SCSC

Scottish Clinical Simulation Centre

ACID: Anaesthetic Critical Incident Drills Teaching Package

Outline

This teaching package is aimed at novice anaesthetic trainees within the first 4 months of training. It is a framework for teaching and practising drills for management of incidents in theatre (originally outlined in the Curriculum for CCT Anaesthetics 2010). Each drill is accompanied by a discussion exercise. Parts of the AAGBI Quick Reference Handbook (www.aagbi.org/safety/qrh) were developed from these drills and the package was updated in 2021 to match the QRH resource where relevant. Drills that do not appear in the QRH are labelled NQ and remain included as useful learning is associated with them.

2-3_Increased airway pressure
2-2_Hypoxia
NQ_Fall in end tidal CO_2
NQ_Rise in inspired CO_2
2-6_Bradycardia
2-1_Cardiac Arrest
2-4_Hypotension
2-5_Hypertension
2-7_Tachycardia
NQ_Convulsions

Running the drills package

Start with the case discussion: these are designed to lead to understanding of the drill and it also forms the pretext for running the drill. The aim is for one trainee to talk through the drill in 'classroom', and then walk through the drill in simulation with input and correction from the observing trainees, followed by performing the drill in simulation. DOPS assessments can be carried out. All drills can be covered in two half-day sessions. Using an airway task trainer is recommended and the information should be verbally fed to the trainee during the drill performance. Each drill is an individual package and can be subsequently rehearsed by the trainees with a spare anaesthetic machine in 10 minutes. There is a guide of how to run each drill with the most basic of equipment. *Introducing a simulated monitor screen to relay the information in a more realistic way detracts from learning the order of the drill and should be avoided.* Pilots of this package indicated that the classroom sessions with case discussions and drill walk through are important first steps to embedding the drill.

The drills may initially appear to be overly simple but it is important to remember that a new trainee cannot safely make the cognitive shortcuts that an expert in anaesthesia makes on a daily basis. There should be an emphasis on developing the systematic approach of the Key Basic Plan, with less focus on trying to work out each underlying cause. Use every drill as an opportunity to run through all of the steps. The "And Finally!" section gives some pointers to commonly misunderstood issues and useful tips in terms of running the drills.

For trainees in Scotland, once they have learned and practised the drills, the Introduction to Management of Anaesthetic Emergencies Course (previously Skills and Drills) at SCSChf.org will give them an opportunity to use the drills in a realistic environment, and introduces the concept of basic non-technical skills.

Ongoing support

Please address any communications or queries to Al May, at the SCSChf.org Alistair.May@ggc.scot.nhs.uk

Quick Guide

The First Time

Intro Slides

- Use to set the scene
- Emphasis on systematic approach

Key Basic Plan

- Take time to explain each step

The Drills

Case Discussion

- Let trainees read it, think about it, have a conversation about it

Talk through

- Explain each step of drill
- Let one trainee talk through

Walk through

- Let trainee walk through in simulation
- Referring to drill, other trainees correcting

Perform

- Without interruption
- +/- DOPS

Keep it simple!

ACID Teaching Package Evaluation: Trainee

How many months of anaesthesia training have you had?

0-3 3-6 6-12 >12

The ACID package has increased my confidence in dealing with critical incidents

1 2 3 4 5

(strongly disagree) (strongly agree)

I found the format of the key basic plan useful

1 2 3 4 5

(strongly disagree) (strongly agree)

I am comfortable having DOPS assessments carried out as part of the ACID package

Yes No

It would be useful to practise these drills as a table top exercise with other trainees

1 2 3 4 5

(strongly disagree) (strongly agree)

The one thing I liked most about the ACID package was:

The one thing I want to be changed with the ACID package is:

Please return to the trainer for your session

Certificate of attendance

Anaesthetic Critical Incident Drills (ACID) Training

This is to certify that

Dr. _____

Attended ACID training

On ___/___/_____

Trainer (s)

_____ _____ _____

A simulation based package supported by scschf.org

SCSC HF

SCSC

Scottish Clinical Simulation Centre

ACID: Anaesthetic Critical Incident Drills Training Package

What is a drill for?

What is a drill for?

- Standard process for keeping the patient safe
- **Vital** when you don't have a wealth of experience
- Useful when you *do* have a wealth of experience:
  - When you're stressed
  - When a lot of things are happening
  - When uncommon events occur

What are we going to be doing?

- Discuss Key Basic Plan
- Each Critical Incident:
  - Clinical Case Discussion
  - Talk through drill
  - Walk through drill
  - Perform drill
- Opportunity for DOPS
- These drills are to help you: they're not rules!!

What incidents are included?

2-3_Increased airway pressure	2-1_Cardiac Arrest
2-2_Hypoxia	2-4_Hypotension
NQ_Fall in end tidal CO_2	2-5_Hypertension
NQ_Rise in inspired CO_2	2-7_Tachycardia
2-6_Bradycardia	NQ_Convulsions

At the end of this session you will be able to:

- Demonstrate a structured approach to management of critical incidents in theatre

- Take away the drills to practice amongst yourselves

- There are no surprises planned!
- There are no prizes for guessing the underlying problem!
- There may however be prizes for demonstrating a systematic approach to managing critical incidents*

*Terms and conditions apply

1-1 Key basic plan v.1

This Key Basic Plan will detect and identify almost all initial problems, allowing you to fix or temporise. There are specific drills for specific problems later on in the QRH. Using the same systematic approach:

- Increases the chance of identifying the problem.
- Reduces the risk of missing the problem.
- Limits fixing attention inappropriately.

START

1. **Adequate oxygen delivery (Note Box B)**
   - Pause surgery if possible.
   - Check fresh gas flow for circuit in use AND check measured F_iO_2.
   - Visual inspection of entire breathing system including valves and connections.
   - Rapidly confirm reservoir bag moving OR ventilator bellows moving.
2. **Airway (Box C)**
   - Check position of airway device and listen for noise (including larynx and stomach).
   - Check capnogram shape compatible with patent airway.
   - Confirm airway device is patent (consider passing suction catheter).
   - Consider whether you need to isolate equipment (Box D).
3. **Breathing**
   - Check chest symmetry, rate, breath sounds, SpO_2, measured VT_{exp}, $EtCO_2$.
   - Feel the airway pressure using reservoir bag and APL valve (Box E) <3 breaths.
4. **Circulation**
   - Check rate, rhythm, perfusion, re-check BP.
5. **Depth**
   - Ensure appropriate depth of anaesthesia, analgesia and neuromuscular blockade.
6. Consider surgical problem.
7. Call for help if problem not resolving quickly.

Box A: CRITICAL CHANGES

If problem worsens significantly or a new problem arises, call for **help** and go back to **START** of key basic plan.

Box B: ADEQUATE OXYGEN DELIVERY

Altering fresh gas flow may require change of vaporiser setting.

Box C: AIRWAY

Noise: Listen over the larynx with a stethoscope to get more information (e.g. leak / obstruction).

Tracheal tube: You can pass a suction catheter to check patency.

Box D: ISOLATE EQUIPMENT

Ventilate lungs using self-inflating bag connected **DIRECTLY** to tracheal tube connector.

DO NOT use the HME filter, angle piece or catheter mount.

- If increased pressure manually confirmed, re-connect machine.
- If increased pressure **NOT** manually confirmed, assume problem with machine/circuit/HME/filter/angle piece/catheter mount: check and replace as indicated.

Box E: BREATHING

Remember that airway 'feel' depends on your APL valve setting and fresh gas flow.

You can only "feel" a maximum of what the APL valve is set to.

