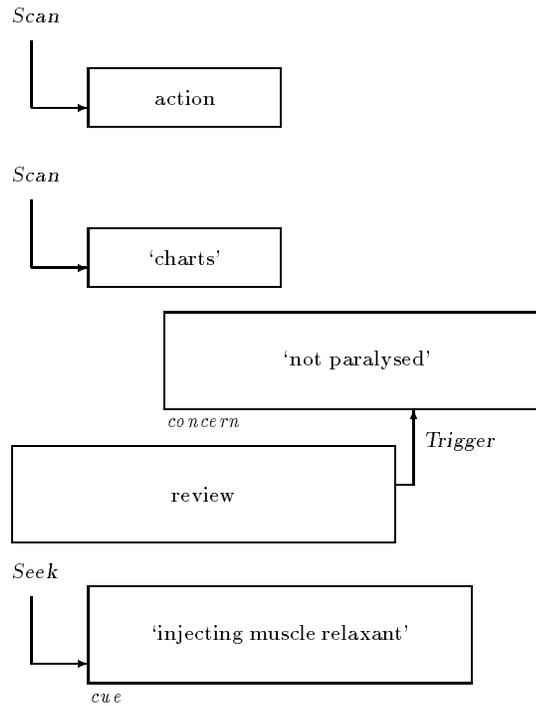
EPISODE LOB-56[12:10:16]

DR: She may not be paralysed actually. I should put the nerve stimulator on.

DR: She is partially paralysed, not totally. [after checking with nerve stimulator]

DR: He's only given her 2 more vecuronium.

†SUMMARY: After seeing from the chart that, during her leave, the supervisor only gave the patient 2 milligram of vecuronium, the anaesthesiologist hypothesised that the patient could be only partially paralysed. She tested her hypothesis with a nerve stimulator.
‡NOTE: This episode demonstrated how the anticipation helped the anaesthesiologist to focus her attention. The monitor, the nerve stimulator, is not usually attached to the patient.



EPISODE LOB-57[12:13:38]

DR: I could have given pancuronium but vecuronium can last 45 minutes so I don't have to worry about it till after 1 o'clock. And when you add these two drugs together, it lasts even longer, like two hours. So at the end of the case the patient is still paralysed and you may not be able to reverse her.

†SUMMARY: The anaesthesiologist gave a retrospective account of the decision process of choosing between pancuronium and vecuronium.

‡NOTE: Even though the anaesthesiologist did not know exactly when the surgery would finish, but for the purpose of deciding what muscle relaxant to use, she knew that a long lasting one was not adequate.

EPISODE LOB-58[12:20:38]

DR: It takes a while to get used to a drug. At the first few times, I tried to do what the instruction said. But it wasn't that easy, because I didn't know how long it lasts before they begin to move. I didn't know what's going to happen. I took young and healthy patients to practice the drugs.

‡NOTE: The strategy is generally used by anaesthesiologists. Due to partial understanding of drugs, anaesthesiologists have to get used to drugs in various situations, such as combinations of drugs. This verbalisation also shows the importance of 'knowing what's going to happen'.

EPISODE LOB-59[12:35:14]

DR: Are you done? [to SUR]

SUR: < no, but asking about the dosage of adrenaline used internally >

Annotated Protocols from an Esophagoscopy



Case description

A 69 year old male was for a salivary stent esophagoscopy. He came to the hospital at the end of August for a major GI bleed. At that time he had a cancer at the junction between his esophagus and stomach. The esophagus was removed and a tube installed upto his neck, but the tube falled apart at the end. The surgeon is to put a stent to keep it open. The patient has come back several times for the same procedure.

The subject was a fourth year resident. A staff anaesthesiologist was at her assistance, but only for two brief periods. So She did the case essentially on her own.

Legend

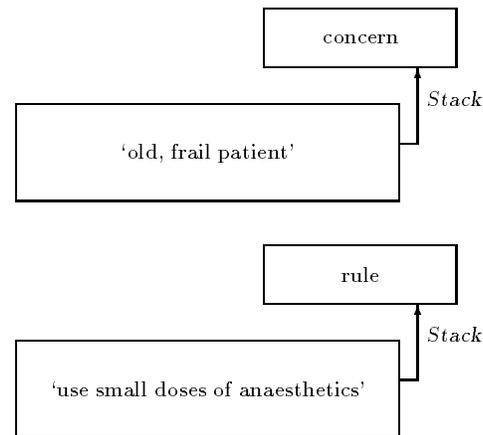
X	the observer
DR	the anaesthesiologist
PT	the patient
NUR	a nurse
SV	the supervisor
SUR	a surgeon
< ... >	inaudible or omitted speech
< >	< abbreviated speech >
{ }	{ <i>Describing activities</i> }

Annotated protocols

EPISODE SAL-1 [Pre-op]

{The anaesthesiologist was briefing the observer}

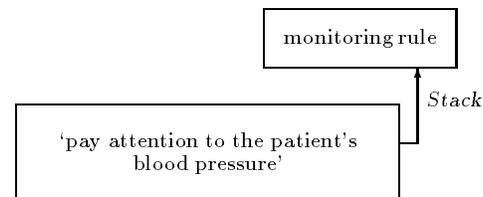
†SUMMARY: The patient is an old, frail man. He does not need as much anaesthetic as a young man.



EPISODE SAL-2 [Pre-op]

{The anaesthesiologist was briefing the observer}

†SUMMARY: The patient had a history of high blood pressure. He may not need special treatment for that but I have to watch for his blood pressure.



EPISODE SAL-3 [08:26:00]

DR: That's 12.8 [blood sugar test, done while the patient waited outside after the patient was brought down and was found that the blood sugar was too high: 28]

DR: Sorry for the delay [talk to SUR]

SUR: We are okay.

†SUMMARY: The patient's sugar test on the previous day was too high. DR did not feel comfortable with that reading and sent sample for another test.

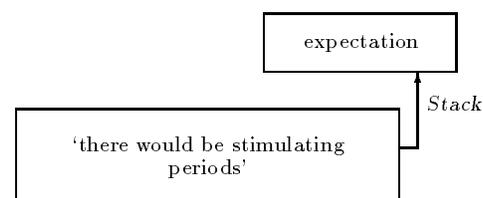
EPISODE SAL-4 [08:26:37]

DR: Is this going to be flexible esophagoscopy or rigid?

SUR: It's going to be both.

†SUMMARY: While preparing drugs, DR asked the surgeon about the surgical nature.

‡NOTE: Flexible esophagoscopy is not as stimulating as a rigid one. While preparing for drugs, the anaesthesiologist was thinking about the dosages of drugs, which were influenced by what the surgeon intended to do.



EPISODE SAL-5 [08:27:50]

DR: I am just looking at previous anaesthetic records. [Talk to X] If you look at the doses he tolerated last time... He had procedures done before.

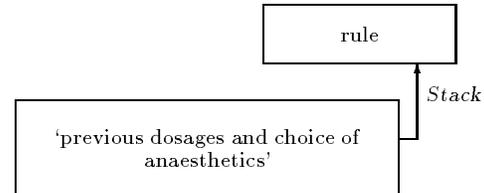
X: Is this repeated procedure?

DR: It is a repeated procedure, almost identical. I am just looking to see what doses of medication he tolerated before.

X: That's the previous chart.

DR: This is previous chart. This is from 2 October, and this is 6 September.

‡NOTE: The chat was just available with the patient. Because the anaesthesiologist knew it was a repeated procedure, it would be interesting to know how much anaesthetics the patient received in previous operations.



EPISODE SAL-6 [08:28:40]

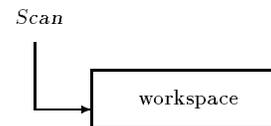
DR: We are just putting a few monitors on you [talk to PT]

DR: < ... > those monitors we just give him a little of oxygen [to NUR]

EPISODE SAL-7 [08:29:22]

DR: Now, what's been hang in there? fluid bag [the patient came in with an iv line in] Is it D5W < ... >?

‡NOTE: The anaesthesiologist scanned the workplace for things needed to be done.



