Crisis Management in the Operation Theatre

How to diagnose and/or treat crisis

1. Pattern Recognition
2. COVER ABCD + A SWIFT CHECK (Correct 60% of cases, making 99% functional diagnosis)
3. Go through the sub-algorithms

How to handle crisis in the Operation Theatre

1. Declare a crisis
2. Ask for help + allocation of tasks
3. Prepare “trolleys”
4. Diagnose and/or treat the problem

How to answer questions in viva

1. Keep talking
2. Follow the COVER ABCD + A SWIFT CHECK sequence if you have no idea

How to prepare for exam

1. Learn and practice COVER ABCD + A SWIFT CHECK
2. Train yourself to talk
3. Train yourself to act
4. Build up your knowledge, read up the sub-algorithms
Summary of COVER ABCD + A SWIFT CHECK

| C | Circulation, Capnograph, and Colour (saturation) |
| O | Oxygen supply and Oxygen analyser |
| V | Ventilation (intubated patient) and Vaporisers |
| E | Endotracheal tube and Eliminate machine |
| R | Review monitors and Review equipment |

| A | Airway (with face or laryngeal mask) |
| B | Breathing (with spontaneous ventilation) |
| C | Circulation (in more detail than above) |
| D | Drugs (consider all given or not given) |

A Be Aware of Air and Allergy  
**SWIFT CHECK** of patient, Surgeon, process, and response
Four levels of response – SCARE (scan-check-alert/ready-emergency)
### The 24 Sub-Algorithms

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Table 2 “A SWIFT CHECK” (the checklist arising from the mnemonic need not be memorised but should be immediately available in the operating theatre)

| A | Air embolus | Hypotension, hypocarbia |
| A | Anaphylaxis | Hypotension, bronchospasm, urticaria |
| A | Air in pleura | Pneumothorax, any unexpected circulatory or respiratory deterioration |
| A | Awareness | Consider dilution of anaesthetic gases, “resistant” patient |
| S | Surgeon/situation | Vagal stimulation, caval compression, bleeding, direct myocardial stimulation |
| S | Sepsis | Hypotension, desaturation, acidosis, hyperdynamic circulation |
| W | Wound | Trauma, bleeding, tamponade, pneumothorax, problems due to retractors |
| W | Water intoxication | Electrolyte disturbance, fluid overload |
| I | Infarct | Myocardial conduction or rhythm problem, hypotension, poor cardiac output |
| I | Insufflation | Vagal tone, reduced venous return, pulmonary venous or paradoxical arterial gas embolism |
| F | “Fat” syndrome | Desaturation and/or hypotension, especially after induction and in the lithotomy position including distended abdomen for any cause |
| F | Full bladder | May cause marked haemodynamic changes and/or sympathetic stimulation |
| T | Trauma | Consider spinal injury, undiagnosed sub-or diaphragmatic injury, ruptured vissus |
| T | Tourniquet down | Local anaesthetic toxicity or unseen bleeding |
| C | Catheter/IV cannula/chest drain problems | Leaks, failure to deliver, wrong drug or label, obstructed, wrong connected, wrong rate |
| C | Cement | Haemodynamic change with methylmethacrylate |
| H | Hyperthermia (hypothermia) | Tachycardia and hypercarbia/ECG changes, (poor perfusion, ECG changes) |
| H | Hypoglycaemia | Consider inappropriate or inadvertent insulin preoperatively, fasting and beta blockers, hepatic compromise and beta blockers |
| E | Embolus | Fat, thrombus, amniotic fluid; hypotension, hypocarbia, ECG changes |
| E | Endocrine | Hyperthyroid or hypothyroid/adrenal medullar or cortex/pituitary/ diabetes/5-HT |
| C | Check | Right patient, right operation, right surgeon |
| C | Check | Case notes, preoperative status, preoperative drugs, preoperative diseases |
| K | K+ | Potassium and any other electrolyte abnormality (“hyper” or “hypo”), ECG changes, CNS signs |
| K | Keep | Keep the patient “asleep” until a new anaesthetic machine can be obtained (e.g. diazepam, ketamine) |

If the problem has not been solved, direct the available resources to its solution. Get skilled and experienced help. Work from first principles.
AIRWAY OBSTRUCTION

SIGNS
- Noisy, poor or absent ventilation
- Increased inspiratory efforts/tracheal tug
- Paradoxic chest/abdominal movements

MANAGEMENT
- Cease stimulation/surgery
- 100% oxygen *(1)*
- Try chin lift/jaw thrust *(2)*
- Request immediate assistance *(3)*
- Consider allowing the patient to wake up, or
  ensure adequate depth of anaesthesia *(4)* and
  visualise and clear the pharynx/airway *(5)*
  - If the problem is laryngospasm → page 12**(5)**
  - If the problem is regurgitation → page 16**(5)**
- Insert oral and/or nasal airways
- Reposition head, apply chin lift/jaw thrust *(2)*
- Try “team” mask CPAP/IPPV *(3)*

IF YOU CANNOT VENTILATE *(6)*
- Have someone feel the pulse and call out the SpO₂ *(1) (7)*
  - If not already paralysed
  - Consider suxamethonium and atropine, see *(8) and *(9)* on page 13**(7)**
  - Make one attempt at intubation under direct vision

IF YOU CANNOT INTUBATE
- Consider a laryngeal mask *(8)*

IF THIS FAILS
- Do an immediate cricothyrotomy
- Ventilate with 100% oxygen

IF YOU CANNOT VENTILATE VIA AN ETT
- Consider:
  - Misplaced/inked/blocked ETT → page 7**(19)
  - Pneumothorax → page 45**(19)
- Consider possible obstruction distal to ETT:
  - Try pushing a small tube past it
  - Or push the obstruction down one bronchus
  - And ventilate the other lung with a clean tube

The sub-algorithm forms a facing page of the Crisis Management Manual*(15)*,*
- Numbers in brackets refer to Notes in the right hand panel.
- **Page references refer to the Crisis Management Manual*(15)*,*

FURTHER CARE
- Review the patient to:
  - Confirm a clear airway
  - Exclude pulmonary aspiration
  - Exclude post obstructive pulmonary oedema
  - Explain what happened
- There is a risk of awareness:
  - Go and see the patient in the ward later on
  - Explain again and reassure them *(9)*
  - Advise them to warn future anaesthetists.

NOTES:
- It was judged that correct use of the algorithm would have led to earlier
  recognition of the problems and/or better management in 11% of the 62
  relevant incidents reported to AIMS.
- *(1) Desaturation was documented in 65% of cases.*
- *(2) This may release mild laryngospasm and some obstructions.*
- *(3) See *(4) on page 13.*
- *(5) Tasks for “team” include mask CPAP/IPPV and subsequent intubation or
  cricothyrotomy, if necessary.*
- *(4) Ask for 4 people
  Person I to hold mask and jaw with 2 hands and intubate.
  Person II to hold emergency oxygen and button squeeze the bag.
  Person III to ensure adequate anaesthesia and IV access.
  Person IV to find and pass equipment and help others.*
- *(5) This will often relieve laryngospasm and is a prerequisite for pharyngoscopy
  and suction. 14% of cases of laryngospasm presented as airway
  obstruction.*
- *(6) This is vital at this stage, half of the incidents reported had blood, secretions,
  a foreign body, or intravenous mass. Obviously, an intravenous mass cannot be
  cleared; core should be taken not to cause bleeding. This step is also
  important before using CPAP or IPPV to prevent aspiration.*
- *(6) Get an assistant to have a scalpel and tube ready for you, as this will save
  time once the decision to proceed with cricothyrotomy is made.*
- *(7) There were 4 cardiac arrests, 3 dysrhythmias and 1 death.*
- *(8) The LMA is easy to insert and works well in about 95% of cases. It does not
  provide airway protection. See Caponas.*
- *(9) Provide written advice and document this in the medical record.*

These notes comprise a reverse side of a page of the Crisis Management Manual*(15)*,*
- Page references refer to the Crisis Management Manual*(15)*,*

Crisis Management in the Operation Theatre – 12 Dec 2009
LARYNGOSPASM

SIGNS (1,2)*
- Inspiratory stridor/airway obstruction
- Increased respiratory efforts/tracheal tug
- Paradoxic chest/abdominal movements
- Desaturation, bradycardia, central cyanosis

THINK OF (1,2)*
- Airway irritation and/or obstruction
- Blood/secrections in the airway
- Regurgitation and aspiration
- Excessive stimulation/light anaesthesia

MANAGEMENT
- Cease stimulation/surgery (2)
- 100% Oxygen (3)
- Try gentle chin lift/jaw thrust (4)
- Request immediate assistance
- Deepen anaesthesia with an IV agent (5)
- Visualise and clear the pharynx/airway
  - If you suspect aspiration — page 16** (6)
  - If you suspect airway obstruction — page 14** (7)
- Try mask CPAP/IPJV, if this is unsuccessful
  - Give suxamethonium unless contraindicated (8)
  - Give atropine unless contraindicated (9)
- Again, try mask CPAP/IPJV (10)
- Intubate and ventilate (11)

FURTHER CARE:
- Careful postoperative review of the patient to:
  - exclude pulmonary aspiration (6)
  - exclude post-obstructive pulmonary oedema (8)
- explain what happened to the patient.
- There is a risk of awareness:
  - go and see the patient in the ward
  - explain again, and reassure the patient.