Measured expired tidal volume gives additional information.

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, fine bore suction catheter, stethoscope, AmbuBag, paper and pen for capnograph, role player as surgeon.

The initial set up is:

IPPV, ETT, FGF 2L each of Oxygen and Air, volatile set to 1-2 MAC. Patient head down.

The information to feed as the drill runs:

FiO_2 is 0.5
Connections are tight (or you are standing on inspiratory limb)[iv]
Bellows are moving

Airway is in same position externally, no noise
Capnograph trace shows spontaneous respiratory effort[ii] or sloping phase II prolonged expiration[iii]
ETT is tied with no external signs obstruction
Suction catheter passes easily (or not)
Ventilation with AmbuBag feels like high airways pressure-ask "what does it mean if it felt normal?"

RR is 15, Symmetrical, no added sounds (or wheeze)[iii]
SpO2 is 96%
Expired tidal volume is 300ml, $EtCO_2$ is 4.5
Airway pressure is 39cmH_2O
There are 0 (or 3)[ii] twitches on TOF

Pulse rate is 84, sinus
Peripheral perfusion is normal
NIBP is 125/60

EtVolatile is 1 MAC
Analgesia is 5mg Morphine 10 minutes ago
Surgery is ongoing

Examples of the underlying problem could be:

i. Increased pPeak due to patient position, pneumoperitoneum.
ii. Increased pPeak due to inadequate paralysis with patient position & pneumoperitoneum.
iii. Increased pPeak due to bronchospasm with patient position & pneumoperitoneum.
iv. Increased pPeak due to inspiratory limb occlusion.

And Finally!

"Confirm pPeak" by switching to bag and altering APL. With the APL set at 20-30 and high FGF, the bag will "feel OK" even if the circuit is completely occluded. Let the trainee feel the bag when your thumb is occluding the circuit behind your back. Remember to look at expired volume as well. Please note, passing suction catheter down ETT is not part of key basic plan for all drills.

2-3_Increased airway pressure

You are 30 minutes into anaesthetic maintenance of a 35 year old female undergoing elective gynaecological exploratory laparoscopy under general anaesthetic. Her history includes cigarette smoking and she is otherwise fit and healthy. Since moving to the head down position, the peak airway pressure has gone up to 39cmH2O from 15cmH2O following induction. The uneventful induction was with Propofol 200mg, Rocuronium 30mg and Morphine 5mg. She has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane. You have 4 minutes to manage this problem.

2-3 Increased airway pressure v.1

Using these steps from start to end should identify any cause of increased airway pressure in theatre.
Avoid spending excessive time and attention on one aspect until you have run through the whole guideline.

START

1. **Adequate oxygen delivery**
   - Pause surgery if possible.
   - Consider surgery related cause.
   - Increase fresh gas flow AND give 100% oxygen AND check measured F_iO_2.
   - Visual inspection of entire breathing system including valves and connections.
   - Rapidly confirm reservoir bag moving OR ventilator bellows moving.
   - Confirm increased airway pressure by switching to hand ventilation (<3 breaths) (Box B).
2. **Airway**
   - Check position of airway device and listen for noise (including larynx and stomach).
   - Check capnogram shape compatible with patent airway.
   - Confirm airway device is patent (consider passing suction catheter).
   - Isolate patient from anaesthetic machine and breathing system (Box C).
   - If machine/breathing system problem excluded, consider whether airway device should be replaced or its type changed.
3. **Breathing**
   - Check chest symmetry, rate, breath sounds, SpO_2, measured VTexp, $ETCO_2$.
   - Feel the airway pressure using reservoir bag and APL valve (Box B).
   - Consider potential causes and actions (Box D).
4. **Circulation**
   - Check heart rate, rhythm, perfusion, recheck blood pressure.
   - If circulation unstable, consider if it is due to high airway pressure gas trapping.
5. **Depth:** Ensure adequate depth of anaesthesia and analgesia.
6. If not resolving, call for help AND check arterial blood gas, 12-lead ECG, chest X-ray.

Box A: CRITICAL CHANGES

If problem worsens significantly or a new problem arises, call for **help** and go back to **START** of **1-1 Key basic plan**

Box B: FEEL THE AIRWAY PRESSURE

Remember that airway "feel" depends on your APL valve setting.
You can only "feel" a maximum of what the APL valve is set to.
Measured expired tidal volume gives additional information.

Box C: EXCLUDE ANAESTHETIC MACHINE/BREATHING SYSTEM PROBLEM

Ventilate lungs using self-inflating bag connected **DIRECTLY** to tracheal tube connector.
DO NOT use HME filter, angle piece or catheter mount.

- If increased pressure manually confirmed, re-connect machine
- If problem resolved, assume problem with machine, circuit, HME, filter, angle piece or catheter mount: check and replace.

BOX D: POTENTIAL CAUSES AND ACTIONS

- Inadequate neuromuscular blockade.
- If laparoscopic surgery, consider releasing pneumoperitoneum and levelling patient position.
- Consider potential causes:
  - Laryngospasm and stridor → **3-6**
  - Bronchospasm → **3-4**
  - Anaphylaxis → **3-1**
  - Circulatory embolus → **3-5**
  - Aspiration, pulmonary oedema; bronchial intubation; foreign body; pneumothorax.
- Consider potential actions: tracheal/bronchial suction; bronchodilator; PEEP; diuretic; bronchoscopy.

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, LMA, fine bore suction catheter, stethoscope, AmbuBag, role player as surgeon.

The initial set up is:

SV, LMA (instructor can squeeze lungs to simulate spontaneous ventilation, use ETT if excessive leak). FGF 2L each of Oxygen and Air, volatile 3-4 MAC (disconnect inspiratory limb)[iv]

The information to feed as the drill runs:

FiO_2 is 0.5
Connections are tight (or inspiratory limb disconnected)[iv]
Bag is moving (or only moving slightly on expiration)[iv]
SpO_2 probe is connected

Airway is in same position, no noise (or air leak)[ii]
Capnograph trace looks normal shape (or has a little inspired CO_2)[iv]
LMA is tied with no signs obstruction
Suction catheter passes easily

RR is 4, (or 28)[iv], symmetrical, no added sounds (or wheeze)[iii]
SpO2 is 90%
Expired tidal volume is 200ml
$EtCO_2$ is 7.4
Airway pressure is 0 to +1

Pulse rate is 61, sinus
Peripheral perfusion is normal
NIBP is 95/40

EtVolatile is 2-3 MAC
Analgesia is 200mcg Fentanyl 10 minutes ago and ilioinguinal field block
Surgery is ongoing

Examples of the underlying problem could be:

i. Unexpected hypoxia due to drug induced hypoventilation
ii. Unexpected hypoxia due to drug induced hypoventilation and leak around LMA
iii. Unexpected hypoxia due to drug induced hypoventilation and bronchospasm
iv. Unexpected hypoxia due to inspiratory limb disconnection

And Finally!

Trainees tend to skip the checking of "adequate oxygen delivery" part of the drill. You can reinforce the importance of this by surreptitiously disconnecting the inspiratory limb of the circle for one run of the drill if this is the case.

2-2_Hypoxia

You are 15 minutes in to anaesthetic maintenance of a fit and healthy 35 year old male undergoing elective repair of inguinal hernia under general anaesthetic. The SpO_2 has been gradually dropping since moving from the anaesthetic room in to theatre and is now 90%. The uneventful induction was with Propofol 200mg and Fentanyl 200mcg followed by an Ultrasound guided ilioinguinal field block with 10ml 0.25% levobupivacaine. He has a size 4 LMA in situ, breathing Oxygen, Air and Sevoflurane. You have 3 minutes to manage this problem.