EPISODE SAL-8 [08:29:43]

{Pulse Oximeter on}

DR: Let me see this < ... > Now let's turn off it for a little bit. [the pulse oximeter]

‡SUMMARY: DR was examining the patient's arm and checking the i.v. line.

EPISODE SAL-9 [08:29:57]

DR: You can just relax that arm. You don't have hold up it. Could you just put your arm down? That's good. [Talking to PT]

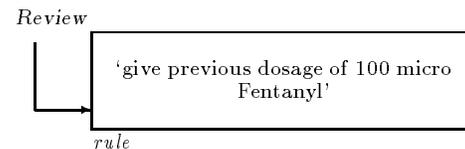
DR: A little curarine so he doesn't get fasciculated.

DR: A nice, deep breath [to PT]

DR: 100 micro of Fentanyl. He had last time.

‡SUMMARY: DR started induction sequence.

‡NOTE: As for an old, frail man, the anaesthesiologist would like to give as little anaesthetic as possible. 100 micro is a relatively small dose according to textbooks. Previous usage gave a good indication as to what dosage the patient could take.



EPISODE SAL-10 [08:30:51]

DR: I changed his iv bag. He doesn't need the D5W now.

EPISODE SAL-11 [08:31:18]

DR: You're going to get a little bit of sleepy in a few second from now. [to PT]

DR: Are you itching there? [see PT using one had to scratch the other]

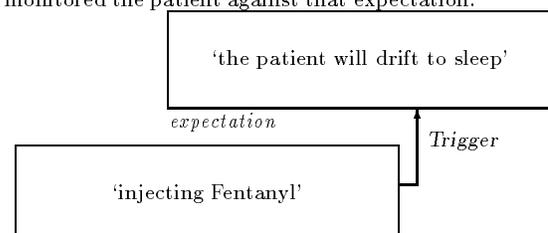
PT: Yes.

DR: It will go away. I just put a drug going into your intra venous You're going to drift into sleep now. When you wake up, you will be in the recovery room. [to PT]

DR: Nice, big breath. [to PT]

‡SUMMARY: DR was waiting for Fentanyl to take effect.

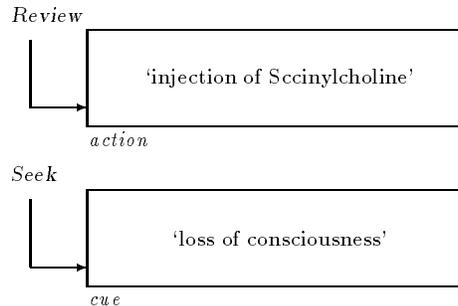
‡NOTE: The action of injecting Fentanyl cause the anaesthesiologist to expect that the patient would lose consciousness. She monitored the patient against that expectation.



EPISODE SAL-12[08:32:50]

DR: He is just asleep. A little of bit of Succinylcholine to relax him.
 DR: I am not talking to self; I am talking to the microphone. [to NUR]

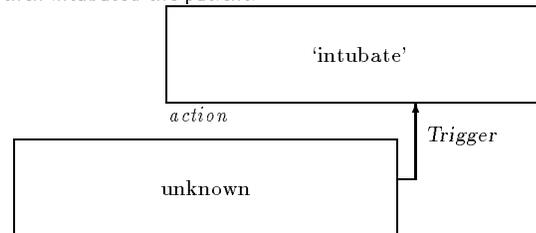
‡NOTE: While monitoring the patient, the anaesthesiologist was rehearsing the next step: injection of succinylcholine, which was triggered by the detection of asleep cue.



EPISODE SAL-13[08:33:22]

DR: I am going to intubate him because of the esophagoscopy.
 DR: Hard to get good feel on the hand bag.
 DR: < ... > if I intubate him < ... > it will be okay.
 DR: I can see if he is not circulating through it.
 DR: I just tape that up.
 DR: So, it may not fit for a guy who is diametre.... 8 and half tube. Well, it could be a lot ... [to SUR]

‡SUMMARY: DR was getting ready to intubate the patient, and then intubated the patient.



EPISODE SAL-14[08:35:02]

{The ETT was just in.}
 DR: Okay, open the ventilator. Big guy, I'll give him a litre
 {Adjusting ventilator}
 DR: Now, check his blood pressure again.

‡SUMMARY: After checking the ETT position, DR opened up the ventilator.
 ‡NOTE: It was interesting that the anaesthesiologist made detailed verbalisation in referencing her decision process of volume setting for the ventilator. when coming to the point of decision, she scanned the patient and gave a slightly high volume.

EPISODE SAL-15[08:35:26]

DR: I couldn't find any paper tape right aside. [to NUR]
 NUR: There are some ...
 DR: Okay. Could you just hold that for a second because the tube tilted [to NUR]
 {Securing tube}

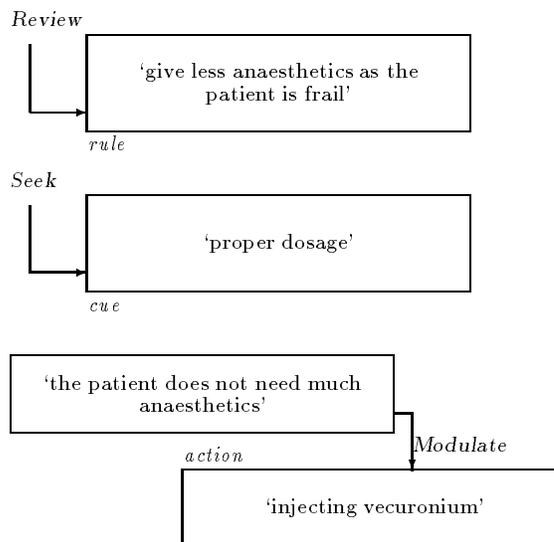
EPISODE SAL-16[08:36:31]

DR: Do you want pillow out? [to SUR]
 SUR: < ... >

EPISODE SAL-17[08:36:43]

DR: You are going to be how long? about an hour?
 SUR: A bit over half an hour.
 DR: Okay.
 DR: I give vecuronium.
 DR: 4 miligram of vecuronium, which is not much. He is not totally paralysed but should be enough for a case of low 40 minutes.

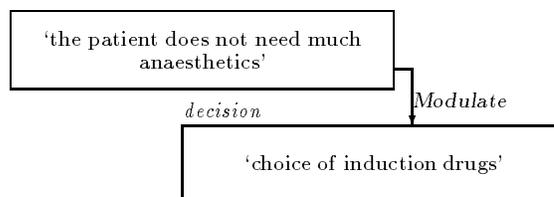
‡NOTE: According to textbook, the initial dosage for vecuronium is 0.01-0.015 mg/kg, i.e. 10-15 miligram for this patient. 4 miligram is a relatively a small dose. It is also interesting to note that the anaesthesiologist confirmed with the surgeon again with regarding the time estimation. Vecuronium lasts about 40 minutes. As in the pre-op interview, the anaesthesiologist had made the decision of giving less anaesthetics. She did not want to give more than the patient needed. A couple of factors influenced the decision. One is the length of the surgery, the other is the status of the patient.



EPISODE SAL-18[08:37:28]

{DR relaxed and was approached by X}
 X: You're very quick.
 DR: I tried to be quick [in intubation].
 DR: Is anything you want me to say?
 X: You're doing perfectly.
 DR: I gave lidocaine, because he had hypertension and he was given before. I would not have given it except it was given to him before. He was not hypertensive when he came in; he was normotensive. His blood pressure has been fine.
 DR: This is not as stimulating as bronchoscopy. I would have sprayed lidocaine if it were bronchoscopy. But with esophagoscopy I intubated in normal way. Hopefully we checked his blood pressure every three minutes and get him what he needs. He is elderly man and he looks quite ill and frail. I don't think he will take as much anaesthetic as a healthy young man.

‡NOTE: In this retrospective report, the anaesthesiologist revealed that she had considered to remove lidocaine from the induction sequence due to the consideration that the patient was weak.



EPISODE SAL-19[08:39:02]

X: A general question: when you drew up drugs, did you actually determine what dosages you were going to use, or you decided the dosage while you injected them?