NOTES:
- It was judged that correct use of this algorithm would have led to earlier recognition of the problem and/or better management in 16% of 189 relevant incidents reported to AMPS.
  1. 77% of cases were clinically obvious. 14% presented as airway obstruction, 5% as regurgitation, 4% as desaturation.
  2. Causes and precipitating factors: Airway manipulation – 44%; blood/secrections in the airway – 12%; regurgitation/vomiting – 9%; surgical stimulation – 5%; moving the patient – 4%; inherent volatile anaesthetics – 2%; failure of anaesthesia delivery system – 2%.
  3. 61% of reports documented desaturation.
  4. The cricothyroid muscle is the only tensor of the vocal cords. Gentle stretching of this muscle may overcome moderate laryngospasm. In applying jaw thrust, gentle pressure should be exerted on the angle of the mandible, and not on soft tissues.
  5. Try 20% of the induction dose; this may be all that is needed (5% of cases were managed in this way); for more details, and for advice about children see (8) and (9) below.
  6. 3% of cases were associated with aspiration.
  7. 20% of cases presenting as airway obstruction were due to laryngospasm.
  8. Suxamethonium: Delay in relieving severe laryngospasm was associated with post-obstructive pulmonary oedema in 4% of cases; 15% of cases were managed with suxamethonium without intubation.
  9. 0.5mg/kg IV to relieve laryngospasm (see page 132): 1.0–1.5mg/kg IV for intubation.
  10. 0.01mg/kg. Bradycardia occurred in 6% of all cases and in 23% of patients less than 1 year of age.
  11. 26% of cases were managed by mask CPAP/IPJV.

These notes comprise a reverse side of a page of the Crisis Management Manual1.

* Page references refer to the Crisis Management Manual1.

** Page references refer to the Crisis Management Manual1.
REGURGITATION/VOMITING

MANAGEMENT
Inform the surgeon
Head down, lateral posture, if feasible
Apply cricoid pressure
Try to clear and suction the airway
Give 100% oxygen
Consider deepening anaesthesia (1)* to visualise and clear the pharynx/airway
Try gentle mask CPAP/IPPV with cricoid pressure (2)*
Ventilate the lungs with cricoid pressure
IF YOU CANNOT VENTILATE → page 14**
Give suxamethonium and atropine.
Intubate with cricoid pressure, expedite surgery.

ASPIRATION
SIGNS (3)
Laryngospasm/airway obstruction
Bronchospasm/wheeze/crackles
Hypoventilation/dyspnoea/apnoea
Reduced compliance (ARDS)
Desaturation/bradycardia/arrest.

FURTHER CARE
Sedation, analgesia, IPPV via ET intubation
Suction airway, optimise FiO2 and PEEP
Bronchoscopy and lavage if necessary
Bronchodilators as necessary (4)
Chest X ray. If normal, and
If saturation is adequate, extubate (5)
If stable after 2 hours in recovery, send to the ward and arrange for follow up (5)
If unstable or saturation is inadequate (5)
Maintain intubation and IPPV
Admit to a high dependency area (6)

Explain what happened to relations/friends
Repeat chest X ray and blood gases
Consider PEEP bronchodilators, inotropes
Culture spuuma
Antibiotics; not routine
Consider other causes (7)
Reassess daily (8).

Explain what happened to the patient
Arrange follow up as necessary.

* Numbers in brackets refer to Notes in the right hand panel.

NOTES:
It was judged that the correct use of the algorithm would have led to earlier recognition of the problem and/or better management in 19% of the 96 incidents of aspiration reported to AINS.
(1) An alternative is to allow the patient to recover consciousness and to start again. Deepening anaesthesia may be necessary to properly visualise and clear the pharynx/airway without precipitating laryngospasm and/or further aspiration or vomiting.
(2) An alternative, if the patient’s condition allows, and the appropriate equipment and assistance is at hand, is to proceed immediately with intubation.
(3) Diagnosis of regurgitation, vomiting or aspiration was clinically obvious in 70% of cases. However 15% of cases of aspiration presented as delayed, 6% as laryngospasm, 3% as airway obstruction, 2% as bronchospasm, 1% occurred with difficult intubation, 1% presented with hypovolaemia, 0.5% as pulmonary oedema and 0.5% as cardiac arrest.
(4) Salbutamol: 0.5% 1 ml (5mg) by mask nebuliser 4 hourly.
(5) “Stable”: saturation 95% with FiO2 < 0.3, heart rate < 100, respiratory rate < 20/minute (adults), no bronchospasm, apyrexial.
(6) Major morbidity ensued in 50% of all cases of aspiration and death ensued in 4%.
(7) Bronchospasm, pulmonary oedema, ARDS, pulmonary embolism and other causes of ET tube obstruction may present a similar respiratory picture as aspiration.
(8) Steroids and antibiotics should not be used early or routinely.

These notes comprise a reverse side of a page of the Crisis Management Manual12.
DIFFICULT INTUBATION

REMEMBER, PATIENTS DO NOT DIE FROM FAILED INTUBATION – ONLY FAILED VENTILATION

Always have skilled assistance, preferably another anaesthetist, when difficulty is expected or the patient’s cardiorespiratory reserve is low.

MANAGEMENT

Call for skilled assistance
Call for the difficult intubation trolley
Maintain oxygenation at all times
Have someone feel the pulse and call out the SpO2.

If you cannot ventilate the lungs → page 14*

If you can ventilate by face mask, consider

- waking up the patient OR
- maintaining anaesthesia and trying to intubate (1)**

Try basic manoeuvres first:
- Optimise the head and neck position (2)
- Try laryngeal manipulations such as “BURP” (3)
- Try a well-lubricated gum elastic bougie or stylet (4)
- Try different laryngoscope blades
If these fail:
- Consider inserting an LMA (5)
- Consider other techniques: Blind nasal Retrograde Lighted stylet
If an LMA is in place consider whether to proceed and whether steps should be taken to secure endotracheal intubation (5)
- Confirm correct placement of endotracheal tube.

FURTHER CARE

Review the situation
Exclude other complications (6)
There is a risk of awareness:
- Go and see the patient in the ward
- Explain again and reassure them (7)
- Advise them to warn future anaesthetists (8).

The sub-algorithm forms a facing page of the Crisis Management Manual28;

** Numbers in brackets refer to Notes in the right hand panel.

NOTES:

1. Techniques will vary with the experience and familiarity with the techniques of the individual anaesthetist.
2. Avoid multiple attempts at laryngoscopy/intubation, as this may cause bleeding and laryngeal oedema, worsening the situation.
3. This may require 2 assistants:
   - to apply pressure to the larynx and/or the back of the neck,
   - to lift the head up.
5. The most common aid to facilitate successful intubation in the AIMS series was the gum elastic bougie (46%), followed by a stylet (23%).
6. The LMA is easy to insert and works well in about 95% of cases. It does not provide airway protection.
7. Airway trauma
   - Pulmonary aspiration
   - Post-obstructive pulmonary oedema
   - Cardiovascular signs and symptoms.
8. Provide written advice and document this in the medical record.
9. Document the problem in the case notes and give the patient a letter to warn future anaesthetists. If a particular precipitating event was significant, or a particular action was useful in resolving the crisis, this should be clearly explained and documented. Consideration should also be given to a hazard alert device such as a Medic-alertM bracelet.

These notes comprise a reverse side of a page of the Crisis Management Manual28.
DESATURATION

EMERGENCY MANAGEMENT
Complete Cover ABCD—A SWIFT CHECK (1)*
Hand ventilate with 100% oxygen
Confirm the FiO₂ is appropriate
Confirm the ETCO₂ is appropriate, if it is low consider:
  - Anaphylaxis → page 48**
  - Pneumothorax → page 46**
  - Air (or other) embolism → page 44**
  - Auscultate again, specifically exclude endobronchial intubation (2)

REVIEW AND TREAT OTHER POSSIBLE CAUSES
Underlying cardiopulmonary problems
  - If bronchial secretions or plugs are suspected (3)
    - Posture and suction ETT/bronchi
    - Give a “long slow blow” especially in children
    - If cardiovascularly stable consider PEEP/CPAP
  - If acute shunt is suspected (4)
    - Ensure the patient is supine and level
    - If a pneumoaponeumonectomy is present, deflate the abdomen
    - Consider gas embolism (5)

Pulse oximeter malfunction (6)
Consider: polycythaemia, methaemoglobinemia, acute tricuspid incompetence, probe sited distal to an AV fistula.

* Numbers in brackets refer to Notes in right hand panel.

FURTHER CARE
Reassess the situation
If persistent/unstable desaturation consider:
  - Completing/abandoning surgery
  - Chest X-ray, blood gases
If stable and well saturated, see (5) on page 17*
  - Wake the patient up and extubate
If unstable or desaturated, see (5) on page 18*
  - Admit to ICU/HDU

NOTES:
It was judged that correct use of the algorithm would have led to earlier recognition of the problem and/or better management in 16% of the 264 relevant incidents reported to AMS.
(1) The use of COVER ABCD accounted for 89% of applicable incidents reported to AMS. Use of the desaturation sub-algorithm accounted for a further 9% of applicable incidents.
(2) Endobronchial intubation was the commonest cause of desaturation in unsedated patients reported to AMS. It should be specifically excluded early. Further details may be found in (4) below.
(3) 2% of incidents were due to bronchial plugs or excessive bronchial secretions, which can produce marked desaturation, especially in young children. A shunt effect is produced, which may be unmasked by abolition of hypoxic pulmonary vasoconstriction with induction of anaesthesia.
(4) “Obstructive syndrome” refers to the rapid desaturation which may be seen at induction when congestion of obese patients, or those with obstructive airways, is exacerbated by a sudden increase in positive end-expiratory pressure (PEEP). The pharyngeal and laryngeal pads, spontaneous ventilation and hyperventilation all exacerbate the problem, resulting in sudden desaturation at the start of a case and progressive desaturation during the maintenance phase.
(5) 0.8% of incidents involved suspected gas embolism.
(6) 1% of incidents involved unusual causes of pulse oximeter malfunction, including acute tricuspid incompetence, polycythaemia and methaemoglobinemia. Acute tricuspid incompetence may lead to the oximeter sensing the venous pulse. A large supraglottic device and a saturation of 70-75% is commonly seen. Arterial saturation, when directly measured, may be quite acceptable. Polycythaemia may lead to artefactually low saturation readings with high directly measured arterial oxygen saturations or tensions. Methaemoglobinemia, depending on its extent, will cause the saturation to approach 85%.