2-2 Hypoxia / desaturation / cyanosis v.1

Using these steps from start to end should identify any cause of unexpected hypoxia in theatre.
Avoid spending excessive time and attention on one aspect until you have run through the whole drill.

START

❶ **Adequate oxygen delivery**

- Pause surgery if possible.
- Increase fresh gas flow AND give 100% oxygen AND check measured F_iO_2.
- Visual inspection of entire breathing system including valves and connections.
- Rapidly confirm reservoir bag moving OR ventilator bellows moving.
- If SpO_2 low, is it accurate? Consider whether poor perfusion could be the problem.

❷ **Airway**

- Check position of airway device and listen for noise (including over larynx and stomach).
- Check capnogram shape compatible with patent airway.
- Confirm airway device is patent (consider passing suction catheter).
- Isolate patient from anaesthetic machine and breathing system (Box B).
- Once machine/breathing system problem excluded, consider whether airway device should be replaced or its type changed.

❸ **Breathing**

- Check chest symmetry, rate, breath sounds, SpO_2, measured VTexp, $ETCO_2$.
- Feel the airway pressure using reservoir bag and APL valve (Box C) <3 breaths.
- Consider potential causes and actions (Box D).
- Consider muscle relaxation to optimise ventilation.

❹ **Circulation**

- Check heart rate, rhythm, perfusion, recheck blood pressure.
- If circulation unstable, consider if this is secondary to hypoxia.

❺ **Depth**

- Ensure adequate depth of anaesthesia and analgesia.

❻ If not resolving call for help AND check arterial blood gas, 12-lead ECG, chest X-ray.

Box A: CRITICAL CHANGES

If problem worsens significantly or a new problem arises, call for **help** and go to **START** of **GUIDELINE 1-1 Key basic plan**.

Box B: ISOLATE EQUIPMENT

Ventilate using self-inflating bag connected **DIRECTLY** to tracheal tube connector. **DO NOT** use HME filter, angle piece or catheter mount:

- If problem resolves: assume problem with machine, circuit, HME, filter, angle piece or catheter mount: check and replace.
- If increased pressure manually confirmed: re-connect machine.

Box C: AIRWAY PRESSURE

Remember that airway "feel" depends on your APL valve setting. You can only "feel" a maximum of what the APL valve is set to. Measured expired tidal volume gives additional information.

BOX D: POTENTIAL CAUSES AND ACTIONS

- Hypoxia with increased airway pressure → **2-3**
- Inadequate movement or expired volume: assist/increase ventilation.
- Asymmetrical chest expansion: exclude bronchial intubation/foreign body/pneumothorax.
- Consider potential actions: tracheal/bronchial suction; bronchodilator; PEEP; diuretic; bronchoscopy.
- Consider potential causes:
  - Laryngospasm and stridor → **3-6**
  - Bronchospasm → **3-4**
  - Anaphylaxis → **3-1**
  - Circulatory embolism → **3-5**
  - Cardiac ischaemia (or infarction) → **3-12**
  - Cardiac tamponade → **3-9**
  - Sepsis → **3-14**
  - Malignant hyperthermia crisis → **3-8**
  - Aspiration, pulmonary oedema, congenital heart disease

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, stethoscope, AmbuBag, paper and pen for capnograph, role player as surgeon.

The initial set up is:

IPPV, ETT, FGF 1L each of Oxygen and Air, volatile 2-3 MAC (or disconnect capnograph tubing)[ii]

The information to feed as the drill runs:

FiO_2 is 0.4
Connections are tight (or capnograph disconnected)[ii]
Bellows are moving

Airway is in same position externally
Capnograph trace looks normal shape (or no trace)[ii]
ETT is tied with no signs obstruction

RR is 15, Symmetrical, no added sounds
SpO2 is 96%
Monitored expired tidal volume is 500ml
$EtCO_2$ is 3.1 (or 0)[ii]
Airway pressure is 15cmH_2O

Pulse rate is 74, sinus
Peripheral perfusion is poor, radial pulse is weak
NIBP is 70/30-delay this number and ask "what does it mean when the NIBP keeps cycling?"

EtVolatile is 1-2 MAC (or 0)[ii]
Analgesia is 5mg Morphine, 100mcg Fentanyl and Fascia iliaca block 5 minutes ago
Surgery is about to start

Examples of the underlying problem could be:

i. Fall in end tidal CO_2 due to reduced cardiac output with relative hyperventilation
ii. As i. but with additional disconnection of capnograph tubing

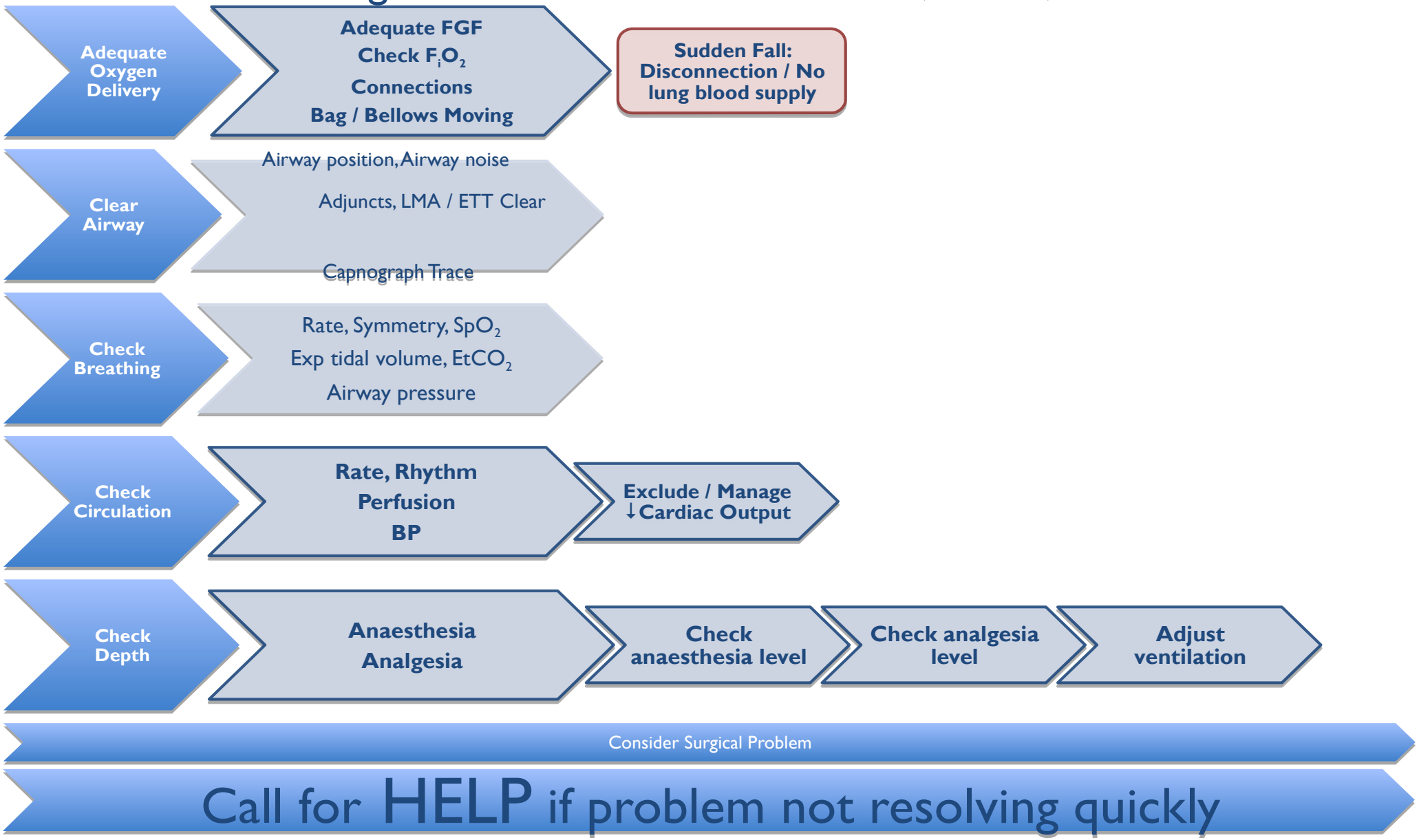
And Finally!