DR: I tends to draw up what I commonly use. When the patien arrives the room, I may alter that. Sometime I have to alter my anaesthetic because, as a senior resident, I have to give what the staff person wants me to do. I would not have given the patient curarine because he is an old man he won't muscle pain, but most of the staff people would give that. So I gave that because that's not officially my anaesthetic.

EPISODE SAL-20[08:40:00]

SUR: < needs sucker >

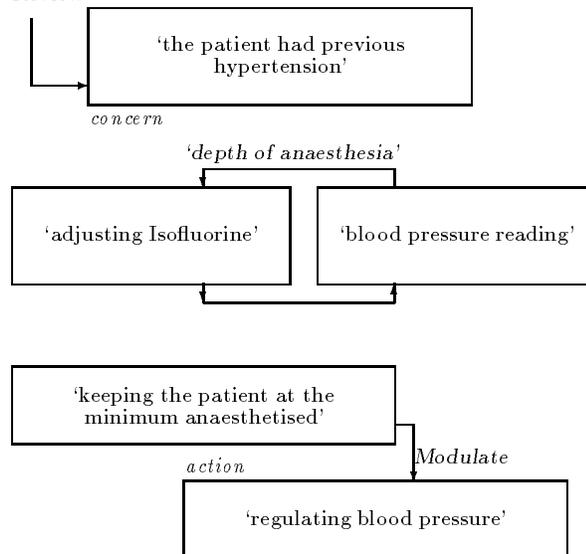
DR: < sure >

EPISODE SAL-21[08:40:05]

DR: His blood pressure has gone up a little bit but that is still quite satisfactory. I turned up the Isoflurine a little bit. He is doing fine.

‡NOTE: As the anaesthesiologist chose to use small dose of anaesthetics, she monitored the patient's anaesthetic depth very carefully. Essentially she laid down a narrow envelop of status for managing the patient.

Review



EPISODE SAL-22[08:40:41]

DR: I like to put the patients into sleep fairly quickly when they come to the room. I think they get nervous and. I like to draw up narcotics < ... > . When I did the surgar test, I wanted the patient stay outside but when he came in I put him into sleep quickly.

X: Is that fair to say that a lot of what you are doing is not because you are required or desciplined but you care about the patient.

DR: That's right. A lot of things we do is to make the anaesthetic smooth. Probably I just have to give these two [point to the 5-6 syringes on the anaesthesia cart]. and that's Pentothal, to put him to sleep, and vecuronium, an intermediate muscle relaxant, to keep him still. I used a lot of fluorine to block his response. But these other drugs, curarine, is just to prevent his muscle from circulating and, lidocaine is to prevent his blood pressure won't go up, and fentanyl, is just to give a little bit more of pain killer, and succinylcholine, is very just to put in the tube quickly. I could have easily not given them as all, by just given vecuronium. [to X]

DR: For short case like this, I don't use nerve stimulator. I am usually pretty confident on how long that drug will last. But for the next case, I'll use nerve stimulator, because it is really important that they don't move and if it is a really long operation you can forget when you last time gave it. [X]

EPISODE SAL-23[08:43:31]

{SV stepped in and greeted DR}

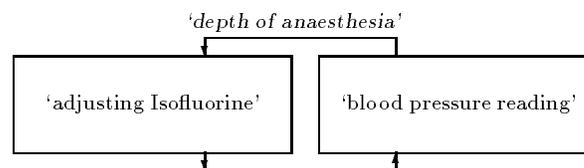
DR: [In response to SV's question about blood sugar at the beginning of the case] That was fine. I checked the blood sugar and it was 12.8 and I sent it to the lab. But it was 28 yesterday...

SV: Is that right? Did they give him anything?

DR: No, I did not find that in the chart. They gave him <...> But I was not happy when I brought him in with last sugar in the chart being 28.

SV: Definitely.

EPISODE SAL-24[08:44:14]



DR: Blood pressure just fell off a little bit so I put him back to 0.5% [of Isofluorine] [talking to X]

EPISODE SAL-25[08:45:04]

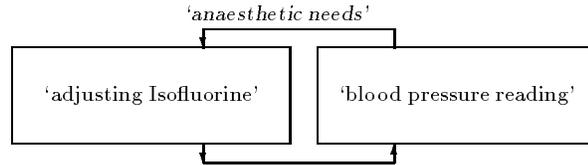
DR:

{talk
to SV: about the second case} The next lady, I haven't really got a consent to put an epidural because her ability to speak English was not very good.

SV: Is it kind of easy to put in an epidural?

DR: She is quite a compact. She will be a fairly difficult epidural. So I am kind of hesitating about doing it. If I were just able to speak to her, I will much more comfortable with it.

EPISODE SAL-26[08:46:57]



DR: His pressure has fallen off a little bit. It is not dangerous. So I just lower the Isoflurine a little bit more.

EPISODE SAL-27[08:48:17]



DR: Blood pressure, now, returned.

EPISODE SAL-28[08:48:44]

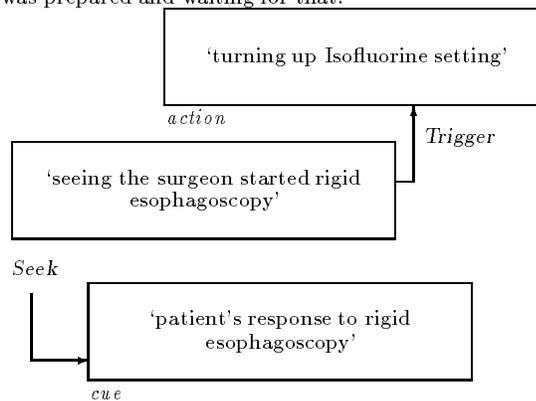
DR: Usually what I do is that during this case I am starting to get ready for the next case.
 DR: I got this drug, nitroglycerin, drawn up for the next case, because she... her blood pressure is high on the floor, and she tells me that she's got high blood pressure and she doesn't take medication very often, just occasionally. Her blood pressure was a little bit high on the floor. Usually [stressed pronunciation] those patients are harder to control in the operating room. So I am expecting her blood pressure to bounce around a lot, up and down.

‡NOTE: This episode has little to do with this case; its analysis is in Episode Lob-5 on page 253 . It is worth noting that the anaesthesiologist prepared the next case in the middle of this case.

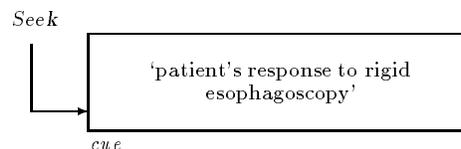
EPISODE SAL-29[08:49:55]

DR: Her blood pressure is going to go up...I don't know that for sure but I turned up the Isoflurine because they [the surgeons] are going to do a rigid esophagoscopy now and I think it's gonna...and I also hear that the heart rate just sent up a bit so it sounded like went up a bit. I think it's gonna be more stimulating now so I turned my fluorine up.
 DR: This is to reverse the patient at the end of the operation. When I give it I'll have it ready. Even though the nerve stimulator shows that they are totally reversed ... we have no way of knowing exactly. They can be still 70% blocked and the nerve stimulator will show nothing. It doesn't hurt the patient So I give it to everybody because I don't want to have somebody to stop breathing in the recovery room and then look at me and say "did you reverse the patient?"

‡SUMMARY: DR saw that the surgeon was going to start rigid esophagoscopy. She turned up the vapouriser setting.
 ‡NOTE: This is a demonstration of feedforward control. At the beginning of the case the anaesthesiologist asked the surgeon whether there would be a rigid esophagoscopy. Apparently she was prepared and waiting for that.



EPISODE SAL-30[08:50:35]



DR: You can hear the heart rate going faster so ... quite stimulating. [to X]

EPISODE SAL-31[08:50:59]

DR: I get rid of my syringes. Some people don't. [to X]

EPISODE SAL-32[08:51:12]

DR: Because the next case is a big case I am a little bit of behind my room even though I did not bring him into the room soon because I couldn't bring him in before I got blood sugar back. So I want to go quick for the next one. That's why I want everything ready in maybe...