These notes comprise a reverse side of a page of the Crisis Management Manual12.
BRONCHOSPASM

SIGNS (1)*
Increasing circuit pressure
Desaturation
Wheeze (auscultate)
Rising ETCO₂ and prolonged expiration
Reduction in tidal volumes

THINK OF (2)
Anaphylaxis/allergy to drugs/IV fluids/latex
Airway manipulation/initiation/secretions/trauma
Oesophageal/endobronchial intubation
Pneumothorax
Inadequate anaesthetic depth or failure of anaesthetic delivery system

EMERGENCY MANAGEMENT
100% Oxygen
Cease stimulation/surgery
Request immediate assistance
Deepen anaesthesia (3)
If intubated exclude endobronchial or oesophageal position (4)
If mask/LMA in use consider early:
Laryngospasm/airway obstruction → pages 12 & 14**
Regurgitation/vomit/aspiration → page 16** (5)
Give adrenaline or salbutamol (see over)
If you cannot ventilate via an ETT consider:
Misplaced/kinked/blocked ETT or circuit → page 7**
Pneumothorax → page 46**
Aspiration → page 16**
Anaphylaxis → page 48**
Pulmonary oedema → page 24**
Consider possible obstruction distal to ETT
Try pushing a small tube past it, or push the obstruction down one bronchus and ventilate the other lung.

CONSIDER ANAPHYLAXIS → page 48**
CONSIDER PULMONARY OEDEMA → page 24**

* Numbers in brackets refer to Notes in the right hand panel.
** Page references refer to Crisis Management Manual®.

FURTHER CARE:
Depends on patient's condition, and cause
Bronchodilators as necessary
Chest X-ray
Admit to HDU/JCU if necessary

NOTES:
(1) 30% of 103 relevant incidents described increased peak inflation pressures, and a further 31% described "bronchospasm" whereas the initial signs: 21% reported desaturation as the first sign.
3% reported rising ETCO₂ and 3% revealed a flat capnogram indicating no gas flow
(2) Anaphylaxis = 22/103 (21%) of incidents.
Of the remaining 81 cases of bronchospasm:
44% occurred at induction and of these:
64% were due to airway irritation
17% were due to ETT displacement
11% were due to aspiration
8% were due to other causes.
36% occurred during maintenance and of these:
31% were due to ETT problem
14% were due to aspiration with an LMA
20% occurred during emergence/recovery and of these:
38% had no specific cause identified
25% were due to pulmonary oedema
18% were due to aspiration.
(3) 55% of cases of bronchospasm at induction were idiopathic or presumed to be due to airway irritation from laryngoscopy and/or intubation.
(4) 12% were associated with oesophageal intubation and 2.5% with endobronchial intubation.
(5) 12% of cases were associated with aspiration.

Recommended dosages:
Salbutamol 0.5% 1ml (3mg) solution nebulised for adult
or nebulised puffer, 2 puffs (0.1mg/puff)
or 0.5% 0.1 ml in 1 ml, injected into ET (0.5mg adult).
Adrenaline 0.001 mg/kg bolus (0.01 ml/kg of 1:10 000 solution).
Repet bolus, or commence infusion 0.00015mg/kg/min
Adrenaline, easy dosing for adults, see page 71**

Titrated to heart rate, blood pressure, and bronchodilator effect.

These notes comprise a reverse side of a page of the Crisis Management Manual®.
* Page references refer to the Crisis Management Manual®.
PULMONARY OEDEMA/ARDS

SIGNS (1)*
Respiratory distress/tachypnoea
Desaturation
Increased inspiratory pressure
Pink frothing sputum up ETT/ILMA (diagnostic)
Crepitations or bronchospasm

PRECIPITATING FACTORS
Fluid overload (2)
Non-cardiogenic:
Pulmonary oedema (3)
Anaphylaxis
Neurogenic
Septic
Pulmonary aspiration
Multiple organ failure
Cardiogenic (4)

EMERGENCY MANAGEMENT
Titrated inspired oxygen concentration against SpO2
Head up 15°/st up
If self ventilating/apply CPAP (5)
Intubate if necessary
PPV and PEEP if intubated
Consider drug therapy: morphine/GTN/frusemide (6)
The sub-algorithm forms a facing page of the Crisis Management Manual*.

* Numbers in brackets refer to Notes in the right hand panel.

FURTHER CARE
Consider and investigate likely cause
Review perioperative fluid balance/renal function
Non-cardiogenic; consider post airway obstruction
Allergy/anaphylaxis → page 48*
Aspiration → page 16*
Septic → page 64*
Multiple organ failure, eg major trauma, pancreatitis
Renal → renal function tests
Cardiogenic:
ECG
Cardiac enzymes
Echocardiogram
Chest X-ray
Consider admission to high dependency area/ICU

The COVER ABCD—A SWIFT CHECK algorithm was successful in the management of the initial physiological upset, however it was considered that the use of this specific sub-algorithm would be required once the initial diagnosis of pulmonary oedema was made.

(1) Hypoxia – 46%; pink frothy sputum – 23%; increased airway pressures – 14%, respiratory distress – 14%, crepitations or wheeze – 9%.
(2) Fluid overload was judged to be the cause in 46% of incidents. 81% of these had pre-existing conditions making them more susceptible to overhydration: age >70, cardiovascular disease or hypertension, renal failure and chronic airway limitation.
(3) 23% of incidents were judged to be post upper airway obstruction.
(4) 14% were judged to be cardiogenic in origin, eg. valvular heart disease, ischaemia/infarction, cardiac failure, arrhythmia.
(5) CPAP is important specific therapy for pulmonary oedema (in addition to treatment for hypoxia).
(6) Preload reduction:
   Morphine 1 mg IV doses
   GTN infusion 50µg in 300ml
   Commence at 0.1 ml/kg/hr
   Fluid reduction:
   Frusemide 0.5mg/kg IV if fluid overload (place urinary catheter)
   If hypotensive:
   Adrenaline infusion: start with 0.00015 mcg/kg/min
   Adrenaline: for easy adult dosing, see page 71*
   Titrates against heart rate and blood pressure

These notes comprise a reverse side of a page of the Crisis Management Manual**.

* Page numbers refer to the Crisis Management Manual*.
BRADYCARDIA

EMERGENCY MANAGEMENT

Complete ABC/DEA SWIFT CHECK
Do not hesitate to treat as Cardiac Arrest → page 38* (1)**
Ensure adequacy of oxygenation and ventilation (2)

If hypotensive (3)
Inform and interrogate the surgeon
Turn off vaporiser
Crystalloid 10 ml/kg bolus and repeat if necessary
Atropine 0.01 mg/kg (that is 0.6 mg for an adult)
Consider adrenaline 0.001 mg/kg IV bolus (1ml of 1:10,000)
Followed if necessary by an infusion of adrenaline starting at 0.00015 mg/kg/min (1ml/min of 1mg in 100ml)
Increase monitoring – ECG, arterial line, CVP
Consider external pacemaker (transvenous or transcutaneous)

REVIEW AND TREAT PROBABLE CAUSES: (4)

Drugs (5)
Inhalational agent overdose. Consider also suxamethonium, induction agents, neostigmine, and opioids. Check drugs given by
surgery.
Airway (7)
Hypoventilation → page 20*
Hypoxia → page 26*
Vagal Reflexes (6)
Cessae stimulation
Regional Anaesthetic (7)
Consider: Vasodilatation, bradycardia, respiratory failure.
Ensure: Volume loading, vasopressors (early adrenaline), airway
support, left lateral displacement during pregnancy.
Surgical Factors (8)
Consider: IVC compression, pneumoperitoneum, retractors position.
Ensure: Surgeon aware.
Undetected Blood Loss (9)
Improve IV access, fluid replacement, cross match.
Cardiac Event (4)
Consider: Tension pneumothorax, haemothorax, tamponade,
embolism (gas, amionic or thrombus), sepsis, myocardial depression
(from drugs, ischaemia, electrolytes, trauma).
Ensure: Review of appropriate sub-algorithms.

The sub-algorithm forms a facing page of the

* Page references refer to the Crisis Management Manual!3.
** Numbers in brackets refer to Notes in the right hand panel.