Unless the ventilator settings are wildly incorrect, the last thing to do is alter ventilation, as this will merely mask a drop in cardiac output. Extreme spontaneous hypoventilation also causes low $EtCO_2$ due to the effects of anatomical dead space- ask the trainees to show you where the effective dead space is with the circle system attached.

NQ_Fall in $EtCO_2$

You are 10 minutes in to anaesthetic maintenance of a 75 year old male undergoing urgent DHS for fractured hip sustained within the last 24 hours. He has hypertension and peripheral vascular disease and he is on Aspirin, Ramipril and Bendrofluazide. The uneventful induction was with Propofol 150mg, Fentanyl 100mcg and Vecuronium 6mg, followed by 5mg Morphine and fascia iliaca block with 30ml 0.25% Levobupivacaine. He has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane. His $EtCO_2$ was 5.8 following intubation and has gradually reduced to 3.1. You have 3 minutes to manage this problem.

Management of Fall in $EtCO_2$ - Look, Listen, Feel:



In order to run this drill you will need:

Anaesthetic machine, breathing system (Bain if available[i], alternative: circle system[ii]), empty vapouriser, intubation head part task trainer, ET tube, stethoscope, AmbuBag, paper and pen for capnograph, role player as surgeon.

The initial set up is:

IPPV, ETT with Bain[i] patient is beginning to breathe-instructor can squeeze lungs, (or Circle)[ii] FGF 2L each of Oxygen and Air, volatile 2 MAC.

The information to feed as the drill runs:

FiO_2 is 0.4
Connections are tight
Bag is moving

Airway is in same position externally
Capnograph trace shows $FiCO_2$ 1.8 and spontaneous breathing
ETT is tied with no signs obstruction

RR is 20, Symmetrical, no added sounds, SpO2 is 96%
Monitored expired tidal volume is 600ml, $EtCO_2$ is 6.5
Airway pressure is not available on Bain, or 0-2cmH_2O
4 twitches with TOF

Pulse rate is 82, sinus
Peripheral perfusion normal
NIBP is 125/60

Monitored EtVolatile is 1.5 MAC
Analgesia is 50mcg Fentanyl given 5 minutes ago
(The sodalime is exhausted)[ii]
Surgery is ongoing, this is a closed reduction and the procedure will last less than 15min from now

Examples of the underlying problem could be:

i. Rise in inspired CO_2 due to inadequate fresh gas flow for circuit
   [Mapleson D (Bain): 70mlkg (5Lmin^{-1}) for IPPV; 200-300mlkg^{-1} (14Lmin^{-1}) for Spont]
ii. Rise in inspired CO_2 in circle due to soda lime exhaustion

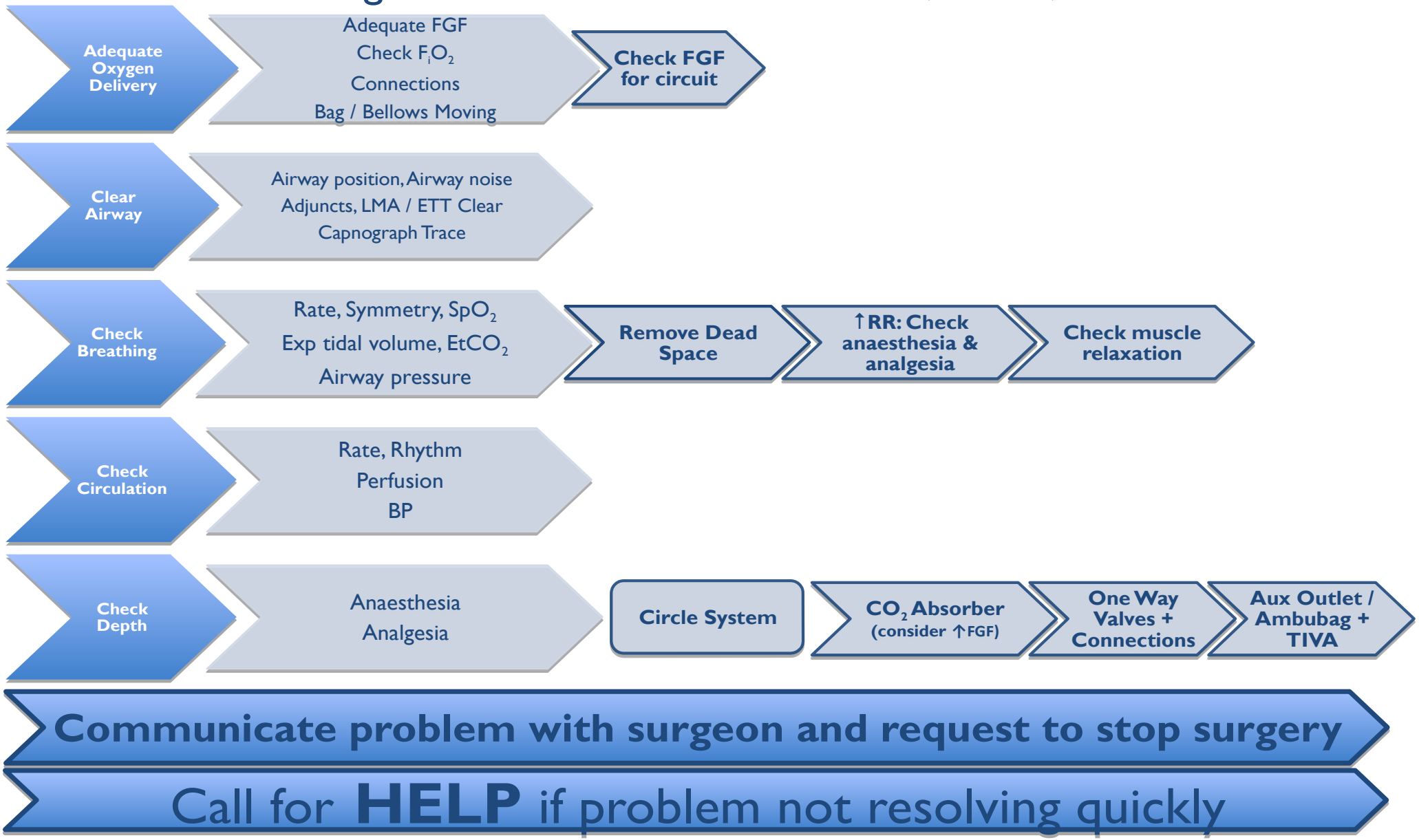
And Finally!

This drill can be used as a platform to briefly discuss commonly used breathing circuits. "Communicate problem with surgeon" and "Help" are in bold because $FiCO_2$ signifies an equipment problem, which may not be easy for a trainee to resolve. Ask them "Where is the dead space in this circuit?" Options to maintain anaesthesia in the face of equipment failure is a good discussion to have: "Where / what is my backup circuit?" "How do I use the Aux Gas outlet?"