X: So the production pressure is on you...

DR: Well, I don't like my room being late. Cases get cancelled and nurses get to do extra work. Trying hard anyway.

EPISODE SAL-33[08:51:39]

DR: SUR, does the next patient have a MED?

SUR: Yes.

DR: The patient told me specifically that she wasn't having a cut here [in the neck].

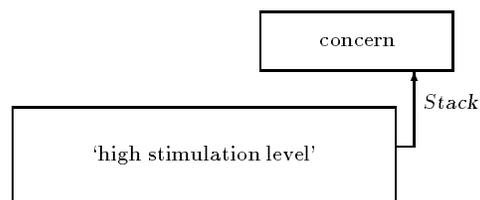
DR: I was just checking. The patient told me that she wasn't having a certain procedure but she is having that procedure. That makes a difference what I ... [to X]

DR: It's a bit of slow [comparing to without]. She is having an extra procedure. See, that's the normal thing of what they do. I was really surprised that the patient told me that she wasn't having it done.

DR: That makes a difference in terms of what anaesthetics I choose to give. That's why I want to ask I can be as ready before.

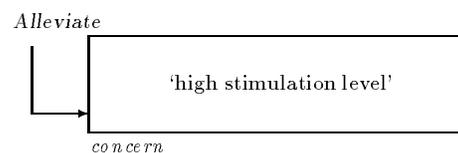
‡NOTE: This episode is actually related to the next case. See Episode Lob-6 on page 253.

EPISODE SAL-34[08:52:08]



DR: See his blood pressure has gone right up to 122/177 even though I turned this up [Isoflourine] because it is very stimulating.

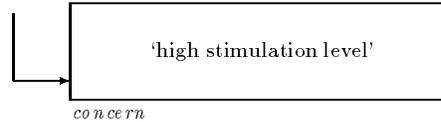
EPISODE SAL-35[08:52:19]



DR: Now he is going back to the flexible thing... [interrupted]

EPISODE SAL-36[08:52:22]

Review



DR: Is that what you put in? [to SUR]

SUR: < ... >

DR: I can't remember seeing one before. [to SUR]

DR: Huge [size, of the brochoscopy tube] [to X]
 {Increasing isofluorine level}

X: You're really reacting to the surgery process

EPISODE SAL-37[08:55:47]

X: You are not going to use the automatic pump? [to DR, after seeing her preparing two syringes of propofol for the next case]

‡NOTE: This episode also relates to the next case (described in Appendix I).

DR: Oh I'd love to if I can find one. I may run out to see if I can spot one. I am just drawing this so to put the patient to sleep. But usually I can not find one. Somebody has got it. I have to do the old fashion way. It was not as nearly as good. It is hard to control the patient's blood pressure because you are too busy doing things and the patient starts to move and you say 'Oh, I forget'. I need another set of hands.

EPISODE SAL-38[08:56:47]

X: Is that normal that you change the setting of the vapouriser up and down when you see the surgeon uses different kinds of tubes and size of tubes?

‡NOTE: The anaesthesiologist described how a concern would modulate the anaesthesiologist's monitoring strategy and attention.

DR: I think most people do though they don't normally say it out, because what they [the surgeons] do make a huge difference on what I do. I also have to keep an eye on them, watching them to make sure that they don't pull my tube [ETT]. But it is easy to put the tube back in if they pull it out. If this guy were difficult to intubate I'd have put my hand on it [to hold the tube]...

EPISODE SAL-39[08:58:17]

SUR: < ... >asking notes

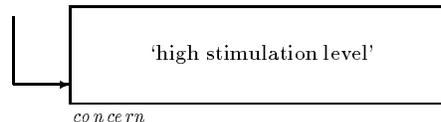
DR: I left them in [the records]

EPISODE SAL-40[08:58:48]

DR: His blood pressure has gone up.

EPISODE SAL-41[08:58:59]

Remove



DR: Are you guys starting to finish? [ask SUR]

SUR: < ... >yes

DR: Then I'll turn everything down and wait.

EPISODE SAL-42[08:59:30]

DR: Oh, SUR, for your next case, I don't think I'll do an epidural, for two reasons. First I couldn't get a very good consent from her because she doesn't speak a very good English. The other reason is that she is fairly obese and I think she is bit of hard to do. Maybe you can do some blocker and PCA.

EPISODE SAL-43[09:01:00]

DR: Finished [to SUR]
 SUR: < ... >Almost

EPISODE SAL-44[09:03:45]

DR: Did you finish so that I can wake up the patient?
 [to SUR]
 SUR: Yes.
 DR: I gave her a reversal, and put her on 100% oxygen to
 blow off my nitrous oxide.
 {Using the nerve stimulator}
 DR: He is waking up as fast as I would want. This is to
 make sure that my muscle relaxant is reversed.

EPISODE SAL-45[09:08:08]

DR: Blood pressure has dropped a little bit because he
 is not stimulated.

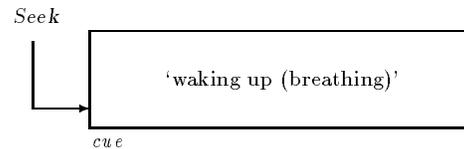
EPISODE SAL-46[09:09:14]

DR: Sometimes they [patients] don't breath is because
 what we called 'over-ventilated' --- you keep the
 CO₂ too low. I am just trying to raise the CO₂.
 {Trying to wake up the patient by calling his name}
 DR: I did not give him that much of anaesthetic.

‡NOTE: The anaesthesiologist tried to give as little anaesthetic
 as possible and expected the patient to wake up very quickly.
 The mismatch upset the anaesthesiologist.

EPISODE SAL-47[09:11:20]

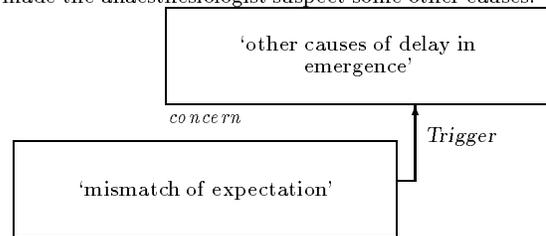
{suspecting breathing sign: whether the touch of air reser-
 voire has given a false sign}
 DR: Come on, sir. You don't have any anaesthetic.
 Quite ridiculous.
 DR: < ... >Wake patient by verbal command



EPISODE SAL-48[09:12:24]

DR: Can you put these leads back on for me? [to NUR],
 to put back on the ECG leads that had just been
 taken out] His rate is little slow and I want to
 know what he is doing.
 DR: Well, I don't know which one it is and goes to where
 [ECG leads to its electrodes]. I make it up.

‡NOTE: The mismatch between the anaesthesiologist's expecta-
 tion that the patient would wake up quickly and the observation
 made the anaesthesiologist suspect some other causes.



EPISODE SAL-49[09:13:08]

DR: I just speed up a little bit [to SUR]

EPISODE SAL-50[09:13:43]

DR: Okay good [commenting on the findings of ECG]
 DR: Take a deep breath [to PT] I just take off the
 leads again.

EPISODE SAL-51 [09:14:42]

NUR: Blood pressure cuff off?

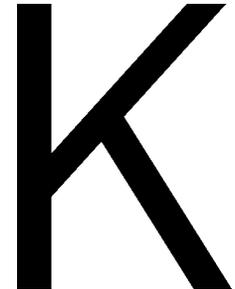
DR: Yes.

NUR: [For the next case] Are you going to use epidural?

DR: No. So hopefully we will be fast. We can make some time.

{Patient was brought to the recovery room and the case finished}

Excerpts from a By-Pass-Valvular-Replacement



section*Case description

A 35 year old, 85 kg, female with a stormy medical history was under operation for aortic arch stenosis, aortic and mitral valve replacement: two aortic coronary bypasses, and two crafted carotid arch bypasses.

The patient had two previous cancer procedures: a hysterectomy and a lobectomy.

The subject was an attending anaesthesiologist with more than 30 years of practice experience. A junior (second year) resident was with him.