FURTHER CARE

If the situation warrants:
Continue the adrenaline infusion, nitrate against heart rate and blood
pressure.
Consider transvenous or transcutaneous pacing
Consider an urgent cardiology consult

NOTES:
It was judged that correct use of the algorithm would have led to earlier
recognition of the problem and/or better care in 4% of 295 relevant
incidents reported to ANMs.
(1) 25% presumed as cardiac arrest.
(2) Airway problems were a factor in 19% of cases.
(3) 31% of cases were associated with hypotension.
(4) See left hand panel for the most common causes. Other important causes
include myocardial events (particularly inferior ischaemia/infarction),
anaesthesia, pneumothorax and air/other emboli. At least one of these
factors was responsible in 5% of cases. Multiple causes occurred in 22% of
cases.
(5) Drugs were a factor in 40% of cases. Those most commonly implicated
were inhalational agents (50%), opioids (33%), intravenous anaesthetics
(14%) and suxamethonium (9%). Other drugs included muscle relaxants,
anticholinesterases, mepivacaine and phentolamine.
(6) Vagal reflexes were a factor in 14% of cases, usually following a surgical
stimulus. The stimulus should be ceased and the problem usually resolves.
(7) Regional anaesthesia was a factor in 9% of cases.
(8) Surgical factors were present in 4% of cases.
(9) In addition to intraoperative losses, preoperative blood loss and occult
losses (i.e. into the chest cavity) were also reported. Hypovolaemia was a
factor in 3% of cases.

These notes comprise a reverse side of a page of the
TACHYCARDIA

EMERGENCY MANAGEMENT
Complete COVER ABCD-A SWIFT CHECK
Do not hesitate to treat as Cardiac Arrest → page 38* [1]**
If hypertensive → page 34* [2]
If hypotensive (3)
- Confirm change in blood pressure is real (4)
- Recheck that vasopressor(s) are off
- Crystallloid 10 ml/kg bolus and repeat if necessary.

DIAGNOSE RHYTHM
If sinus tachycardia → page 32* [5]
If not sinus tachycardia choose treatment based on severity of hypotension (6)
If severe, use synchronised cardioversion
Start at 100J, if unsuccessful, 200J
Consider antiarrhythmic drugs (see below)
If mild, use appropriate antiarrhythmic drugs
VT: Lidocaine 1 mg/kg IV (or amiodarone 5 mg/kg) (7)
AF: Digoxin 0.05 mg/kg IV (or amiodarone 5 mg/kg) (8)
SVT: Adenosine 6-12 mg IV (or intravenous beta blocker: atenolol 1 mg boluses) (9)

REVIEW AND TREAT PROBABLE CAUSES
Hypovolaemia (10)
Consider: Blood loss, dehydration, diuresis, sepsis
Ensure: Adequate IV access, fluid replacement, cross match and check haematocrit.

Drugs (11)
Consider: Induction and inhalation agents, atropine, local anaesthetic toxicity, adrenaline, cocaine, vasopressors.
Airway: (12)
Hyperventilation → page 20*
Hypoxia → page 26*
Anaphylaxis (13) → page 48*

Reflex stimulation (14)
Consider: Laryngoscopy, CVC insertion, surgical manipulation.
Ensure: Adequate anaesthesia.
Cardiopulmonary Problems (15)
Consider: Tension pneumothorax, haemothorax, tamponade, embolism (gas, amniotic or thrombus), sepsis, myocardial irritability (from drugs, ischaemia, electrolytes, trauma), pulmonary oedema.

** Numbers in brackets refer to Notes in the right hand panel.

FURTHER CARE
Monitor for myocardial ischaemia
Consider further drug therapy

NOTES:
It was judged that correct use of the algorithm would have led to earlier recognition of the problem and/or better management in 3% of 123 relevant incidents reported in AIMS.
(1) 17% presented as cardiac arrest.
(2) There was associated hypertension in 26% of cases.
(3) There was associated hypotension in 33% of cases.
(4) Use sphygmomanometer and auscultate the blood pressure. When using an arterial line check the zero and calibrate.
(5) With sinus tachycardia, treatment is that of the primary cause. In the vast majority of cases this alone will result in resolution. If it is persistent and associated with hypotension, refer to hypotension [page 32]*.
(6) Non sinus tachycardia was present in 46% of cases including ventricular tachycardia in 13%, paroxysmal supraventricular tachycardia in 9%, atrial fibrillation in 8% and atrial flutter in 1%.
(7) Ventricular tachycardia:
100-200/min slightly irregular, broad complexes
IV lidocaine 1 mg/kg (or amiodarone 5 mg/kg)
Also, see palpitations VT (page 11)*.
(8) Atrial fibrillation/flutter:
100-200/min, irregular narrow complexes, no P waves
(lidocaine 250-500mg/min, ventricular rate 100 or 150),
IV digoxin 0.01 mg/kg (or amiodarone 5 mg/kg).
(9) Paroxysmal supraventricular tachycardia 150-250/min, regular narrow complexes, obscured P waves, IV adenosine 6-12 mg (or atenolol 1mg IV bolus).
(10) Hypovolaemia was associated with 3% of cases, however it is the commonest cause of tachycardia and hypotension. It is so common it is not usually regarded as an incident.
(11) Drugs were associated in 33% of cases. The most commonly implicated were induction and volatile agents, atropine, local anaesthetic toxicity, adrenaline, cocaine and vasopressors.
(12) Airway problems were often one of multiple contributing factors but were specifically reported in 4% of cases: hypovolaemia/hypotension occurred in the setting of difficult intubation and circuit problems, and caused secondary light anaesthesia in some instances.
(13) Allergy/anaphylaxis was a factor in 11% of cases.
(14) Autonomic reflex stimulation was reported in 9% of cases.
(15) Cardiopulmonary problems as causes were reported in 8% of cases.

These notes comprise a reverse side of a page of the Crisis Management Manual 14.

Crisis Management in the Operation Theatre – 12 Dec 2009

15
HYPOTENSION

EMERGENCY MANAGEMENT
Complete aECPR–A SWIFT CHECK (1)*
Confirm the blood pressure change is real (2)
Don’t hesitate to treat as Cardiac Arrest → page 38**
Inform and interrogate the surgeon
Redcheck vaporisers are off (3)
Improve posture: lie flat, elevate legs, if possible
IV fluids: crystalloid bolus – 10 ml/kg, and repeat as necessary
Give vasopressor: metaraminol 0.005–0.01 mg/kg IV bolus (4)
If severe give adrenaline 0.001 mg/kg IV bolus, then 1 ml of 1:10,000
Followed if necessary by an infusion of adrenaline starting at
0.00015 mg/kg/min (1 ml/min of 1 mg in 100 ml)
If erythema, rash or wheeze is evident go to anaphylaxis page 48**
If bradycardic give atropine and go to page 28**
If pulseless go to cardiac arrest page 38**
If desaturated or cyanosed go to hypoxia page 26**
Increase monitoring – ECG, arterial line, CVP

REVIEW AND TREAT PROBABLE CAUSES (5)
Hypovolaemia (6)
Consider: Blood loss, dehydration, diuresis, sepsis.
Ensure: Adequate IV access, fluid replacement, cross match
Drugs (3)
Consider: Induction and inhalational agents, opioids, suxamethonium, anti-cholinestereases, local anaesthetic toxicity, vancomycin, protamine, vasopressor/vasoconstrictor infusion problems, drug ampoule or syringe error and drugs given by surgeon.
Ensure: Agent ceased, support circulation
Regional Anaesthesia (7)
Consider: Vasodilation, bradycardia, respiratory failure.
Ensure: Volume loading, vasopressors (early adrenaline), airway support, left lateral displacement during pregnancy.
Surgical Events (8)
Consider: Vagal reflexes, obstructed venous return, pneumoperitoneum, retractors and position.
Ensure: Surgeon aware.
Cardiopulmonary Problems (9)
Consider: Tension pneumothorax, haemothorax, tamponade, embolism (gas, amniotic or thrombus), sepsis, myocardial depression (from drugs, ischaemia, electrolytes, trauma).

The sub-algorithm forms a facing page of the Crisis Management Manual17.
* Numbers in brackets refer to Notes in the right hand panel.
** Page references refer to the Crisis Management Manual17.

FURTHER CARE
Review and treat probable cause(s)
See precipitating factors, and (3) to (9)
Consider further fluid/diuretic therapy
Consider invasive haemodynamic monitoring
Arterial pressures
Filling pressures

NOTES:
It was judged that correct use of the algorithm would have led to earlier recognition of the problem and/or better management in 6% of 438 relevant incidents reported to AIMs.

1. COVER ARCD accounted fully for 12% of hypotension incidents.
2. Use a sphygmomanometer and auscultate the blood pressure.
3. When using an arterial line, check the zero and calibration.
4. Drugs were a factor in 26% of causes (inhaled and intravenous anaesthetic agents 7% each, opioids 5%, suxamethonium 2%). Other drugs implicated included vasodilators, isotropes (pump malfunction), IV local anaesthetics, vancomycin, protamine and desflurane. Vapourizer problems made up 32% of inhalational agent induced hypotension. 2% of all drug related hypotension was related to syringe or ampoule errors.
5. Options include IV boluses of adrenaline 0.05 mg/kg (especially with pregnancy).
6. Hypovolaemia was a factor in 2% of cases, but is often unreported. It is such a common cause of hypotension that it is not usually reported as an incident.
7. Regional anaesthesia was a factor in 14% of cases.
8. Surgical events were a factor in at least 5% of cases. Ralflex stimulation was induced by anaesthetic procedures (laryngoscopy, CVC placement) as well as surgical manipulations (vessicular traction, eye surgery).
9. Cardiopulmonary problems were a factor in 6% of cases.