NQ_Rise in $FiCO_2$

You are 10 minutes in to anaesthetic maintenance of an unfasted 25 year old male undergoing emergency reduction of ankle dislocation under general anaesthetic. He is otherwise fit and healthy. The uneventful rapid sequence induction was with Thiopentone 500mg and Suxamethonium 100mg, followed by Fentanyl 50mcg. He has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane via a Bain circuit in the anaesthetic room. There is now $FiCO_2$ appearing in the circuit. You have 3 minutes to manage this problem.

Management of Rise in $FiCO_2$ - Look, Listen, Feel:



In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, stethoscope, AmbuBag, role player as surgeon.

The initial set up is:

IPPV, ETT, FGF 1L each of Oxygen and Air, volatile set to 1.5 MAC.

The information to feed as the drill runs:

FiO_2 is 0.5
Connections are tight
Bellows are moving
There is a pulse and there are Pwaves

Airway is in same position externally, no noise
Capnograph trace is normal
ETT is tied with no signs obstruction

RR is 12, (or 5)[ii] Symmetrical, no added sounds
SpO2 is 96%
Monitored expired tidal volume is 400ml
$EtCO_2$ is 4.1
Airway pressure is 15cmH_2O

Pulse rate is 36, regular
Peripheral perfusion is normal
NIBP is 80/60

EtVolatile is 1.1 MAC (or 2.1 MAC)[ii]
Analgesia is 100mcg Fentanyl 15 minutes ago
Surgery is ongoing and second surgeon is manipulating the cervix

Examples of the underlying problem could be:

i. Bradycardia due to dilatation of cervix
ii. Bradycardia due to excessive depth of anaesthesia

And Finally!

Use this drill as an opportunity to discuss different intervention criteria in the anaesthetized patient based on specific contextual factors, similar to the hypotension drill. The potential cause of drug error should be highlighted as an often missed event. This can be an opportunity for demonstrating operation of pacing mode with defibrillator.

2-6_Bradycardia

You are 20 minutes in to anaesthetic maintenance of a 29 year old female undergoing elective laparoscopy for investigation of pelvic pain. She has a history of SVT twice in the past 8 years but is on no medication. She is otherwise fit and healthy. The uneventful induction was with Propofol 180mg, Fentanyl 100mcg followed by Rocuronium 30mg. She has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane. She has a narrow complex bradycardia at a rate of 42 which developed from an initial heart rate of 70. You have 3 minutes to manage this problem.

2-6 Bradycardia v.1

Bradycardia in theatre should not be treated as an isolated variable: remember to tailor treatment to the patient and the situation.
Follow the full steps to exclude a serious underlying problem.

START

❶ **Immediate action**: Stop any stimulus, check pulse, rhythm and blood pressure:
- If no pulse OR not sinus bradycardia OR severe hypotension: use Box A.
- If pulse present AND sinus bradycardia: use Box B.

❷ **Adequate oxygen delivery**
- Check fresh gas flow for circuit in use AND check measured F_iO_2.
- Visual inspection of entire breathing system including valves and connections.
- Rapidly confirm reservoir bag moving OR ventilator bellows moving.

❸ **Airway**
- Check position of airway device and listen for noise (including larynx and stomach).
- Check capnogram shape compatible with patent airway.
- Confirm airway device is patent (consider passing suction catheter).

❹ **Breathing**
- Check chest symmetry, rate, breath sounds, SpO_2, measured VTexp, $ETCO_2$.
- Feel the airway pressure using reservoir bag and APL valve <3 breaths.

❺ **Circulation**
- Check rate, rhythm, perfusion, recheck blood pressure.

❻ **Depth**
- Consider current depth of anaesthesia AND adequacy of analgesia.

❼ Consider underlying problem (Box C).

❽ Call for help if problem not resolving quickly.

❾ Consider transcutaneous pacing (Box D).

Box A: CRITICAL BRADYCARDIA

Give atropine 20 $\mu g.kg^{-1}$ (adult 0.5-1 mg) with fluid flush.
If no pulse: (or heart rate <60 bpm infant or neonate):
- Delegate (minimum) 1 person to chest compressions
- **→ 2-1 Cardiac arrest**

Box B: DRUGS FOR BRADYCARDIA

- Glycopyrrolate 5 $\mu g.kg^{-1}$ (adult 200-400 µg)
- Ephedrine 100 $\mu g.kg^{-1}$ (adult 3-12 mg)
- Atropine 10 $\mu g.kg^{-1}$ (adult 300-600 µg)
- Isoprenaline 0.5 $\mu g.kg.min^{-1}$ (adult 5 $\mu g.min^{-1}$)
- Adrenaline 1 $\mu g.kg^{-1}$ (adult 10-100 µg) in emergency only

Box C: POTENTIAL UNDERLYING PROBLEMS

- Consider whether you could have made a drug error.
- Consider known drug causes (eg. remifentanil, digoxin etc).
- Surgical stimulation with inadequate depth.
- Also consider: high intrathoracic pressure; pneumoperitoneum; local anaesthetic toxicity **(→ 3-10)**; beta-blocker; digoxin; calcium channel blocker; myocardial infarction, hyperkalaemia, hypothermia, raised intra-cranial pressure.

Box D: TRANSCUTANEOUS PACING

- Attach pads and ECG leads from pacing defibrillator.
- Set to PACING MODE.
- Set PACER RATE.
- Increase PACER OUTPUT from 60 mA until capture (spikes align QRS).
- Confirm capture: electrical AND mechanical (femoral pulse).
- Set PACER OUTPUT 10 mA above capture.

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, fine bore suction catheter, stethoscope, AmbuBag, paper and pen for capnograph, role player as surgeon. The cardiovascular drills can be made more engaging by including an ALS mannequin with rhythm generator, which could be available from your resuscitation department.

The initial set up is:

IPPV, ETT, FGF 1L each of Oxygen and Air, volatile1.5 MAC.

The information to feed as the drill runs:

The surgeon is able to stop surgery immediately and perform chest compressions
There is no-one in the next door theatre, the senior is in a different part of the hospital

FiO_2 is 0.5, Connections are tight

Airway is in same position externally
Capnograph trace is flattened
ETT is tied with no signs obstruction, Suction catheter passes easily

RR is 12, Symmetrical, no added sounds, SpO2 is not reading
Monitored expired tidal volume is 500ml
$EtCO_2$ is 0.6, Airway pressure is 15cmH_2O

There is no pulse, the rhythm is VF

The SpO2 was 95% before the arrest
Estimated blood loss has been around 200ml
Preoperative Potassium was 5.4 this morning
Temp is 36.0
There have been no other drugs given but the levobupivacaine vials cannot be found
The ECG looked ischaemic before the arrest
There have been no surgical problems

Examples of the underlying problem could be:

i. Cardiac arrest due to ischaemia and hyperkalaemia or hypovolaemia or LA toxicity

And Finally!

All trainees will have managed a cardiac arrest but the situation is vastly different in theatres. The cardiac arrest team is unlikely to be of help unless there are too few pairs of experienced hands nearby. Furthermore, the arrest may be due to something the anaesthetist or surgeon has done. After having watched many (simulated!) cardiac arrests in theatre, it is clear that administering chest compressions is often delayed-this is why "start chest compressions" appears at the top. Calling for help also includes tasking someone to bring a defibrillator into the theatre.