The transcription was done by the observer.

Legend

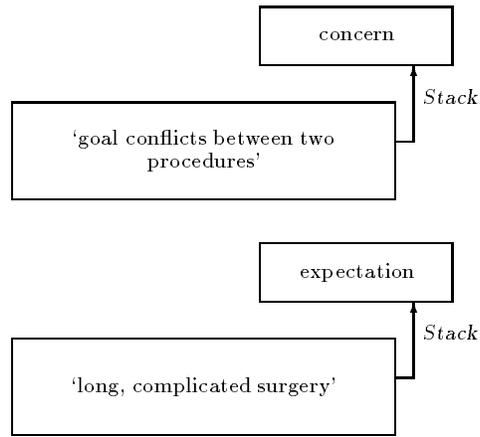
X	the observer
DR	the anaesthesiologist
RE	the resident
PT	the patient
NUR	a nurse
PER	the perfusionist
SUR	a surgeon
< ... >	inaudible or omitted speech
< >	< abbreviated speech >
{ }	{ <i>Describing activities</i> }

Selected Annotated protocols

EPISODE BY-1 [Pre-op interview]

{The anaesthesiologist gave an overview of the case.}

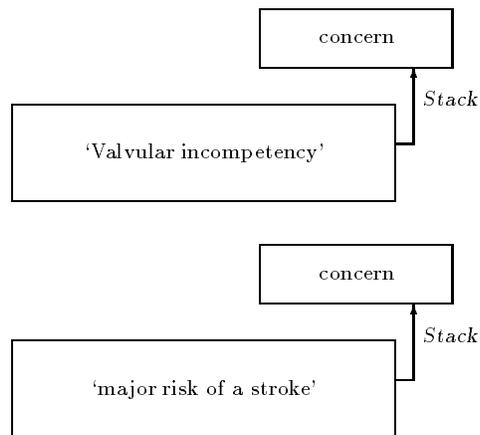
†SUMMARY: There are several major operations going on all together. Some of them have conflicting requirement. For example, the things that are good for aortic coronary bypass may not be the good things that you want for carotid arch bypasses. So there is conflicting goals for the brain and the heart.



EPISODE BY-2 [Pre-op interview]

{The anaesthesiologist gave an overview of the case.}

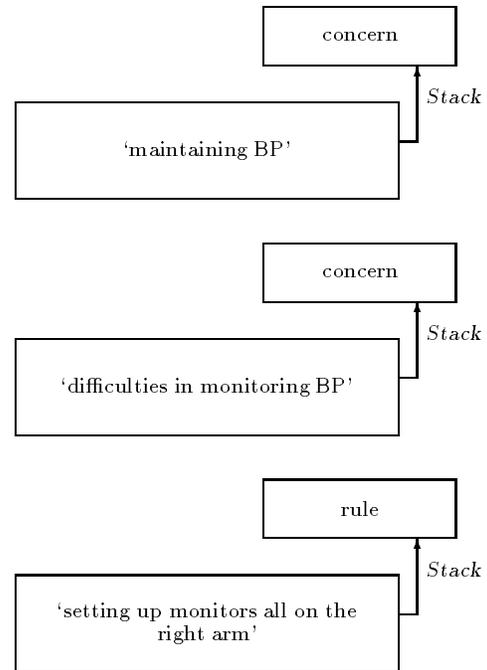
†SUMMARY: The patient has a valvular incompetent, and left side heart failure. Though the failure is not as controlled as it could be. So the patient runs a major risk of having a stroke.



EPISODE BY-3 [Pre-op interview]

{The anaesthesiologist gave an overview of the case.}

†SUMMARY: Maintaining BP can be a problem, as the problem is not distal. The monitoring is a problem. We'll have arterial line, oximetry all on the right side.

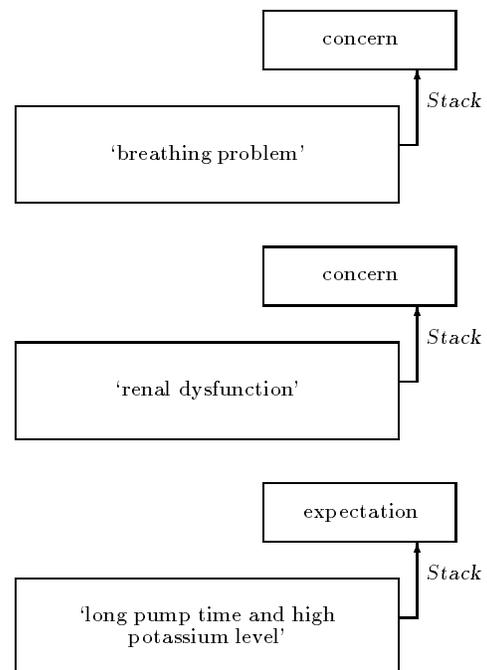


EPISODE BY-4 [Pre-op interview]

{The anaesthesiologist gave an overview of the case.}

†SUMMARY: Other considerations:

- The patient is a little breathless.
- The patient has been on diuretics for a long time.
- The pump time is going to be long, and therefore there will be large amount of potassium.

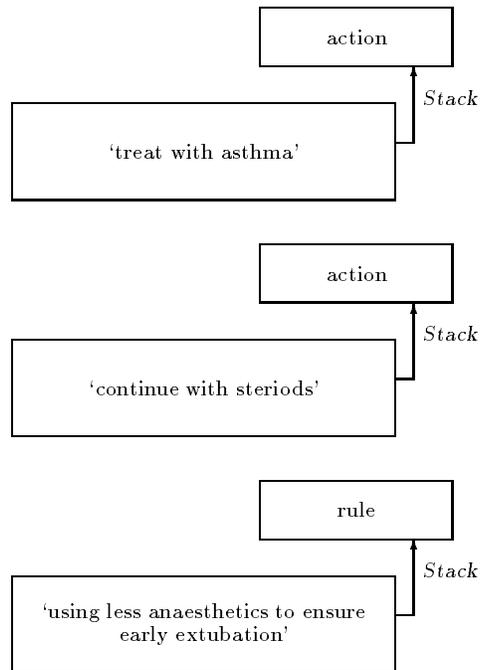


EPISODE BY-5 [Pre-op interview]

{The anaesthesiologist gave an overview of the case.}

†SUMMARY: Other considerations:

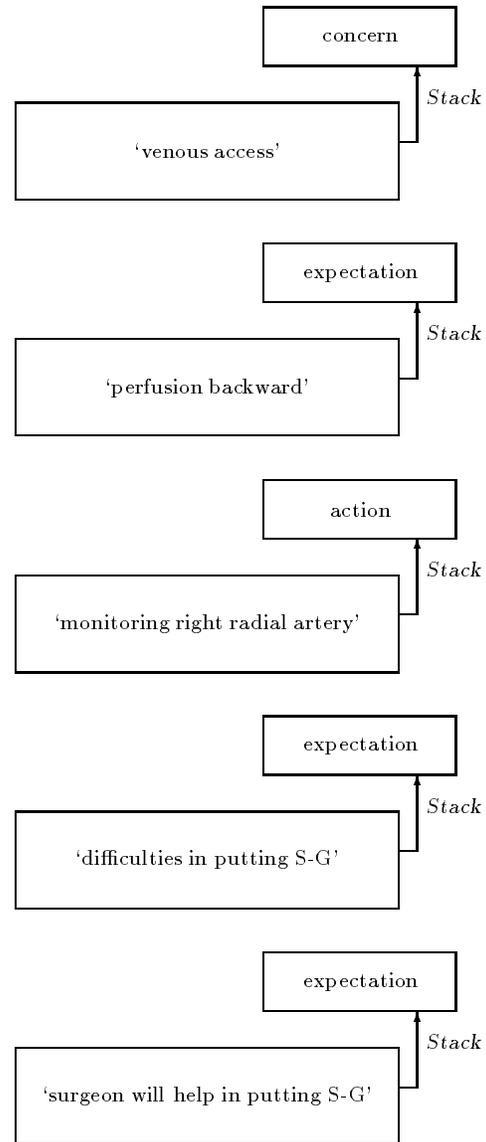
- The patient has been treated with asthma
- The patient is also on steroids, for the heart failure
- The patient will be extubated early, so not to give her too much anaesthetics.