These notes comprise a reverse side of a page of the Crisis Management Manual17.
HYPERTENSION

PRECEITATING FACTORS (1)*

Give particular consideration to:
- Drug errors (1)
- Awareness or light anaesthesia (2)
- Pre-existing hypertension (3)
- Airway problems (4)
- Surgical factors (5)
- Hypocalcaemia (6)
- Unusual/uncommon conditions
- Phaeochromocytoma
- Hyperthyroidism
- Malignant hyperthermia
- Raised intracranial pressure
- Fluid overload

EMERGENCY MANAGEMENT

Complete COVER ABCD — A SWIFT CHECK (7)
- Confirm the blood pressure change is real (8)
- Deepen anaesthesia/assess depth
- Specifically consider vasopressors, stop them (9)
- Inform and interrogate the surgeon; cause stimulation
- Recheck for drug errors and delivery of anaesthesia
- Consider an appropriate dose of opioid (10)
- Consider antihypertensive therapy:

BE CAUTIOUS USING HYPOTENSIVE AGENTS IF THE POSSIBILITY OF LIGHT ANAESTHESIA EXISTS

Consider GTN 50 mg in 500 ml 3% dextrose and start at 0.1 ml/kg/hr
(adult dose 5–10 mg/hr)

If tachycardia is troublesome:
- Give atenolol 0.015 mg/kg by IV bolus injections (11)
- Titrate drugs against effect


* Numbers in brackets refer to Notes in the right hand panel.

FURTHER CARE

Review and treat probable cause(s)
See precipitating factors and (1) to (9) below
Resolution will usually follow
Consider invasive blood pressure monitoring

NOTES:

It was judged that correct use of COVER ABCD followed by the hypotension sub-algorithm would have identified the specific cause in 79% of 72 relevant incidents reported to ANMS. In 21% no obvious cause was apparent, but was assumed to be a combination of light anaesthesia and/or excessive surgical stimulation and in all cases was effectively treated by rapidly deepening anaesthetic depth.

(1) Drug errors, secondary to drugs being given — 40%, or following drugs unintentionally not being given — 14%.
(2) Presumed light anaesthesia — 21% of reports. Due to inter-individual variation, failure to deliver agents: vapouriser, nitrous oxide, syringe driver failure.
(3) Preoperative hypertension — 61% of the 252 reports received by ANMS.
(4) Causes included hyperventilation, hypercapnia and hypotension.
(5) Surgical stimulus, water intubation, cardiac outflow.
(6) Hypercapnia in 11%. Due to hypoventilation, snares line exhaustion, sticking valve in circuit system, inadequate fresh gas flows in non rebreathing circuits.
(7) Use of the COVER ABCD — A SWIFT CHECK algorithm identified 73% of incidents reported to ANMS.
(8) Use a sphygmomanometer and auscultate the blood pressure.
- When using an arterial line, check the zero and calibration. In 4% of cases the hypertension was serious.
(9) Intra-arterial vasopressor administration was the commonest reported cause — 40%.
(10) After reviewing the drugs administered to date, give opioids if judged appropriate, i.e. fentany 0.25–0.5 mg/kg, alfentanil, titrated to effect.
(11) Esmolol, a b blocker with a rapid onset and short duration of action, in a dose of 0.25–0.5 mg/kg may be a better choice if available.

These notes comprise a reverse side of a page of the Crisis Management Manual 10.
## MYOCARDIAL ISCHAEMIA

**SIGNS** *(1)*
- ST changes – elevation or depression
- T wave flattening or inversion
- Ventricular dysrhythmias

**PRECIPITATING FACTORS**
- Pre-existing cardiovascular disease
- Haemodynamic instability
- Tachy- or bradycardia
- Hypoxia or hypertension
- Pulmonary oedema
- Awareness/light anaesthesia/intubation *(2)*

### EMERGENCY MANAGEMENT

Inform the surgeon
Defer, or rapidly complete, surgery
Ensure adequate oxygenation
Correct any haemodynamic derangement *(3)*
  - If hypotenive → page 37**
  - If hypertensive → page 34**
  - If tachycardic → page 30**
  - If bradycardic → page 28**

If ischaemia does not resolve rapidly *(4)*
- Commence glyceryl trinitrate (50 mg in 500ml 5% dextrose) and start at 0.1 ml/kg/hr.
- Titrate against clinical response
- Consider multilead ECG monitoring *(5)*
- Monitor ECG continuously
  - Aim for heart rate = 30%
- If the myocardial ischaemia is significant, consider short-acting β-blocker to cover emergence.


* Numbers in brackets refer to Notes in the right hand panel.

### FURTHER MANAGEMENT

- Obtain a 12 lead unfiltered ECG as soon as possible to assist in the diagnosis.
- Admit to HDU/ICU/CCU
- Consider invasive monitoring:
  - Blood pressure
  - Cardiac filling pressures
- Further investigation: arterial ECG/cardiac enzymes
- Continue oxygen therapy for at least 2 days.

### NOTES:

It was judged that correct use of the algorithm would have led to appropriate management in 90% of cases, and would have led to earlier recognition of the problem and/or better management in 47% of the reported cases. The remaining 10% would have required the use of sub-algorithms (eg. air embolism).

1 In all cases, ECG changes were reported as the means of detection. The diagnosis should be confirmed where possible by comparing monitor changes to a pre-operative trace.

2 In 73% of cases there were associated cardiopulmonary abnormalities:
   - 43% – hypotension;
   - 25% – tachycardia/hypertension;
   - 5% – desaturation.

3 15% of cases were judged secondary to light anaesthesia and 50% of these occurred with intubation.

4 Resolution of ischaemia followed correction of cardiopulmonary abnormalities alone in 35% of cases.

5 It is well recognised that Standard 3 lead monitoring for ischaemia is very insensitive. Use the CMS configuration to maximise the detection of ischaemia if multilead monitoring is not in use.

These notes comprise a reverse side of a page of the Crisis Management Manual**6.
Crisis Management in the Operation Theatre – 12 Dec 2009

CARDBAC ARREST
See page 11 for Basic Life Support*

PRECIPITATING FACTORS
Pre-existing disease states (1)**
Cardiac
Respiratory
Renal
Consequent upon surgical manoeuvres (2)
Error or fault in anaesthetic technique
Inadequate ventilation
Essential monitoring not in use (3)
Drug problems (4)
Oversed
Induction/reversal drugs
Anaphylaxis → page 48*
Opioid overdosage

EMERGENCY MANAGEMENT
Complete Cover ARCD-A SWIFT CHECK
Inform the surgeon
Stop surgery/blood loss
Place patient supine and expose the chest
Percutaneous thump/external cardiac compression†
Intubate and ventilate with 100% oxygen
ECG, for rhythm clues (5)
Delegate tasks as on page 8*
Basic life support as on page 11*

FURTHER CARE
Confirm and correct the cause
Ensure correct adrenaline dosage (6)
If anaphylaxis → page 48*
If sepsisemia → page 64*
Correct/prevent hypothermia
Arrange admission to ICU
Accurately document events as soon as possible

After the crisis, see page 70*

The sub-algorithm forms a facing page of the
Crisis Management Manual13.*
** Numbers in brackets refer to Notes in the right hand panel.
† In witnessed or monitored adult arrests only.

NOTES:
Of the 129 arrests reported to AEMS, there were 28 fatalities, of the 129:
30% occurred outside the operating room
11% occurred in the recovery ward
6% occurred in the induction room
Bradyarhythmia and asystole predominated.
(1) Pre-existing disease was judged to be the sole contributing factor in 23%,
and was one of several contributing factors in another 40%.
(2) 22% of arrests were directly associated with surgical manoeuvres:
 CO2 insufflation
ergodynamic stimulation
femoral puncture
(3) Essential monitoring: disconnected alarms, circuit oxygen analyser, pulse
oximetry, capnography, spirometry, circuit pressure.
(4) Arrests were closely associated with drug injection in 25% of cases;
Induction drugs: 10%
Anaphylaxis 8% → page 48
(5) Bradyarhythmia 23%:
Asystole 22%,
Tachycardia/VF/VT 14%.
(6) Adult 1mg IV bolus
Pediatric 0.01 mg/kg IV/Intravenous bolus OR
0.1 mg/kg via ET

These notes comprise a reverse side of a page of the
DRUGS/VASCULAR ACCESS

EMERGENCY CHECK
- Review all ampoules/syringes/bags/burettes/cassettes (1)*
- Review all drug labels
- Systematically review all vascular access equipment (5)
- Work from fluid source/cannula/skin interface (4)
- Check vehicles/dilutions/rates/routes are correct
- Correlate doses with effects

ALWAYS CONSIDER
- Wrong patient
- Wrong drug (6)
- Ampoule or syringe swap
- Known allergy
- Right drug (6)
- Wrong dose/rate (2)
- Wrong diluent/dilution
- Wrong time
- Wrong route/site

Failure of intended delivery
- Malpositioned cannula tip (4)
- Incomplete/inaccurate infusion pump
- Cannula disconnected/blocked/kinked
- Line disconnected/blocked/kinked
- Backflow (up to 100%)

Unexpected delivery (6)
- Drug flushed from dead space (7)
- Drip/pump delivering drug inadvertently (8)
- Flushing syringe containing drug
- Someone else giving a drug (3)
- Check for any recognized cannulae in situ (8)

BEWARE
- Any syringe containing relaxant
- Haematoma/extravasation
- Inadvertent intra-articular placement
- Pneumothorax, haemothorax, hydrothorax
- Nerve damage
- Dyssynchronies (cannula tip in heart)
- Cannula dead space


* Numbers in brackets refer to Notes in the right hand panel.
AWARENESS

SIGNS
There may be no obvious signs (1)*
Hypertension
Tachycardia
Reflex activity: Withdrawal/movement
Coughing/sneezing
Pupillary dilation
Swelling/tears

HIGH RISK SITUATIONS (2)
Patient factors: History of drug/alcohol abuse
Highly anxious patient
Previous awareness

Equipment problems (3)
Vaporiser leaking/empty/malpositioned
Incorrectly calibrated vaporiser
Nitrous oxide run out (4)
Failure of drug delivery with TIVA

Drug errors (4)
Syringe swap causing paralysis before induction
Syringe swap causing non-delivery of opioid/sedative
Anaesthetic technique
Deliberate light anaesthesia during crisis management or caesarean section

Opioid based anaesthesia
Regional/local anaesthetic techniques

Anaesthesia with paralysis (5)
Other problems
Laryngospasm/airway obstruction
Difficult/prolonged intubation (6)
Delayed extubation

EMERGENCY MANAGEMENT
Stop painful stimuli
Verbally reassure the patient
Rapidly deepen anaesthesia

Consider amnestic drugs: eg. benzodiazepine
Plan follow up:
In the recovery ward and the next day (7)
As necessary, before discharge


* Numbers in brackets refer to Notes in the right hand panel

FURTHER CARE
Interview the patient post operatively as soon as possible, and several days later (7)
Reassure the patient
Explain what has happened
Be honest and sympathetic
Arrange for follow up
Go through “After the crisis” → page 70*

NOTES:
21 cases of awareness under general anaesthesia were reported to AIMSS. In 43% the conduct of the anaesthetic appeared unremarkable, and was only discovered postoperatively by an unaltered patient complaint. The COOPERATE-ABCD algorithm would have detected almost all cases of awareness where it was actually suspected but would be ineffective in patients who were aware but lacked physical signs to indicate its presence.