2-1_Cardiac arrest

You are 30 minutes in to anaesthetic maintenance of an elderly female undergoing emergency DHS for fractured hip under general anaesthetic. The uneventful induction was with Propofol 100mg and Fentanyl 100mcg followed by Vecuronium 4mg and fascia iliaca block with 30ml 0.25% Levobupivacaine. She has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane. She has developed ventricular fibrillation. You have 3 minutes to manage this problem.

2-1 Cardiac arrest v.1

The probable cause is one or more of: something related to surgery or anaesthesia; the patient's underlying medical condition; the reason for surgery; equipment failure. The first priority is to start chest compressions, then get help, then find and treat the cause using the guideline.

START

1 IMMEDIATE ACTION

- **Declare "cardiac arrest"** to the theatre team AND note time.
- Delegate one person (minimum) to chest compressions 100 min^{-1}, depth 5 cm.
- Call for help: nearby theatres / emergency bell / senior on-call / dial emergency number.
- Call for cardiac arrest trolley.
- As soon as possible, delegate task of evaluating potential causes (Box A).

2 Adequate oxygen delivery

- Increase fresh gas flow, give 100% oxygen AND check measured F_iO_2.
- Turn off anaesthetic (inhalational or intravenous).
- Check breathing system valves working and system connections intact.
- Rapidly confirm ventilator bellows moving or provide manual ventilation.

3 Airway

- Check position of airway device and listen for noise (including larynx and stomach).
- Confirm airway device is patent (consider passing suction catheter).
- **If expired CO_2 is absent, presume oesophageal intubation until absolutely excluded.**

4 Breathing

- Check chest symmetry, rate, breath sounds, SpO_2, measured expired volume, $ETCO_2$.
- Evaluate the airway pressure using reservoir bag and APL valve.

5 Circulation

- Check rate and adequacy of chest compressions (visual and $ETCO_2$).
- Encourage rotation of personnel performing compressions.
- If i.v. access fails or impossible use intraosseous (IO) route.
- Check ECG rhythm for no more than 5 seconds.
- Follow Resuscitation Council (UK) and ERC Guidelines.
- See Boxes B and C for reminders about drugs and defibrillation.

6 Systematically evaluate potential underlying problems and act accordingly (Box A).

7 If there is return of spontaneous circulation, re-establish anaesthesia.

Box A: POTENTIAL CAUSES

4 H's, 4 T's:

Hypoxia **(→ 2-2)**
Hypovolaemia
Hypo/hyperkalaemia
Hypothermia

Tamponade **(→ 3-9)**
Thrombosis **(→3-5)**
Toxins
Tension pneumothorax

Specific peri-operative problems:

Vagal tone
Drug error
Local anaesthetic toxicity **(→ 3-10)**
Acidosis
Anaphylaxis **(→ 3-1)**
Embolism, gas/fat/amniotic **(→ 3-5)**
Massive blood loss **(→ 3-2)**

Box B: DRUGS FOR PERI-OPERATIVE CARDIAC ARREST

Fluid bolus 20 $ml.kg^{-1}$ (adult 500 ml).
Adrenaline 10 $\mu g.kg^{-1}$ (adult 1000 µg – may be given in increments).
Atropine 10 $\mu g.kg^{-1}$ (adult 0.5-1 mg) if vagal tone likely cause.
Amiodarone 5 $mg.kg^{-1}$ (adult 300 mg) after 3rd shock.
Magnesium 50 $mg.kg^{-1}$ (adult 2 g) for polymorphic VT/hypomagnesaemia.
Calcium chloride 10% 0.2 $ml.kg^{-1}$ (adult 10 ml) for magnesium overdose, hypocalcaemia or hyperkalaemia.
Thrombolysis for suspected massive pulmonary embolus.

BOX C: DEFIBRILLATION

Continue compressions while charging: Biphasic 4 $J.kg^{-1}$ (adult 150-200 J)
DO NOT check pulse after defibrillation.
Use 3 stacked shocks in cardiac catheterisation lab.

BOX D: DON'T FORGET!

- **Use waveform capnography. No expired CO_2 = lungs not being ventilated (assume and exclude oesophageal intubation). Very rarely, absent/minimal expired CO_2 = CPR not occurring OR pulmonary circulation disconnected from systemic (e.g. in major trauma).** Sudden increase in $ETCO_2$ usually signals return of spontaneous circulation.
- Optimise position for chest compressions (use overhead for bariatric patients).
- Uterine displacement in pregnant patients.
- Ventilator can free up hands but remember to set to volume control. Minimise intrathoracic pressure: avoid excessive tidal volume and hyperventilation.

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, stethoscope, AmbuBag, role player as surgeon.

The initial set up is:

IPPV, ETT, FGF 1L each of Oxygen and Air, volatile 1.5 MAC.

The information to feed as the drill runs:

FiO_2 is 0.5
Connections are tight
Bellows are moving
HR is 61

Airway is in same position externally, no noise
Capnograph trace is normal
ETT is tied with no signs obstruction

RR is 12, Symmetrical, no added sounds
SpO2 is 96%
Monitored expired tidal volume is 500ml
$EtCO_2$ is 4.8
Airway pressure is 15cmH_2O

Pulse rate is 61
Peripheral perfusion is normal
NIBP is 70/30

EtVolatile is 1 MAC
Analgesia is 5mg Morphine 10 minutes ago and 100mcg Fentanyl 15 minutes ago
Surgery is ongoing, (surgeon is compressing IVC inadvertently)[ii]

Examples of the underlying problem could be:

i. Hypotension due to relative hypovolaemia and beta blockade
ii. Hypotension due to relative hypovolaemia, beta blockade and caval compression by surgeon

And Finally!

You can use this drill to link back to the Fall in $EtCO_2$ drill. It may also be useful to have a discussion about the fact that an acceptable blood pressure depends entirely on the situation. When trainees watch Dr. May being relaxed about a BP of 80/40, they may not appreciate that this isn't going to be OK for every patient in every situation.

2-4_Hypotension

You are 20 minutes in to anaesthetic maintenance of an elderly female undergoing elective umbilical hernia repair. She is usually hypertensive on a beta-blocker and diuretic. She has been fasting all day and is last on your list. The uneventful induction was with Propofol 150mg and Fentanyl 100mcg followed by Vecuronium 4mg and Morphine 5mg. She has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane. Her BP was 120/80 following induction but is now 70/30. You have 3 minutes to manage this problem.

2-4 Hypotension v.1

Hypotension is commonly due to unnecessarily deep anaesthesia, the autonomic effects of neuraxial block, hypovolaemia or combined causes.
You should rapidly exclude a problem in adequate oxygen delivery, airway and breathing first.

START

1 Adequate oxygen delivery

- Pause surgery if possible.
- Increase fresh gas flow AND give 100% oxygen AND check measured F_iO_2.
- Visual inspection of entire breathing system including valves and connections.
- Rapidly confirm reservoir bag moving OR ventilator bellows moving.

2 Airway

- Check position of airway device and listen for noise (including larynx and stomach).
- Check capnogram shape compatible with patent airway.
- Check airway AND airway device are patent (consider passing suction catheter).

3 Breathing

- Check chest symmetry, rate, breath sounds, SpO_2, measured VTexp, $ETCO_2$.
- Feel the airway pressure using reservoir bag and APL valve <3 breaths.
- Exclude high intrathoracic pressure as a cause.