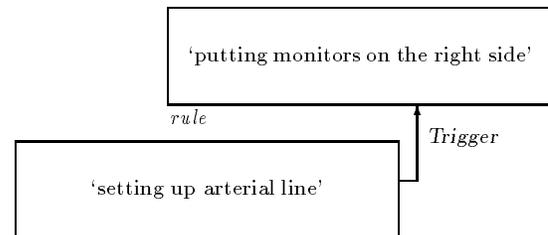
EPISODE BY-6 [Pre-op interview]

{The anaesthesiologist gave an overview of the case.}

†SUMMARY: Other technical problem: the patient has no veins, and can be difficult to put i.v. in. We need to monitor her right radial artery. Because surgeons are going to perfuse backward. Swan-Ganz is a problem but we need a SwanGanz.



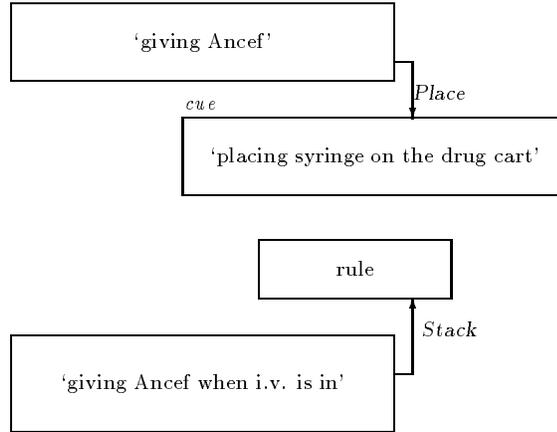
EPISODE BY-7 [00:01:30]



{DR is setting up an arm board for arterial line.}

SUMMARY: The anaesthesiologist was commenting that arterial line would be on the right side, as the blood pressure on left side is not reliable.

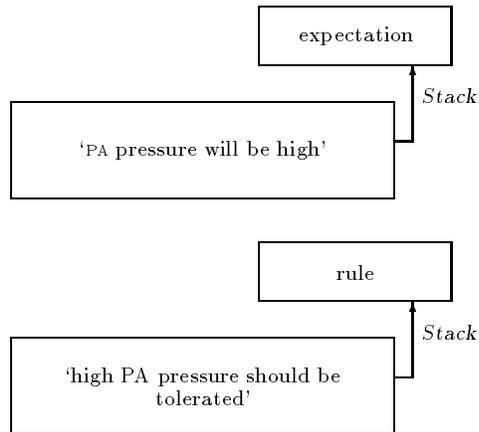
EPISODE BY-8[00:04:30]



{DR is preparing antibiotics (Ancef)}

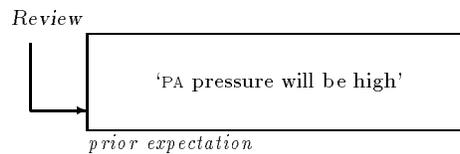
SUMMARY: DR mentioning that Ancef will be given to the patient once i.v. line is in place.

EPISODE BY-9[00:07:18]



SUMMARY: DR is commenting that because of the nature of the patient's conditions, her PA pressure will be high, but it is not a big concern.

EPISODE BY-10[00:21:22]

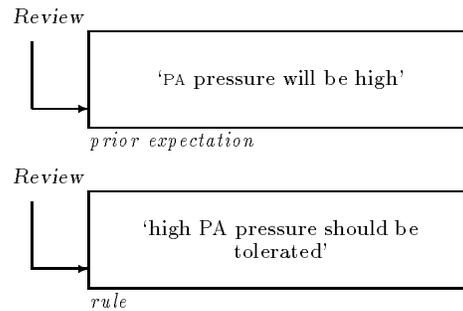


{DR was inserting SG and trying to decide whether it was in wedge position.}

SUMMARY: DR was verbalising his findings from the PA reading. The reading was high (70 mmHg), but he expected it to be high, so he judged that SG was in the wedge position.

EPISODE BY-11[00:28:07]

SUMMARY: DR informed X his reading of the patient's PA pressure: 80/40. He informed also his decision that he would not do anything about it as he expected this reading and the patient had this reading preoperatively.

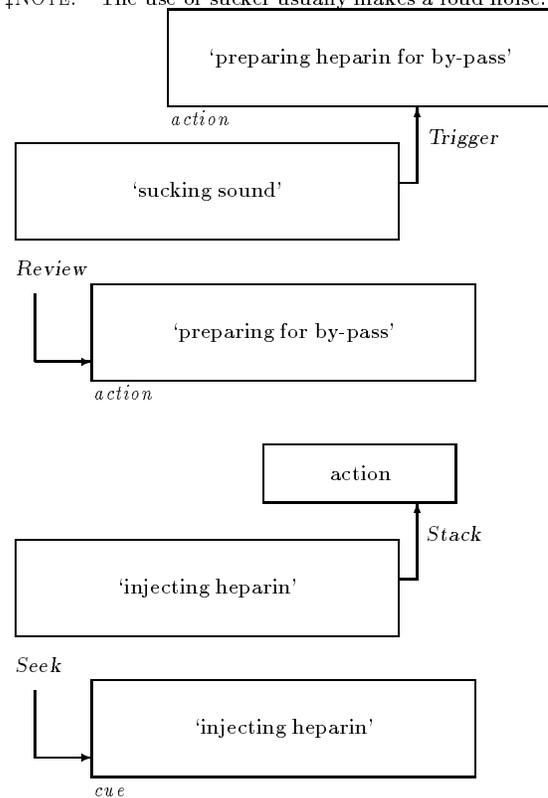


EPISODE BY-12[01:05:26]

{DR started to prepare heparin. The SUR had established the surgical site but not yet cannulated.}

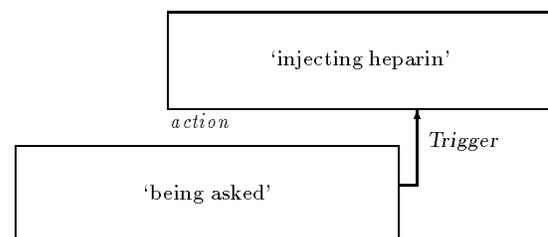
SUMMARY: X asked DR to explain his action. He explained that "when SUR puts sucker in the aorta, you starts to think to put in haprin. They might forget to ask."

‡NOTE: The use of sucker usually makes a loud noise.



EPISODE BY-13[01:15:33]

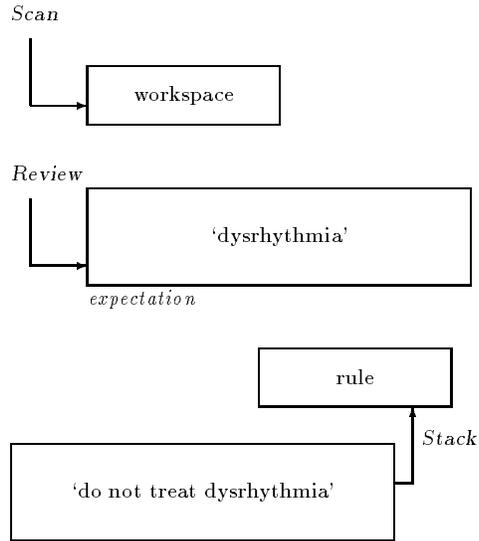
SUMMARY: SUR asked to give heparin.



EPISODE BY-14[01:25:07]

{SUR was cannulating the aorta.}

SUMMARY: DR is commenting on the findings on ECG: "It is now when things can develop very quickly, such as sinus dysrhythmia. But there is no sense to treat it, as SUR is working on that"



EPISODE BY-15[01:32:03]

{The patient was on the pump.}

SUMMARY: RE turned off ventilator. At the same time he turned off auto-switch, too. DR pointed out his error: "you should not do that, as that's a source of error: when someone takes over a case, turns the ventilator on, but not auto switch. In a middle of a busy period, it can be an annoying error."

