Anaesthetic Emergencies

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• Declaration:
  • No Conflicts of Interest
  • No animals hurt in the formulation of this presentation
• Some surgical disciplines may be inadvertently ridiculed
Anaesthetic Emergencies

• Avoiding Emergencies
• “The best way to handle emergencies is to avoid them”
• “If you can’t avoid the emergency be prepared for them”
Anaesthetic Emergencies

• Resources:
  – Standard text books
    • Oxford Handbook of Clinical Anaesthesia
  – On-line resources
    • Wikipedia.org
    • Google
    • http://www.resus.org.au/
    • Australian Patient safety foundation
      – On line Crisis Management manual
    • Clinical Information Access Portal (CIAP)
  – Courses:
    • EMAC/Simulation/EMST
  – Colleagues
Anaesthetic Emergencies

• Avoiding Crises
  – Anaesthesia for dummies is simple – keep patient asleep, air goes in, air comes out, blood goes round and round.
  – But what happens when this doesn’t occur
Anaesthetic Emergencies

• As with all things, in a crisis we need to think of A,B,C.

• Airway assessment
  – The MOUTHS acronym
Anaesthetic Emergencies

• “M” is for mandible:
  – The thyomental distance is important because this is actually the space you will depress the tongue into during laryngoscopy.

• “O” is for opening:
  – Bigger the better, 4cm or 2-3 fingers good.
  – Julia Roberts – fantastic.
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• “U” is for uvula and this really correlates to the Mallampati score, and is a guide to how much room there is in the oropharax to insert instruments.

Class 1: Full visibility of tonsils, uvula and soft palate
Class 2: Visibility of hard and soft palate, upper portion of tonsils and uvula
Class 3: Soft and hard palate and base of the uvula are visible
Class 4: Only Hard Palate visible
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• “T” is for Teeth
  – No teeth is good for intubation but bad for bag and mask.
  – Buck teeth with expensive implants, crowns and bridge work are terrifying
Anaesthetic Emergencies

• “H” is for head
  – Is the neck able to be flexed and extended.

• “S” is for special situations which should promote caution
  – Syndromes
  – Beards
  – Bull Necks
Anaesthetic Emergencies

• “S” is for special situations which should promote caution
  – Morbid Obesity
  – Pregnancy
    • Not fasted
    • Decrease FRC
    • Increased O$_2$ requirement
    • Oedema
Anaesthetic Emergencies

- The Vibe
Anaesthetic Emergencies
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Anaesthetic Emergencies

• Having assessed the airway, these factors have limited sensitivity or specificity.

• The best indicator will always be a recent successful intubation by a similarly skilled and resourced colleague.
Anaesthetic Emergencies

- Failed Intubation:
  - “No-one has died from a failure to intubate, only a failure to oxygenate.”
- Need to think of three aspects:
  - 1) Patient – can I change position etc
  - 2) Equipment – what other equipment is available
  - 3) Personnel – is there a need for more hands, or is there a more experienced clinician near by.
Anaesthetic Emergencies
Anaesthetic Emergencies

• Is anaesthesia safe?
  – Recent triennial report on deaths related to anaesthesia notes that there has been a continued decrease in morbidity and mortality.
    • Attributed to better monitoring, training and safer agents
  – Risk of death said to be in the order of 1 in 53,000.
  – Most deaths were in poor risk candidates.
Anaesthetic Emergencies

• Managing emergencies:
• By their very nature, emergencies are unpredictable in their nature and their severity.
• Anaesthesia is said to be a contact sport, people will be battered and bruised,
• but with proper training and preparation injuries can be minimised.
Anaesthetic Emergencies

• Managing emergencies cont:
• Need to appropriately monitor and review patient during procedure: SCARE
• Think ABC, or if possible
• Think COVER ABCD A SWIFT CHECK
Anaesthetic Emergencies

- “S”: Scan
- “C”: Check
- “A/R”: Alert and Ready
- “E”: Emergency
Anaesthetic Emergencies