(1) There may be no signs to indicate awareness. In 43% of 21 cases of awareness under general anaesthesia, there were no remarkable changes to alert suspicion.

(2) Commonest causes under general anaesthesia included:
- low concentration of volatile agent 38%
- failure to check equipment 19%
- justifiable risk taking 10%

(3) The most frequently identified cause of awareness under general anaesthetic was a low concentration of volatile agent. The commonest preventable cause was secondary to a failure to check equipment, specifically the vaporizer. There were 2 reports related to total intravenous anaesthesia, caused by failure to deliver the drug to the patient. Failure to deliver nitrous oxide was also reported.

(4) There was another group of 20 incidents involving accidental paralysis whilst awake. The majority involved syringe swaps immediately prior to induction, particularly suxamethonium for caesareans.

(5) If full paralysis is avoided except where absolutely necessary there is a greater chance that a patient will be able to indicate that they are aware.

(6) There were 2 reports of awareness during difficult intubations.

(7) Awareness may not manifest for several days after the incident.

These notes comprise a reverse side of a page of the Crisis Management Manual®.
* Page references refer to the Crisis Management Manual®.
AIR (AND OTHER) EMBOLISM

**SIGNS** (1)*
- A sudden fall in ET CO2
- Desaturation and/or central cyanosis
- Air in surgical field or vascular line
- Hypotension
- A sudden change in spontaneous breathing pattern
- A change in the heart rate
- A change in the ECG configuration
- Raised CVP or distended neck veins
- A cardiac murmur or mottled skin

**EMERGENCY MANAGEMENT**
- Inform the surgeon (3)
- Prevent further entrainment/infusion of gas (3)
- Flood the field with fluid
- Aspirate central venous line if already in situ
- 100% oxygen and hand ventilate
- Consider vasodilator or PEEP
- Level the patient

Do not hesitate to treat as a cardiac arrest --- page 38**

Turn the vaporiser off
If hypotensive:
- Volume expansion with crystalloid 10 ml/kg
- Consider adrenaline; give 0.001 mg/kg IV bolus (adult dose 1 ml of 1:10,000) followed if necessary by an adrenaline infusion starting at 0.00015 mg/kg/min (1 ml/min of 1 mg in 100 ml = 10 µg/min) (4).

* Numbers in brackets refer to Notes in the right hand panel.

**FURTHER CARE**
- Careful postoperative review of the patient to:
  - Confirm nature/source of embolism (3)
  - Stabilise long bone fractures
  - Consider admission to ICU
- If there is confirmed cerebral gas embolism
  - Give IV lignocaine at 0.06 mg/kg/min
  - Early hyperbaric oxygen therapy

**NOTES:**
- It was judged that correct use of the algorithm would have led to earlier recognition of the problem and/or better management in 41% of the 38 relevant incidents reported to AIM5.

(1) The following changes were documented in the AIM5 reports: A fall in ET CO2, 68%, desaturation – 80%, hypotension – 56%, a change in heart rate – 24%, a change in ECG configuration – 27%.

(2) In the AIM5 reports, in 22% the source of embolus was via intravascular lines. The remainder were from the surgical field, most commonly: intracranial, hepatobiliary and maxillofacial.

(3) Sources of embolism include:
  - (a) Entrainment of air, from venous sinuses or large veins, high risk procedures include those where the operative site is above the level of the right atrium. Procedures most commonly implicated included neurosurgical and maxillofacial. Others: spinal, intrathoracic, and hepatic.
  - (b) Infusion of air or carbon dioxide, from "unarmed" vascular lines such as warming coils or infusion devices, insufflation of body cavities, "pressures" operator dissection devices and re-use of pan amary blood bags.

  (a) Thromboembolic embolism, most commonly from pelvic veins.
  (b) For embolism; occurring after any trauma, or long bone surgery.

  (4) In some reported cases, norepinephrine has been effective (P. Mackey, personal communication).

These notes comprise a reverse side of a page of the Crisis Management Manual15.
PNEUMOTHORAX

SIGNS [1]*
Difficult breathing
Respiratory distress
Desaturation
Confluent lung fields
Heart rate changes
Unilateral chest expansion
Rebreather
Oxygen
Hypertension
Frequent chest wall movement
Competent trachea
Pericardial effusion
Abdominal distension
Dilated neck veins, raised CVP
Tracheal deviation

PRECIPITATING FACTORS [3]
Any needle or instrument, even days previously [4]
In or near the neck or chest wall
Down the trachea/bronchial tree
External cardiac massage
Fracture ribs, crush injury
Blunt trauma
Airway blockage
Distended neck veins
Emphysema or bullous lung disease

EMERGENCY MANAGEMENT
Inform the surgeon
Inspect the abdomen, the diaphragm from below if visible
Insert an IV cannula into the affected side (5)
Turn off the nitrous oxide
Insert a pleural drain at the same site (6)
Continuous observe the bottle for bubbling and/or swinging
Be vigilant for further deterioration in the patient, it may be due to:
Increased or continuing air leak
Risk of obstruction
Fistula
Distended neck veins

The sub-algorithm forms a facing page of the Crisis Management Manual[5].

* Numbers in brackets refer to Notes in the right hand panel.

FURTHER CARE
If the problem persists, consider cardiac tamponade.
Consider pericardiocentesis and/or opening the chest.
Arrange a chest X-ray and look for:
Blistering of the lung
Position of the tip of the drain. See (6) and (7) below.
Explain the nature of the problem to the patient before discharge from the recovery ward.

NOTES:
[1] The diagnosis is one of exclusion.
In 63% of HS incidents where it was considered, it was not the case. 51% of confirmed pneumothoraces occurred under general anesthesia; detection in this sub-group was aided by desaturation 41%, hypotension 47%.
Note: clinical observation is NOT reliable. See (2).
The commonest cause of unilateral decreased breath sounds is endobronchial intubation.
[2] A sign for tension pneumothorax described in the literature is the patient being remained apneic. This involves detection by palpation of widening of the intercostal spaces on the affected side. The diagnosis is complicated and requires immediate treatment.
Whilst under general anesthesia – 53%. Of the GA subgroup: Post CVC insertion – 41%. Associated with endotracheal tube or intubation procedures – 24%.
[5] Do not wait for confirmation by chest X-ray if the patient is rapidly deteriorating. Insert the cannula just cephalad to the third rib in the midclavicular or midaxillary line, and swiftly withdraw the needle as its tip may be a lung moving lung.
[6] Emergency management of severe trauma (EMS) recommends underwater seal drainage placement just anterior to the midaxillary line, as this avoids the intercostal venous entry which may be punctured using the mid-clavicular approach, and allows drainage of blood.
Always use blunt dissection to penetrate the parietal pleura. Use of finger to sweep away any structures near the opening and then insert the drain.
[7] It should be noted that chest X-ray may not detect a non-tension pneumothorax in a supine patient. Inspiratory AP and lateral views are preferable; a CT scan is the definitive test.

These notes comprise a reverse side of a page of the Crisis Management Manual[1].
ANAPHYLAXIS/ALLERGY

SIGNS
Cardiovascular changes (1)*
- Hypotension, circulatory collapse
Respiratory changes
- Bronchospasm (3)
Pulmonary oedema
Erythema/Skin Rash/Pruritus (4)
Gedema of the face and lips
Nausea and vomiting in awake patients (5)

PRECIPITATING FACTORS (6)
Allergic reaction to drugs, colloids, blood products, latex allergy

EMERGENCY MANAGEMENT
Complete ABCD–A SWIFT CHECK
Do not hesitate to treat as cardiac arrest — page 38**

Inform the surgeon
Request immediate assistance
Cease all drugs/plasma expanders/blood products
Immediate and aggressive volume expansion (7)
Maintain ventilation with 100% oxygen
Elevate the legs, if practical
Give adrenaline bolus 0.001 mg/kg (adult dose 1 ml of 1:10,000)
Start adrenaline infusion 0.00015 mg/kg/min (adult dose 1 ml/min
of 1 mg in 100 ml), and increase as necessary
Tiltate against heart rate and blood pressure

FURTHER CARE
The patient may relapse
Continue the adrenaline infusion, for days if necessary
Consider other drugs (9)
Admit to HDU/ICU
Take bloods for testing as soon as possible (10)
Consult the patient/relatives. See (9) page 15**
Arrange for allergy testing (skin) at 1 month

* Numbers in brackets refer to Notes in the right hand panel.
** Page references refer to Crisis Management Manual®.