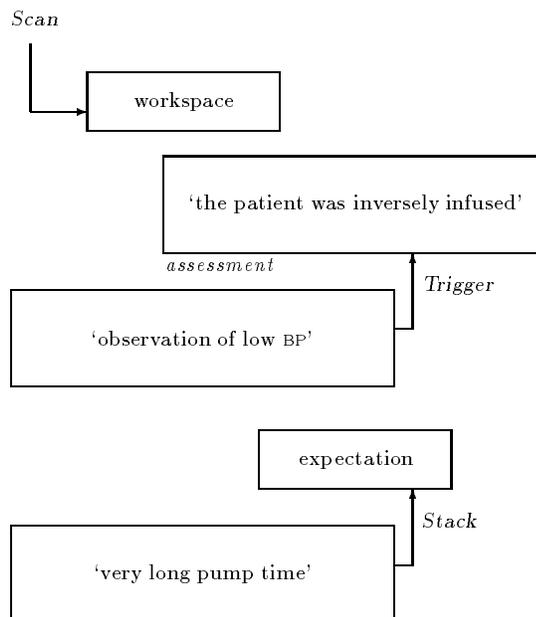
‡NOTE: The anaesthesiologist had established a habit to make the workspace more error-tolerant.

EPISODE BY-16[02:49:43]

{The PT was on pump.}

SUMMARY: DR was commenting that the BP was around 10, so the patient was inversely infused. So SUR could afford to have pump run.

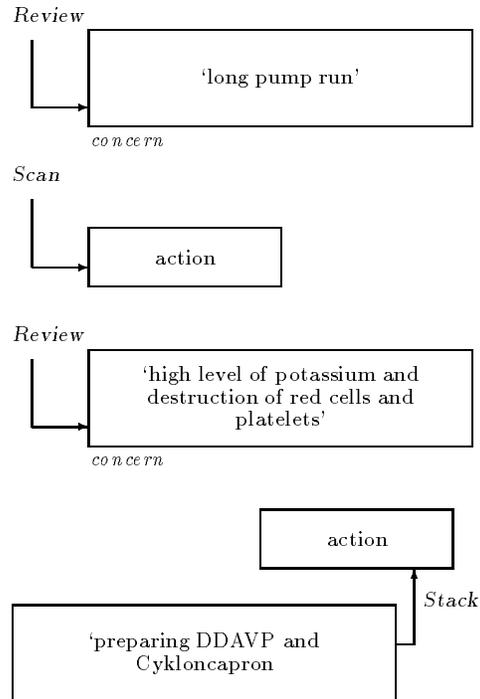
‡NOTE: The anaesthesiologist was expecting that the patient would be infused backward (see Episode By-6). Post-case interview showed that the anaesthesiologist knew this from past experience of working with this particular surgeon. Based on the nature of the surgery, he made the prediction that the surgeon would use the technique of inverse infusion to enable him a prolonged pump run.



EPISODE BY-17[02:52:32]

SUMMARY: DR asked NUR to get DDAVP and Cykloncapron

‡NOTE: Recall in the post-case interview: upon seeing the patient was inversely transfused, the anaesthesiologist was thinking about a few typical concerns for long pump run.



EPISODE BY-18[03:34:43]

{DR saw PER gave more Naqua.}

DR: Have you given any pancuronium? [to PER]

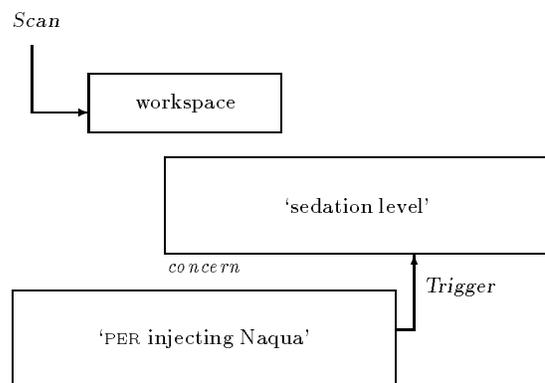
PER: No, I haven't.

DR: Well, you may have to give to her.

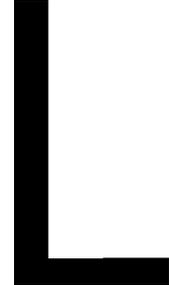
X: Why did you ask that question? [to DR]

DR: PER has given a lot of Naqua. Sometimes what happen is that the perfusionist doesn't know that the underlying problem is improper sedation, and keeps giving Naqua to deal with hypertention.

‡NOTE: Probing question shows that the anaesthesiologist was actively scanning for sign of trouble.



Excerpts from a Bone-Marrow-Harvest



Case description

A young, otherwise healthy, male was for a bone marrow harvest to get ready for chemotherapy. The patient was not admitted into the hospital until the day of operation.

The anaesthesiologist was a staff with about 3 years of attending experience. The case was the first of the day. The case lasted about 1.5 hours.

The transcription was done by the observer.

Selected Annotated protocols

EPISODE BONE-1 [Pre-op interview]

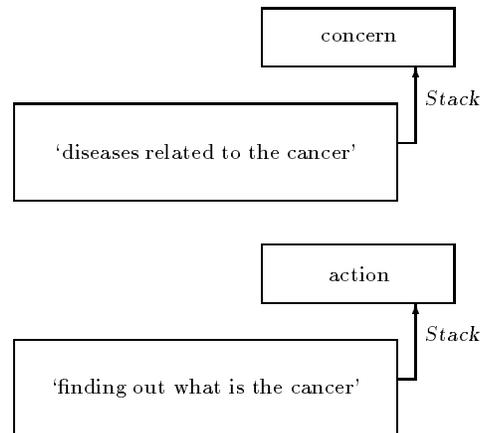
{The anaesthesiologist gave an overview of the case. This was before the anaesthesiologist had seen the patient.}

†SUMMARY: The surgical procedure is to extract bone marrow in a likely cancer patient in preparation of future re-implant
 ‡NOTE: The anaesthesiologist at this time only knew the surgery name. In the assignment chart, only the word 'marrow' was printed. He could also infer, from the fact that the patient had not admitted into the hospital one day in advance, that the patient's condition must be good.

EPISODE BONE-2 [Pre-op interview]

{The anaesthesiologist described his mental activities after seeing the case assignment.}

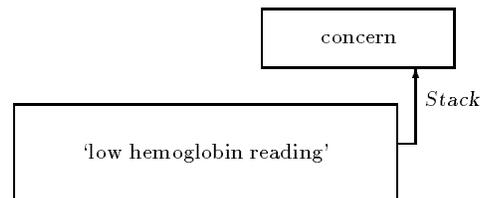
†SUMMARY: The patient is likely to have cancer (unlikely to be a donor), therefore it is important to find out where the cancer is, and what type of the cancer is. There might be special concerns associated with the disease.
 ‡NOTE: The anaesthesiologist focused his attention to diseases. He knew that there were some correlations between a surgery and the patient conditions.



EPISODE BONE-3 [Pre-op interview]

{The anaesthesiologist described his mental activities after seeing the case assignment.}

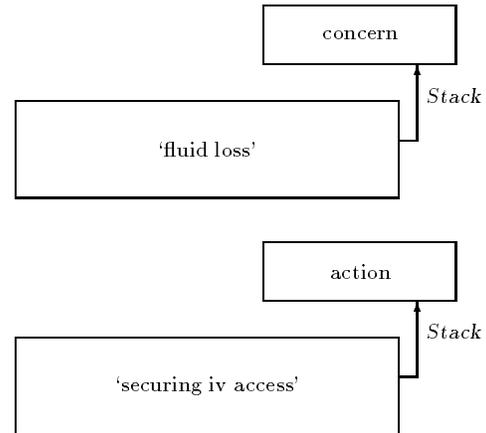
†SUMMARY: The patient's hemoglobin reading is likely to be low.
 ‡NOTE: This is so because the patient is likely to have gone through chemotherapy. Post-case interview showed that, because of the nature of bone marrow harvest, there would be a considerable blood loss, which could exaggerate the problem of low hemoglobin reading.