- “C”: Circulation, Colour Capnography
- “O”: Oxygen Supply, Oxygen Analyser
- “V”: Ventilation, Vaporisers
- “E”: Eliminate Machine, Endotracheal Tube
- “R”: Review Monitors, Review Equipment
Anaesthetic Emergencies

- “A” Airway
- “B” Breathing
- “C” Circulation
- “D” Drugs
- “A” Awareness, Air embolism, air in pleura, anaphylaxis
- “Swift Check” of patient, surgeon and surrounds
## Anaesthetic Emergencies

### SCAN

<table>
<thead>
<tr>
<th>C</th>
<th>Circulation</th>
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<tr>
<td>Note the rate, rhythm and volume of the pulse and note the end tidal carbon dioxide concentration (ETCO2).</td>
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<td>Note</td>
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<table>
<thead>
<tr>
<th>O</th>
<th>Oxygen Supply</th>
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<tr>
<td>Note the rotameter settings and that the bobbins are spinning and calculate the inspired oxygen fraction (FI02).</td>
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<td>Note</td>
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</table>

### Check

| Palpate a pulse. Correlate rate, rhythm and volume with the oximeter and ECG. Check capillary refill and ETCO2 trace. |
| Note |

| If suspicious try the pulse oximeter on yourself. Take arterial blood for a lab check on saturation or blood gases. |

| Briefly increase the oxygen flow rate and calculate the new expected FI02 in the breathing circuit. |

| Check that the changes in the FI02 are in line with the calculated changes in FI02 in the breathing circuit. |
Anaesthetic Emergencies

**ALERT/READY**

Circulation: If there is an impending arrest allocate the circulation* task and ask for the arrest trolley to be fetched

If the oximeter is suspect, resite or replace it and/or do an arterial blood gas. Consider inserting an arterial line.

If adequate saturation cannot be confirmed, administer 100% oxygen. Plan how to provide analgesia and anaesthesia.

Confirm that the gas in the inspired limb of the breathing circuit is 100% oxygen

**EMERGENCY**

If the pulse or ETCO2 fails, feel for a major pulse and start external cardiac massage

If there is any question of cardiac, circulatory or respiratory compromise, give 100% O2 regardless of the saturation

Supply 100% oxygen at a very high flow rate if necessary

Confirm the inspired gas in the breathing circuit is 100% oxygen
Anaesthetic Emergencies

- Scenario 1: 27 yr old male for elective repair of ACL
- No medications, no medical history, never had an anaesthetic, non smoker, binge drinker on weekend.
- Standard induction with midazolam, fentanyl and propofol, maintained with sevoflurane, oxygen and air, prophylactic antibiotics given.
Anaesthetic Emergencies

- Following insertion of LMA difficult to ventilate.
- Noted to be tachycardic
- Post induction BP unmeasurable
- Saturations Falling
- Noted to have widespread wheeze.
- Blanching fine rash noticed on chest.
Anaesthetic Emergencies

- Anaphylaxis
- Said to occur in between 1:10 000 to 1:20 000.
- Is a clearly life threatening condition requiring prompt recognition and treatment.
- Immediate management is 100% oxygen, aggressive IV fluids, intubation and peep, and adrenaline.
Anaesthetic Emergencies

• How does it present (% of patients):
  • No pulse, hypotension: 28%
  • Difficulty inflating lungs: 26%
  • Flushing: 21%
  • Coughing: 6%
  • Rash: 4%
  • Desaturation: 3%
  • Cyanosis: 3%
• Other – ECG changes, wheeze, urticaria: 9%
Anaesthetic Emergencies

- What causes it:
- Neuromuscular blocking agents 70%
- Latex 12.6 %
- Colloids 4.7%
- Induction Agents 3.6%
- Antibiotics 2.6
- Benzodiazepines 2%
- Opioids 1.7%
- Other Agents 2.5% eg radio contrast, protamine, atropine, bone cement
Anaesthetic Emergencies