NOTES:
The earliest signs of anaphylaxis are hypotension, bronchospasm and
integumentary signs. More than one sign manifested in 51% of cases. 65% of
patients were ASA grades 1–2. It was judged that correct use of the algorithm
would have led to earlier recognition of the problem and/or better management
in 30% of 192 relevant incidents reported to AIMS.

(1) Over half of all reactions were judged as severe, and 89% of these
involved circulatory decompensation.
There was hypotension in 68% of all cases.
(2) Heart rate changes were documented in 28% of reactions, being equally
split between tachycardia and bradycardia. Bradycardia invariably heralded
circulatory collapse.
(3) Bronchospasm was documented in 44% of cases.
(4) Erythema/pruritus/rash was documented in 48% of cases. Facial/airway
oedema was an uncommon sign.
(5) Nausea and vomiting occurred in 45% of awake patients.
(6) 35% of cases involved polydrug therapy at induction. Drugs or agents
commonly implicated were:
- Cephalosporins – 24%
- Hormacett – 9%
- Non-depolarising relaxants – 8%
- Pancuronium – 5%
- Thiopentone – 5%
- Blood products – 2%
- Other drugs implicated include: suxamethonium, propofol, protamine,
- amide type local anaesthetics.
(7) Immediate crystalloid bolus of 10 ml/kg. Review and repeat as necessary.
Hormacett and blood products should be avoided.
(8) For easy adult dosing of adrenaline, see (4) on page 71*.
(9) Consider hydrocortisone IV 5 mg/kg.
(10) In the course of an allergic response to foreign antigens, immunoglobulins
are consumed and mast cell tryptase (and other acute phase reactants)
are released. Serial samples are required after the reaction immediately
after treatment, and at one and six hours after the reaction; post mortem
sampling is also possible. Blood samples, frozen at 4°C, should be
dispatched with a full description of the anaesthetic and the clinical events.

These notes comprise a reverse side of a page of the
VASCULAR ACCESS PROBLEMS
A Sub-Algorithm

Approach the diagnosis and management of these problems from a "geographical" perspective:

1. Infusion device/fluid
2. Fluid line/equipment
3. Line deadspace
4. Catheter/skin interface
5. Peripheral vascular tree
6. Central vascular space
7. Staff and environment

EMERGENCY CHECK
Review all ampoules/syringes/bags/burettes/diluents/cassettes
Review all drug labels
Systematically review all vascular access equipment
Work from fluid source via the cannula/skin interface to the tip
Check vehicles/dilutions/rates/routes are correct
Correlate doses with effects
If you have any doubts about the contents of a syringe or infusion discard until prepare a new solution.

ALWAYS CONSIDER
Wrong patient
Wrong drug (3)*
  Ampoule or syringe swap
Known allergy
Right drug (3)
  Wrong dose/rate
  Wrong diluent/dilution
Wrong time
Wrong route/site
Failure of intended delivery
  Malpositioned cannula tip (1)
  Bag/syringe/burette empty
  Cannula disconnected/blocked/kinked (2)
  Line disconnected/blocked/kinked
  Back flow (up a "Y" piece*)
Unintended delivery (3)
  Drug flushed from dead space of IV line or cannula (4)
  Drip/pump delivering drug inadvertently (5)
  "Flushing" syringe containing drug
  Someone else giving the drug
Check for any unrecognised cannulae in situ (5)

BEWARE
Any syringe containing relaxant
Haematoma
Inadvertent intra-arterial placement
Pneumothorax/hemothorax/hydrothorax
Nerve damage
Dysrhythmias (cannula tip in heart)
Cannula dead space

This comprises a page of the Crisis Management Manual5.
* Numbers in brackets refer to Notes below.

NOTES:
(1) 51% of the 12% cases involved a fault at the catheter/skin interface. In 15% of these the cannula was inserted by someone other than the anaesthetist. 98% involved central venous lines.
(2) Incorrect manufacture or assembly of arterial/central/epidural lines – 8%
Disconnection resulting in unrecognised blood loss – 6%
(3) Errors included:
  Connection of wrong infusion pump/fluid – 3%
  Over/underdose fluid/drugs – 5%
  Drug precipitation in the line dead space – 2%
  Anaphylaxis to infusions – 2%
(4) Succinylcholine remaining in the dead space caused late paralysis upon subsequent line flushing in 6 case reports.
(5) Unvisualised cannulae beneath drapes may be the source of disconnections, or be the route of an unknown delivery of drugs/liquids.

Corresponding notes to be shown on the reverse side of the page of the Crisis Management Manual5.
ACUTE TRAUMA SUB-ALGORITHM
Early Management of Severe Trauma (EMS) protocol

As many incidents in trauma patients involve 'catastrophic' such as failure to check due to perceived urgency, it is essential to recheck everything carefully. The best way to do this is to start again with COVER ABCD. If not successful consider possible missed diagnosis - follow EMS system - repeat primary survey, review results to date, and look for missed injuries.

A. Airway Injury
   look for failure to secure airway/failure to ventilate with tube in airway
   manage failed intubation drill, consider surgical cricothyrotomy

B. Cervical Spine Injury
   look for pins, arrows, trauma above clavicles, history of neck pain or tenderness
   manage immobilise neck, review cervical spine X-ray, imaging if possible, further films as required

B. Tension Pneumothorax
   look for distended neck veins, decreased air entry on ipsilateral side, hyperresonance on ipsilateral side, mediastinal shift away
   manage immediate needle thoracotomy, formal USG, insertion

C. Unexplained Blood Loss/ Hypovolaemia
   look for sites of concealed bleeding, chest/abdomen/pelvis, sites of visible bleeding
   manage consider chest X-ray, consider pelvis X-ray, consider diagnostic peritoneal lavage, if severe urgent laparotomy, view operative site, examine known wounds

TRAUMA/BLEEDING

CONSIDER WITH
Any unexplained change in the patient's condition

HIGH RISK SITUATIONS
After high velocity motor vehicle accidents
With any head/neck/chest/abdominal injury, no matter how trivial the external signs
With multiple injuries
Patients with pre-existing systemic disease
Elderly patients

PREVENTING FACTORS (1)*
Breathing: Pneumothorax
Pulmonary contusion
Ruptured diaphragm
Circulation:
Ongoing haemorrhage (isent, occult)
Intracranial hypertension from any cause
Cardiac tamponade
Hypothermia

B. Immediate Airway
Airway injury

EMERGENCY MANAGEMENT (1)
Complete COVER: A SWIFT CHECK
Treat all cervical injuries as unstable unless cleared
Inform the surgeon about any concerns
If there is cardiovascular instability consider:
Haemorrhage: many blood volumes may disappear into a pelvis
into the retroperitoneal space
into the soft tissue damage
Myocardial contusion
Haemopneumothorax

Hypothermia
If you suspect an intra-abdominal problem:
Assess for focal signs
Inform a neurosurgeon
Immediately
Get a CT scan as soon as practicable
Check arterial line, measure filling pressures
Be prepared to completely expose and examine the patient,
Including top to toe, front and back
Check haemoglobin, electrolytes and clotting regularly.

IF THE SITUATION IS STILL UNRESOLVED, RECHECK FOR:
Airway injury
Cervical spine injury
Pulmonary contusion
Brochopneumothorax
Unexplained blood loss/hypovolaemia
Cardiac tamponade
Hypothermia after resuscitation
"1st Degree" intracranial collection
Hypothermia

FURTHER CARE
Maintain vigilance
Continuously reassess the situation
Consider admission to ICU/HCU post operatively.

NOTES:
The COVER - ABCD algorithm detected (82%), diagnosed (68%) and corrected (66%) a high proportion of relevant incident reported to AIMS.

(1) Commonest modes of presentation were, hypoxia/dehydration - 8%, aspiration - 8%, cardiac arrest - 8%, intra-abdominal - 6% and hypothermia - 3%.
(2) 96% of incidents were categorised as "cutting corner" in an effort to save time. Retrospectively, 75% of these incidents was wrong to be perceived rather than real. Failure to check the machine resulted in equipment related problems in 5% of cases.
(3) EMOT - Early Management of Severe Trauma protocol (Australia).
USAIUK equivalent is ALS - Acute Trauma Life Support protocol.

The sub-algorithm forms a set of pages of the Crisis Management Manual.12

* Numbers in brackets refer to notes in the right hand panel.
SEPSIS

SIGNS (1)*
- Confusion/tachypnoea
- Hypotension or tachycardia
- Unexplained desaturation or hypercapnia
- Spiking fever and rigors, or hypothermia
- Unexplained metabolic acidosis
- Oliguria
- Elevated creatinine
- Thrombocytopenia
- Evidence of disseminated intravascular coagulopathy
- Postoperative respiratory failure
- Failure to reverse

EMERGENCY MANAGEMENT (2)
- Complete COVER ABCD – A SWIFT CHECK
- Call for help
- 100% oxygen
- Bolus of crystalloid or colloid 10ml/kg IV
- Consider placing an arterial line
- Consider an adrenaline infusion
- Adrenaline: for easy adult doses, see (4) on page 71**
- Titrate to achieve a mean blood pressure >70mmHg

Further management (3)
- Consider placing a central venous line
- Aim for a CVP of >8mmHg
- Take samples for microscopy and culture of:
  - Blood, urine
  - Any other fluids (e.g. bile, pus, ascites, CSF)
- Record any prior antibiotics
- Give appropriate empirical antibiotics (seek advice if unsure)
- Check haematology, coagulation status, biochemistry, blood gases
- Place a urinary catheter


* Numbers in brackets refer to Notes in the right hand panel.
** Page references refer to Crisis Management Manual112.