EPISODE BONE-4 [Pre-op interview]

{The anaesthesiologist described his mental activities after seeing the case assignment.}

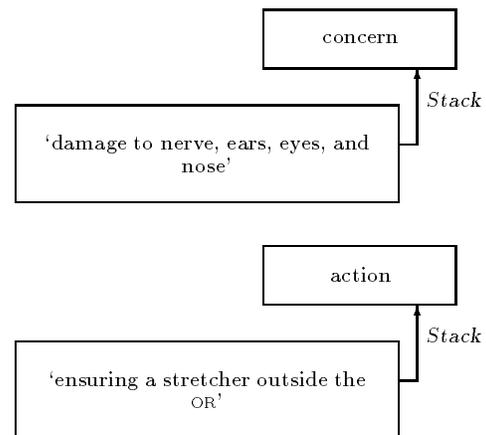
†SUMMARY: Iv access might be a problem due to previous iv (possible numerous previous iv's), and the patient may have lost some fluid.
 ‡NOTE: As the patient was expected lose about 2 litres of blood+marrow, replacing the lost fluid was a major goal for the case. Thus a secure iv became necessary.



EPISODE BONE-5 [Pre-op interview]

{The anaesthesiologist described his mental activities after seeing the case assignment.}

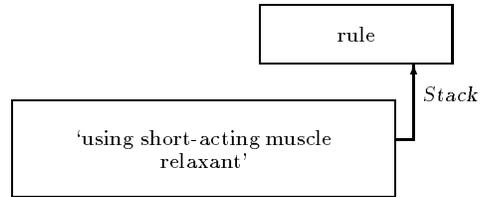
†SUMMARY: The patient will be in prone position, therefore positioning the patient has to be careful, not to press nerves, eyes, ears, and nose. As for ETT security, it is not a major concern as flipping over the patient is not disastrous, but having a stretcher outside is important.
 ‡NOTE: Protecting nerves and organs are routine goals that the anaesthesiologist has to ensure in every case. In a case where the patient is in the prone position, it is more likely that the patient may suffer damage in the areas of nerve, eyes, ears, and the nose.



EPISODE BONE-6 [Pre-op interview]

{The anaesthesiologist described his mental activities after seeing the case assignment.}

†SUMMARY: The surgical procedure itself is not very intrusive. The major part is to cannulate to a bone to extract the marrow. The expect length is 1.5 hours.

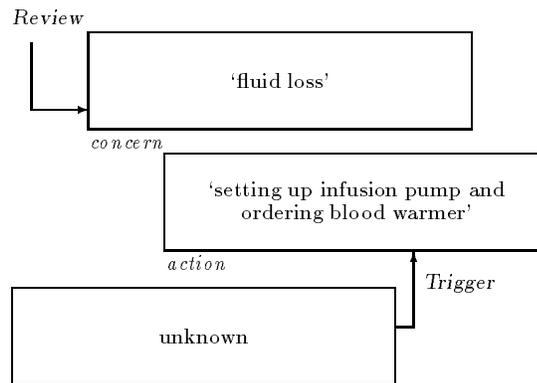


EPISODE BONE-7 [7:50:00]

{The patient has not arrived yet. The anaesthesiologist is in the OR preparing for the case.}

{The anaesthesiologist was setting up an infusion pump and ordered the nurse to get a blood warmer.}

‡NOTE: Because of the expected large fluid shift (about 2 litres expected), the anaesthesiologist prepared a few thing around the concern of replacing fluid. Among them are infusion pump to increase infusion rate, and blood warmer to preserve the patient's heat.

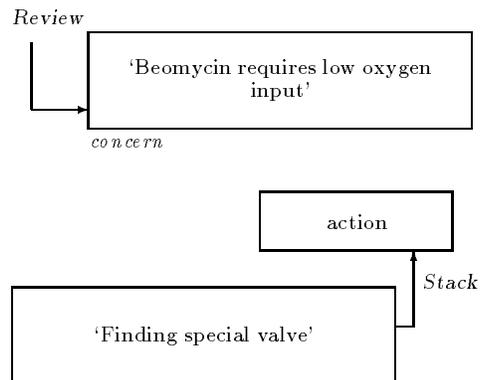


EPISODE BONE-8 [8:02:00]

{The anaesthesiologist had just examined the patient outside the OR. The patient was about to be brought into the OR.}

†SUMMARY: previous medication: the patient has been on high dose of steroids, so his adrenaline level is still suprressed. He is also on Beomycin, so I have to limit the oxygen.

‡NOTE: Post-case interview showed that the anaesthesiologist had anticipated that the patient may be on Beomycin. To limit the oxygen concentration, he had to find a special valve (oxygen blender) to circumvent the inter-lock system built in the anaesthesia machine, which does not allow the oxygen level to be below certain ratio.



EPISODE BONE-9[8:02:00]

{The anaesthesiologist had just examined the patient outside the OR. The patient was about to be brought into the OR.}

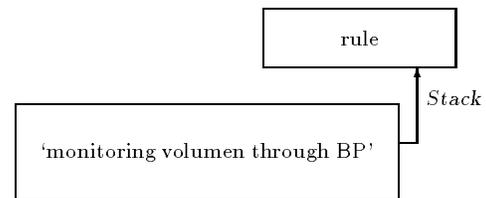
†SUMMARY: The other concern is that he had a mass in his chest. That's why have been very careful about problems with heart and lungs. He had Hodgkin's disease (Lymphoma). So I wait for the chest X-ray to see the mass. But the patient is asymptomatic. There is no significant findings that could change my plan.

EPISODE BONE-10[8:03:00]

{The anaesthesiologist was reporting to the observer}

†SUMMARY: The patient is relatively healthy, as expected. So the monitoring of blood volume can be reasonably achieved by blood pressure. Also watch carefully how much the surgeon has extracted. Based on these two variables the fluid management should be satisfactory.

‡NOTE: In retrospective report, the anaesthesiologist revealed that he had suspected the patient was relatively healthy, or he would have been admitted into the hospital one day in advance. Thus there was no need to use complicated monitoring for fluid management.

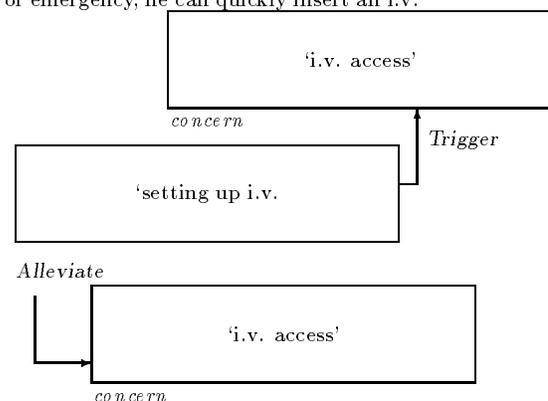


EPISODE BONE-11[8:08:00]

{The patient was on the stretcher beside the table. The anaesthesiologist and others were setting up.}

{The anaesthesiologist examined the patient and found he already had an i.v. port. He tested it and used it as the major i.v. after examined the patient's i.v. access.}

‡NOTE: One of the concern is to ensure secure i.v. access for this patient. Upon finding an existing i.v. port, the anaesthesiologist was surprised. In retrospective report, he explained the decision process. After testing the i.v. port, he found the i.v. satisfactory. He also found that the patient had nice, big veins. Thus if in case of emergency, he can quickly insert an i.v.



Curriculum Vitae

Yan Xiao was born on April 27, 1962, in Shihezi, Xinjiang, China. He attended Lanzhou Railway Institute, Lanzhou, China, for the undergraduate education and earned a B.A.Sc degree in 1982 in mechanical engineering. Right after this he pursued graduate studies in the Department of Systems Engineering in North Vehicle Research Institute in Beijing, China, and continued to work there as a research engineer after getting a M.A.Sc degree in systems engineering in 1985. In 1988, upon receiving a research assistantship, Xiao went to the Department of Industrial Engineering, University of Toronto as a doctoral student.