- Immediate management:
  - Stop the administration of all agents likely to have caused the anaphylaxis. Call for help. Maintain airway, give 100% oxygen, lie patient flat.
  - Give adrenaline 100ug IV or 500ug IM.
  - May need repeated doses, and may need infusion for several days.
  - Give generous amounts of IV fluids
  - Surgery should be cancelled or finished asap.
Anaesthetic Emergencies

- Subsequent Management
- Give antihistamines and corticosteroids
- Bronchodilators for persistent wheeze.
- Adrenaline .05 - .1ug/kg/min or 400ug/hour for 70kg man
- Collect blood immediately, at 1 hour and between 6-24 hours for serum tryptase (>20ng/ml likely anaphylaxis)
- Post op should be nursed in ICU or HDU
Anaesthetic Emergencies

- Scenario 2: 26 yr old obese woman for hysteroscopy D&C. Nil regular meds, mild asthma, some reflux associated with food.
- Standard induction, proseal, maintained on Sevo/Air/Oxygen.
- Placed in lithotomy, head down.
- Gasseous hysteroscopy followed by dilation and curettage.
Anaesthetic Emergencies

- Noted to develop a tachcardia
- SCAN reveals unmeasurable BP. ETCO2 of 15, SaO2 falling.
- Auscultation – mild wheeze
- Auscultation – muffled heart sounds, mill wheel murmure
- Venous Air Emboli secondary to gasseous hysteroscopy
<table>
<thead>
<tr>
<th>Time</th>
<th>Heart Rate</th>
<th>SaO2</th>
<th>B.P.</th>
<th>ETCO2</th>
<th>Drugs</th>
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<td>8:20</td>
<td>92</td>
<td>100</td>
<td>86/52</td>
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<td>8:25</td>
<td>104</td>
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<td>97/62</td>
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<td>8:27</td>
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<td>91</td>
<td>98/59</td>
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<td>Suxamethonium</td>
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<td>71/37</td>
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<tr>
<td>Air/Gas Embolism: Common Procedures</td>
<td>Relative Risk*</td>
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<td>Sitting position craniotomy</td>
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<td>Posterior fossa/neck surgery</td>
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<td>Laparoscopic procedures</td>
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<td>Total hip arthroplasty</td>
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<td>Caesarian delivery</td>
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<td>Central venous access-placement/removal</td>
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<td>Craniosynostosis repair</td>
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<td>Gastrointestinal endoscopy</td>
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<td>Contrast radiography</td>
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<td>Blood cell infusion</td>
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<td>Peripheral nerve procedures</td>
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<td>Vaginal procedures</td>
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<td>Hepatic surgery</td>
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* Approximate expected reported incidences: High > 25%, Medium 5-25%, Low < 5%
Anaesthetic Emergencies

VAE may present as a wide ranging spectrum of pathology. The two major determinants of severity are:

1  The volume of air entrained. Extrapolation from case reports has indicated that the adult lethal volume is 200-300mls or about 3-5mls/kg.

2  The rate of air entrainment. Due to the capacity of the pulmonary vascular tree to dissipate gas, slow entrainment on air can be dissipated with minimal insult, while rapid entrainment can favour the formation of an air lock within the right ventricle. It has been calculated that 100mls/second of air will be entrained through a 14 gauge cannular with a pressure drop of only 5mmHg.
Anaesthetic Emergencies

Minor determinants include:

1. A proximal air entry site facilitates more rapid accumulation of air within the right ventricle.

2. In the anaesthetised patient, spontaneous ventilation results in a negative intra thoracic pressure which will increase any pressure difference between the site of air entrainment and the right heart. Conversely, positive pressure ventilation will decrease this pressure differential. The addition of positive end expiratory pressure (PEEP) will further reduce this differential.