4 Circulation

- Check heart rate, rhythm, perfusion, recheck blood pressure.
- If heart rate <60 bpm consider giving anticholinergic drug (Box B).
- Consider giving vasopressor (Box C) and positioning (e.g. move head down).
- Consider fluid boluses (250 ml adult, 10 $ml.kg^{-1}$ paediatric).
- If heart rate >100 bpm sinus rhythm, treat as hypovolaemia: give i.v fluid bolus.
- If heart rate >100 bpm and non-sinus → **2-7 Tachycardia.**

5 Depth

- Ensure correct depth of anaesthesia AND analgesia (consider risk of awareness).

6 Exclude potential surgical causes (Box D) – discuss with surgical team.

7 Consider causes in Box E and call for help if problem not resolving quickly.

Box A: CRITICAL CHANGES

If problem worsens significantly or a new problem arises, call for **help** and go back to **START** of **1-1 Key basic plan**.

Box B: ANTICHOLINERGIC DRUGS

- Glycopyrrolate 5 $\mu g.kg^{-1}$ (adult 200-400 µg)
- Atropine 5 $\mu g.kg^{-1}$ (adult 300-600 µg)

Box C: VASOPRESSOR DRUGS

- Ephedrine 100 $\mu g.kg^{-1}$ (adult 3-12 mg)
- Phenylephrine 5 $\mu g.kg^{-1}$ (adult 100 µg)
- Metaraminol 5 $\mu g.kg^{-1}$ (adult 500 µg)
- Adrenaline 1 $\mu g.kg^{-1}$ (adult 10-100 µg) in emergency only

Box D: SURGICAL CAUSES

- Decreased venous return (e.g. vena cava compression / pneumoperitoneum)
- Blood loss (unrecognised / undeclared / occult)
- Vagal reaction to surgical stimulation
- Embolism (gas / fat / blood / cement reaction)

Box E: DON'T FORGET!

- Consider whether you could have made a drug error.
- Pneumothorax and/or high intrathoracic pressure can cause hypotension.
- Also consider:
  - Cardiac ischaemia → **3-12**
  - Anaphylaxis → **3-1**
  - Cardiac tamponade → **3-9**
  - Local anaesthetic toxicity → **3-10**
  - Sepsis → **3-14**
  - Cardiac valvular problem
  - Endocrine cause (eg steroid dependency)

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, stethoscope, AmbuBag, role player as surgeon.

The initial set up is:

IPPV, ETT, FGF 1L each of Oxygen and Air, volatile set to 1 MAC.

The information to feed as the drill runs:

FiO_2 is 0.5
Connections are tight
Bellows are moving
NIBP can be rechecked
Surgeon can pause surgery

Airway is in same position externally, no noise
Capnograph trace is normal
ETT is tied with no signs obstruction

RR is 12, Symmetrical, no added sounds
SpO2 is 96%
Monitored expired tidal volume is 500ml
$EtCO_2$ is 5.4
Airway pressure is 15cmH_2O

Pulse rate is 101
Peripheral perfusion is normal
NIBP is 160/90
The bladder is not distended

EtVolatile is 1 MAC
Analgesia is 50mcg Fentanyl 10 minutes ago
Surgery is ongoing and the surgeon has infiltrated lignocaine 2% with Adrenaline 1/200000

Examples of the underlying problem could be:

i. Hypertension due to light anaesthesia and / or local anaesthetic with adrenaline infiltration

And Finally!

Increasing depth and asking the surgeon to pause buys time- this is usually going to be a problem that is relatively straightforward for the trainee to resolve. Use this drill to introduce the concept of human fallibility with the possibility of a drug error (eg. mistaking a syringe), this could be a cause that none of the trainees had considered.

2-5_Hypertension

You are 10 minutes in to anaesthetic maintenance of a 28 year old fit and healthy male undergoing elective nasal septoplasty. The uneventful induction was with Propofol 200mg and Fentanyl 50mcg followed by Vecuronium 4mg. He has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane. His BP was 120/80 following induction but is now 160/90. You have 3 minutes to manage this problem.

2-5 Hypertension v.1

Hypertension is most commonly due to inappropriate depth of anaesthesia or inadequate analgesia.
You should rapidly exclude a problem in adequate oxygen delivery, airway and breathing first.

START

❶ **Immediate actions**

- Recheck blood pressure AND increase anaesthesia AND reduce stimulus.

❷ **Adequate oxygen delivery**

- Check fresh gas flow for circuit in use AND check measured F_iO_2.
- Visual inspection of entire breathing system including valves and connections.
- Rapidly confirm reservoir bag moving OR ventilator bellows moving.

❸ **Airway**

- Check position of airway device and listen for noise (including larynx and stomach).
- Check capnogram shape compatible with patent airway.
- Confirm airway device is patent (consider passing suction catheter).

❹ **Breathing** - exclude **hypoxia** and **hypercarbia** as causes:

- Check chest symmetry, rate, breath sounds, SpO_2, measured VT_{exp}, $ETCO_2$.
- Feel the airway pressure using reservoir bag and APL valve <3 breaths.

❺ **Circulation**

- Check rate, rhythm, perfusion; increase frequency of BP check.
- Check cuff size and location, consider intra-arterial monitoring.

❻ **Depth**

- Ensure adequate depth of anaesthesia and analgesia.

❼ Consider underlying problem (Box B).

❽ Call for help and consider temporising drug (Box C) if problem not resolving.

Box A: CRITICAL CHANGES

If problem worsens significantly or a new problem arises, call for **help** and go back to **START** of **1-1 Key Basic Plan.**

BOX B: POTENTIAL UNDERLYING PROBLEMS

- Inadequate anaesthesia / analgesia (alfentanil can be diagnostic – see Box C for dose)
- Inadequate neuromuscular blockade
- Consider whether you could have made a drug error
- Omission of usual antihypertensives
- Distended bladder
- Vasopressor administered by surgeon
- Surgical tourniquet
- Excess fluid (over-administration / overload / TURP syndrome)
- Medical causes: drug interaction, renal failure, raised intracranial pressure, seizure, thyrotoxicosis, phaeochromocytoma

BOX C: TEMPORISING DRUGS FOR HYPERTENSION

- Alfentanil 10 $\mu g.kg^{-1}$ (adult 0.5-1 mg)
- Propofol 1 $mg.kg^{-1}$ (adult 50-100 mg)
- Labetolol 0.5 $mg.kg^{-1}$ (adult 25-50mg). Repeat when necessary.
- Esmolol 0.5 $mg.kg^{-1}$ (adult 25-50mg) Follow with infusion.
- Hydralazine 0.1 $mg.kg^{-1}$ (adult 5-10mg)
- Glyceryl trinitrate 0.5-5 $\mu g.kg.min^{-1}$ infusion (adult 2-20 $ml.hr^{-1}$ of 1 $mg.ml^{-1}$ solution)

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, stethoscope, AmbuBag, role player as surgeon. The cardiovascular drills can be made more engaging by including an ALS mannequin with rhythm generator, which could be available from your resuscitation department.

The initial set up is:

IPPV, ETT, FGF 1L each of Oxygen and Air, volatile set to 2 MAC.

The information to feed as the drill runs:

There is a pulse of good volume and it is narrow complex
FiO_2 is 0.5
Connections are tight
Bellows are moving
NIBP can be rechecked

Airway is in same position externally, no noise
Capnograph trace is normal
ETT is tied with no signs obstruction
Suction catheter passes easily

RR is 12, Symmetrical, no added sounds
SpO2 is 96%
Monitored expired tidal volume is 500ml
$EtCO_2$ is 5.8 (or 4.5[ii])
Airway pressure is 15cmH_2O

Pulse rate is 126, sinus
Peripheral perfusion is normal (or cool periphery[ii])
NIBP is 100/60

EtVolatile is 1.5 MAC
Analgesia is 100mcg Fentanyl 15 minutes ago and 10mg Morphine 10minutes ago
Temp is 38.0
Surgery is ongoing (the surgeon has found a perforated appendix[i] or a bleeding vessel[ii])

Examples of the underlying problem could be:

i. Tachycardia due to sepsis
ii. Sinus tachycardia due to hypovolaemia

And Finally!