FURTHER CARE
- Continue vigorous fluid resuscitation throughout
- Continue the adrenaline infusion
- If there is continuing instability → ICU

(1) Cardiorespiratory compromise presenting as desaturation – 77%, hypovolaemia – 46%, and hypotension – 30% were the commonest presentations.
- Postoperative respiratory failure was common – 62% of reported incidents: 31% requiring re-intubation.

(2) Sepsis was generally reported in high risk patients:
- 70% were ASA III or above
- Diabetics
- Intensive Care patients
- Immunocompromised patients
- Instrumental urological procedures
- Instrumental enteric and biliary procedures
- Orthopaedic infections

(3) Active infection/sepsis:
- Urological sepsis
- Gynaecological sepsis
- Biliary sepsis
- Pancreatitis
- Abscesses
- Cellulitis/fasciitis

WATER INTOXICATION

SIGNS
In the awake patient – CNS symptoms [1]*
- Drowsiness and confusion
- Nausea and vomiting
- Coma
- Cardiopulmonary
In the anaesthetised patient – CVS symptoms [2]
- Circulatory overload
- ECG changes
- Delayed emergence from anaesthesia

PREMPTING FACTORS
High risk procedures:
- closed cavity irrigation/prolonged operating time
- Anaesthesia:
  - administering large volumes of hypotonic fluids.

EMERGENCY MANAGEMENT
Inform surgeon
Cease irrigation/surgery
Increase FiO₂, monitor blood gases
URGENT, Na⁺, K⁺, Osmolarity (blood)
If symptomatic:
  - 0.9% saline and frusemide 0.5-1.0 mg/kg IV
  - mannitol 0.25g/kg may be considered if not hypovolemic
If severe CNS depression/convulsions:
  - hypertonic saline (3)
  - anticonvulsants

FURTHER CARE
Continue ECG/SpO₂ monitoring
Attention to fluid balance
Monitor electrolytes, osmolarity, blood gases
Mild symptoms – fluid restriction may suffice
Consider central venous line or pulmonary artery catheter
Consider HDU/ICU admission

The sub-algorithm forms a facing page of the
Crisis Management Manual[17].

* Numbers in brackets refer to Notes in the right hand panel.

NOTES:
10 reports of water intoxication were made, 8 involving male urological procedures and 2 involving endometrial ablation. The COVER algorithm deals poorly with this uncommon event and requires a simple specific management algorithm.

It was judged that correct use of the algorithm would have led to earlier diagnosis of the problem and/or better management in 80% of the 10 relevant incidents reported to ANMS.

[1] CNS symptoms appear early but are not specific, therefore a high index of suspicion is required.

[2] Circulatory overload may manifest early as desaturation during general anaesthesia.

ECG changes – CMS position is useful as it enables ST segment analysis.

[3] Over-rapid correction, especially with hypertonic saline, has been implicated in causing neurological problems such as central pontine myelinolysis.

These notes comprise a reverse side of a page of the Crisis Management Manual[17].
EMERGENCY MANAGEMENT
Question the patient; reassure, and sedate if appropriate.
Inform the surgeon as to the nature of the problem.
Complete AB COVER CD® SWIFT CHECK.

If hypotensive → page 32* (1)**
If bradycardic → page 28* (1)**
Do not hesitate to treat as cardiac arrest → page 38* (1)**

Review and treat probable causes: (2)**.
Inadequate fluid loading, blood loss.
High block (aspirate CSF from epidural?)
Drug errors – Wrong drug, concentration or volume
– Wrong site
– Incorrect infusion rate.
Ensure: fluid, drug and infusion rates are correct.

For suspected local anaesthetic toxicity (3)**
Give phenylephrine 15 mg/kg over 30 minutes for CNS integrity.
Control seizures with 50–100 mg of thiopentone but beware of cardiovascular compromise.
For cardiovascular collapse, treat as cardiac arrest → page 38*.

Assess the block (2,4,5)**
If inadequate consider general anaesthesia, local infiltration or further local anaesthesia down the epidural catheter (2)(4)**.
If excessive, administer oxygen and assist ventilation if required (3)(5)**.

Consider needle/catheter problem (6)**
Wrong site – Inadvertent intravascular placement/injection.
– Inadvertent intrathecal placement/injection.
– Inadvertent intrapleural placement/injection.
Trauma
– Haematoma.
– Nerve damage.
– Pneumothorax.
– Pain.
Beware tourniquet failure with Bier's blocks.

FURTHER CARE
Confirm and correct cause
Review patient to determine delayed events (5)(6)
Counsel the patient, arrange follow up

NOTES:
There were 252 reports of incidents involving regional anaesthesia reported to ANS. Of these 78% were either epidural or spinal anaesthesia related.
(1) Hypotension and arrhythmia in epidural/spinal incidents accounted for 30% of all regional anaesthesia incidents, and the deaths in 2%. They involved a combination of high block and or hypovolaemia.
(2) Common precipitants included:
– Inadequate time for assessment
– Elderly patients with multiple medical problems
– Usual desages of local anaesthetics having a more profound effect in the elderly.
– Error in judgement of level of block and or blood loss.
(3) Local anaesthetic toxicity was reported in 30% of all cases with fitting in one third of these.
(4) Failed blocks – 5% of all regional anaesthesia incidents.
(5) Overdosage/spinal – 10% of all regional anaesthesia incidents.
Most common problem cited included:
– Dural puncture – 13% of all reports.
– Post dural puncture headache – 5% of dural punctures, with 75% of these requiring a blood patch.
– Miscellaneous problems of epidurals: abscess, haematoma, subarachnoid migration, and prolonged recovery.
(6) Trauma, infection or pain was reported in 6% of cases.

These notes comprise a reverse side of a page of the Crisis Management Manual10.
ACTION CARD
After the Crisis – The Post Mishap Protocol

1. Contact a mentor/senior colleague: to come and assist in the protocol.
2. The patient: should be informed as soon as possible if he or she has survived. The Coroner’s office is responsible for the body of a dead patient; the surviving patient usually needs intensive care and the anaesthetist must be seen to be there and to be a part of the team.
3. The relatives: Need to be informed promptly and accurately of what has occurred. THE SURGEON MUST NEVER CONDUCT THE INTERVIEW ALONE. This interview should be unhurried, run as a team effort, and may be divided into two parts – first the bad news, and then after a pause, the facts as known. Start with the need for the operation, what the plan was for the anaesthetic and build the basic medical history of the patient. If an opinion is to be offered, make it clear that it is an informed guess, not fact, the autopsy may prove you wrong. Ongoing support and communication channels of a surviving patient and their friends and relatives should be established.
4. The next patient deserves a fresh team and equipment. The unthinkable sequel to an unexpected death is that the next patient also dies because of an undetected equipment fault or overstressed personnel.
5. The equipment and drugs used, if implicated, must be isolated for examination.
6. The medical staff involved need a debriefing session to state what they think occurred, to ventilate their feelings and to learn from the mishap. Critical Incident Stress Debriefing (CISD) may be appropriate after two or three days.
7. The nursing and paramedical staff should attend an end of shift debriefing session to allow immediate reactions to be revealed, and a factual and concise “take away” statement to be given out in order that the hospital staff have information that is appropriate and accurate. The situation may also require a formal CISD. Special consideration should be given to any anaesthesia nurse involved.
8. Administrative details: Check the medical record for accuracy and completeness, prepare formal statements, hospital or departmental incident reports, ANS and TGA reports. The ICU record should be examined frequently. Never alter or destroy the record, but you may annotate with a separate timed, dated and signed postscript.
9. The anaesthetist, as well as the anaesthetist’s family, should be supported and assisted in the immediate post catastrophic period.
10. The courts: Copy, review and understand all relevant records. Notify medical defence and hospital administration. Prepare a personal statement of events for medical defence even if no court action follows.

After the Crisis – Notes

IF THE PATIENT SURVIVES
Talk to the patient at the earliest opportunity
Explain what has happened
Keep it simple and stick to the facts
Avoid guesswork
Do not admit liability but do say sorry
For incidents with risk of psychiatric trauma/awareness/disability/pain, involve psychiatrist/psychologist.
If it was a minor mishap (e.g. superficial care or dental damage)
Arrange for the problem to be corrected as soon as possible at no expense to the patient.

IF THE PATIENT DIES
Contact a senior colleague who will:
- Advise you to stop working that day/night
- Help you with the tasks ahead
- Liaise with medical/hospital administration
- Arrange cover of your duties
Make a factual account as soon as possible referring to the medical record
Do not alter or erase any part of the anesthetic record
You may annotate the medical record with a separately timed, dated and signed postscript
Leave tubes, cannulae, drains, lines etc. in situ.
If there is any doubt at all about what happened, isolate the theatre/equipment/drugs for future examination by an appropriate person who can document the checks performed
Contact the family personally as soon as possible
Arrange an interview in a suitable room
DO NOT let others (e.g. surgeon) conduct the interview alone
Give the bad news first; show empathy and say sorry
Explain the facts as known at the time
Do not offer opinions lightly
Make yourself available to the family (e.g. contact number)
Debrief the staff involved
Seek a good friend/family member for support
Contact the relevant Medical Defence Organization
Contact the Head of Department

These notes comprise a page of the Crisis Management Manual.
Reference


Further Reading


Other topics to study

Neonatal resuscitation
Management of desaturation during one lung ventilation
Others