3. Vessel number and size. Intuitively, the more numbers of vessels and the larger their size will lead to a larger volume and more rapid rate of entrainment.

4. Height above the heart. The higher the location of the vessel disruption above the heart the higher the pressure differential that will favour the entrainment of gas, as well as a siphoning effect of the blood column.

5. With the advent of endoscopy and the use of gas under pressure, the position of the patient for these procedures is less important, and the pressure of the gas the major determinant of volume of gas entrained.
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• Biochemical Effects
• Accumulation of small amounts of air within the right ventricle will result in turbulence and small bubble size which will be embolised to the pulmonary vasculature. These bubbles can cause platelet activation and release of endothelin 1 leading to acute pulmonary hypertension.8 Alternatively the release of inflammatory mediators can lead to a Systemic Inflammatory Response Syndrome (SIRS) like condition.9
• The disruption of normal circulation results in a reduction in the oxygen demand/supply ratio with the potential to produce ischaemia and further organ damage.
Anaesthetic Emergencies

- **Mechanical Effects**
  - When a large volume of air is entrained it can form an air lock within the ventricle and atrium, preventing venous return during diastole and simply being compressed during systole. This will effectively stop any cardiac output. This may be compounded further if massive air entrainment occurs and the right ventricle becomes grossly distended leading to right heart failure.
  - If large volumes of gas embolise to the pulmonary vasculature pulmonary hypertension may result, and this in turn may lead to right ventricular failure.
Anaesthetic Emergencies

• Pulmonary effects
• As previously mentioned the release of inflammatory mediators, hypoxia, or pulmonary hypertension can all lead to respiratory failure.
• Cardiac effects
• These can be primary due to gross dilation of the right ventricle, or secondary due to reduced cardiac output and ischaemia. An air lock will lead to circulatory collapse.
Anaesthetic Emergencies

- Management
- Head down left lateral, flush IV fluids, vasopressors, ionotropes as required.
- Intubate, 100% oxygen
Anaesthetic Emergencies

• VAE present as a sudden onset of effectively cardiac arrest. As such in managing this situation it is important to recall the ALS algorhythm and look for the the four H’s and four T’s.

• Hypoxia, Hypovolaemia, Hypo/Hyperthermia, Hypo/Hyperkalaeamia or other metabolic disorders

• Tamponade, Tension, Toxins, Thrombosis
Adult Cardiorespiratory Arrest

BLS Algorithm
  if appropriate

- Precordial thump
- Attach Defib - monitor

Assess rhythm/pulse

Shockable
  VF / Pulseless VT

Attempt Defibrillation
  1 shock

- Manual Biphasic 200J
- Manual Monophasic 360J

Immediate CPR
  2 Minutes

During CPR
  IF NOT ALREADY DONE
  - Check electrode/paddle position
  - 8 contact
  - Attempt/verify/secure IV access
  - Give adrenalin 1mg & repeat every 3 minutes

CORRECT REVERSIBLE CAUSE:
- Hypoxaemia
- Hypoxia
- Hypovolaemia
- Hyper/hypothermia
- Hypocalcaemia & other metabolic disorders
- Tamponade
- Tension pneumothorax
- Toxins / Poisons / Drugs
- Thromboembols - pulmonary / coronary

CONSIDER
  Advanced arrhythmia
  Antiarrhythmic:
  - Amiodarone 300mg
  - Lidocaine 1:1.5 mg/kg
  - Magnesium 6mmol
  - Electrolytes
    - Potassium 5mmol
  - Buffer
    - NaHCO3 1mmol/kg
  - Atropine (1.5mg) + Pacing (for asystolia & severe bradyarrhythmia)

Immediate CPR
  2 Minutes

Non-Shockable
  PEA / Asystole

Note:
1. For witnessed arrest, when using a manual defibrillator, give up to 3 stacked shocks at first defibrillation attempt. If further shocks are required these should be single shocks.
2. Default biphasic energy.
Anaesthetic Emergencies
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