Although sinus tachycardia will often be accompanied with hypertension and be simple to solve, make sure you have a brief discussion about ruling out the uncommon causes. As always, use the opportunity to run through the drill systematically.

2-7_Tachycardia

You are 20 minutes in to anaesthetic maintenance of a 21 year old fit and healthy male undergoing emergency laparoscopy for presumed appendicitis. He is usually fit and healthy. The uneventful rapid sequence induction was with Thiopentone 450mg, Fentanyl 100mcg and Suxamethonium 100mg, followed by Vecuronium 4mg and Morphine 10mg. He has a size 8 ETT in situ, being ventilated with Oxygen, Air and Sevoflurane. His heart rate pre-induction was 90 but it has gradually risen to 126. You have 3 minutes to manage this problem.

2-7 Tachycardia v.1

Tachycardia in theatre is often due to inadequate depth of anaesthesia / analgesia or alternatively a reflex to hypotension.
Tachycardia should not be treated as an isolated variable: remember to tailor treatment to the patient and the situation.
Follow the full steps to exclude a serious underlying problem.

START

❶ **Immediate action**: Stop any stimulus, Check pulse, rhythm and blood pressure:
- If no pulse or impending arrest: use Box A.
- If narrow complex AND not hypotensive first increase depth of anaesthesia/analgesia.

❷ **Adequate oxygen delivery**
- Check fresh gas flow for circuit in use AND check measured F_iO_2.
- Visual inspection of entire breathing system including valves and connections.
- Rapidly confirm reservoir bag moving OR ventilator bellows moving.

❸ **Airway**
- Check position of airway device and listen for noise (including larynx and stomach).
- Check capnogram shape compatible with patent airway.
- Confirm airway device is patent (consider passing suction catheter).

❹ **Breathing**
- Check chest symmetry, rate, breath sounds, SpO_2, measured VTexp, $ETCO_2$.
- Feel the airway pressure using reservoir bag and APL valve <3 breaths.

❺ **Circulation**
- Check rate, rhythm, perfusion, recheck blood pressure, obtain 12-lead ECG if possible.

❻ Consider underlying problems (Box B).

❼ Consider rate control (Box C).

❽ **Call for help;** consider electrical cardioversion (Box D) if problem not resolving quickly.

❾ **Depth:** Consider current depth of anaesthesia AND adequacy of analgesia.

Box A: CRITICAL TACHYCARDIA

If no pulse, delegate one person (minimum) to chest compressions and **→ 2-1 Cardiac arrest.**
If hypotension worsening or impending arrest, consider electrical cardioversion (Box D).

Box B: POTENTIAL UNDERLYING PROBLEMS

- Stimulation with inadequate depth.
- Consider drug error.
- Also consider: central line/wire; hypovolaemia; primary cardiac arrhythmia; myocardial infarction; electrolyte disturbance; local anaesthetic toxicity **(→ 3-10)**; sepsis **(→ 3-14)**; circulatory embolus, gas/fat/amniotic **(→ 3-5)**; anaphylaxis **(→ 3-1)**; malignant hyperthermia crisis **(→ 3-8)**

Box C: DRUGS FOR TACHYCARDIA

- Fluid bolus 10 $ml.kg^{-1}$ (adult 250 ml)
- Magnesium 50 $mg.kg^{-1}$ (adult 2 g) over >10 min, max conc. 200 $mg.ml^{-1}$
- Amiodarone 5 $mg.kg^{-1}$ (adult 300 mg) over >3 min, NOT in polymorphic VT
- Labetalol 0.5 $mg.kg^{-1}$ (adult 25-50 mg), repeat when necessary
- Esmolol 0.5 $mg.kg^{-1}$ (adult 25-50 mg)
- Adenosine 0.1 to 0.5 $mg.kg^{-1}$ (Adult 3 to 18 mg) – for SVT

Box D: ELECTRICAL CARDIOVERSION

- Attach pads and ECG from defibrillator.
- Ensure adequate depth / sedation / analgesia for cardioversion.
- Engage synchronisation and check for sync spikes on R-waves.
- Start with 1 Jkg^{-1} (adult 50-100 J) biphasic.
- Remember to hold shock button until sync shock delivered.

In order to run this drill you will need:

Anaesthetic machine, breathing system, empty vapouriser, intubation head part task trainer, ET tube, fine bore suction catheter, stethoscope, AmbuBag, role player as surgeon.

The initial set up is:

SV, LMA, FGF 1L each of Oxygen and Air, volatile set to 1.0 MAC.

The information to feed as the drill runs:

FiO_2 is 0.5
Connections are tight
Bag is moving but not very much

Airway is in same position externally, no noise
Capnograph trace is irregular
LMA is tied and the patient has clenched teeth
Suction catheter passes with difficulty (patient is clenching teeth)

RR is 12, Symmetrical, no added sounds
SpO2 is 91%
Monitored expired tidal volume is 200ml
$EtCO_2$ is 6.1
Airway pressure is 0cmH_2O

Pulse rate is 100 regular
Peripheral perfusion is normal
NIBP is 130/90

EtVolatile is 1.0 MAC
Analgesia is 50mcg Fentanyl 5 minutes ago
Surgery is ongoing

Examples of the underlying problem could be:

i. Epileptic seizure under anaesthesia

And Finally!

Similar to the Cardiac Arrest drill, a seizure in the theatre environment has slightly different implications to other areas. There could be an emphasis on early control of seizure to prevent injury. It can be easy to forget to check blood sugar, and other reversible underlying causes must also be excluded. SpO_2 is in bold to highlight hypoxia as a potential cause.

NQ_Convulsions

You are 10 minutes in to anaesthetic maintenance of a 54 year old female undergoing elective hysteroscopy for postmenopausal bleeding. She has a history of epilepsy and is on 300mg Carbamazepine twice daily and has self-terminating seizures about once every two months. She is otherwise fit and healthy. The uneventful induction was with Propofol 180mg and Fentanyl 50mcg. She has a size 4 LMA in situ, spontaneously breathing Oxygen, Air and Sevoflurane. She has just begun to have a generalized seizure. You have 3 minutes to manage this problem.

Management of Convulsions - Look, Listen, Feel:

Adequate Oxygen Delivery

Adequate FGF
Check F_iO_2
Connections
Bag / Bellows Moving

FiO_2 1.0

Prevent injury

Notify Surgeon

Clear Airway

Airway position, Airway noise
Adjuncts, LMA / ETT Clear
Capnograph Trace

May need to stop seizure to manage airway

Check Breathing

Rate, Symmetry, **SpO_2**
Exp tidal volume, $EtCO_2$
Airway pressure

Assist Breathing

Check Circulation

Rate, Rhythm
Perfusion
BP

Check Depth

Anaesthesia
Analgesia

Check BM

Stop Seizure:
Induction Agent
Benzodiazapine
$MgSO_4$ (Eclampsia)
Dextrose (Hypo)

Look for treatable cause:
Hypoxaemia, LA Toxicity, Drugs (NB social history), Sepsis, Pyrexia, Intrinsic CNS, Metabolic

Consider Surgical Problem

Call for HELP if problem not resolving quickly