How Would You Manage This?
Activity
In groups, see if you can figure out what is happening in your scenario & how you would manage the situation?
Complications under anaesthesia are thankfully relatively low

- Anaphylaxis – 1 in 10,000
- MH – 1 in 50,000
- Difficult intubation – 1 in 30,000 (true incidence unknown)

APSF (2006)
Prior Preparation Prevents Poor Performance!
What Can We Do to Prepare?

- COVER ABCD in ventilated pts
- AB COVER CD in spontaneously breathing pts
- A SWIFT CHECK
- Scenario development
  - Low – high fidelity simulation
- Develop logical orders of thinking
  - Who, what, when, where, why, how?
  - Reassurance: What’s happening? Why it’s happening? What to do? How to fix it?

APSF (2006)
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
# A SWIFT CHECK

<table>
<thead>
<tr>
<th>Condition</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Air Embolism</td>
<td>Hypotension/hypocapnia</td>
</tr>
<tr>
<td>A Anaphylaxis</td>
<td>Hypotension/bronchospasm/rash</td>
</tr>
<tr>
<td>A Air in the pleura</td>
<td>Pneumothorax</td>
</tr>
<tr>
<td>A Awakening during anesthesia</td>
<td>Insufficient Anesthesia</td>
</tr>
<tr>
<td>S Situation-Surgeon</td>
<td>Vagal/myocardial stimulation</td>
</tr>
<tr>
<td>S Sepsis</td>
<td>Hypotension/acidosis/hyperdynamics</td>
</tr>
<tr>
<td>W Wound</td>
<td>Trauma/hemorrhage</td>
</tr>
<tr>
<td>W Water poisoning</td>
<td>Water overload/hyponatremia</td>
</tr>
<tr>
<td>I Infarction</td>
<td>Arrhythmia/low output/hypotension</td>
</tr>
<tr>
<td>I Insufflation</td>
<td>Drop in venous return/embolism</td>
</tr>
<tr>
<td>F Fatty Syndrome</td>
<td>Desaturation/hypotension</td>
</tr>
<tr>
<td>F Full bladder</td>
<td>Sympathetic Stimulation</td>
</tr>
<tr>
<td>T Trauma</td>
<td>Bone marrow involvement</td>
</tr>
<tr>
<td>T Tourniquet loss</td>
<td>Local anesthetic toxicity</td>
</tr>
<tr>
<td>C IV Catheter</td>
<td>Mistaken administration of the drug</td>
</tr>
<tr>
<td>C Cement</td>
<td>Hypotension due to methylmethacrylate</td>
</tr>
<tr>
<td>H Hyperthermia (hypothermia)</td>
<td>Tachycardia/hypercapnia/arrhythmias</td>
</tr>
<tr>
<td>H Hypoglycemia</td>
<td>Hyperinsulinism</td>
</tr>
<tr>
<td>E Emboli</td>
<td>Thrombi/fat/LA/arrhythmias/hypotension</td>
</tr>
<tr>
<td>E Endocrine</td>
<td>Hyperthyroidism/diabetes</td>
</tr>
<tr>
<td>C Check-up</td>
<td>Right patient/right surgery/right surgeon</td>
</tr>
<tr>
<td>C Check-up</td>
<td>Pre-operative evaluation</td>
</tr>
<tr>
<td>K K+</td>
<td>Hyper/hypokalemia/arrhythmias</td>
</tr>
<tr>
<td>K Sedate the patient</td>
<td>Whenever needed due to equipment issues (anesthesia machine)</td>
</tr>
</tbody>
</table>

4 Aes: Awareness; Air Embolism; Air in the pleura or pneumothorax; and Allergies or Anaphylaxis.

SWIFT CHECK: Quick evaluation of what the surgeon is doing (the position of the patient on the operating table...
**Principles of Crisis Management**

* Preparation
  - Know where your emergency equipment is & how to use it
  - Know where & who your resources are
  - Know your available staff (i.e. skill levels)
  - Know your pt (i.e. their history)
  - Know your algorithms & guidelines (i.e. arrest flowcharts, difficult airway algorithms, P & P)
Do you perform Mock Scenarios or have Workshops in your facility?
Principles cont’d…..

* Management
  - Be able to assess & treat
  - Be able to function as a team
  - Seek help early (don’t be afraid to hit the arrest button)
  - Formation of a team [leadership & roles] (i.e. how many attendees are required; dependent on the situation e.g. MH need all the hands you can get)
  - Primary survey should be completed (identify what the issue is!)
  - Find & treat the causes
  - Ensure your anaesthetist/ surgeon avoids fixation (i.e. worried about problem with machine when patent airway not maintained)
  - Monitor effectiveness of interventions
  - Maintain controlled chaos (calm environment)
Principles cont’d…..

* Management
  - Review what’s happened
  - Perform secondary survey (head to toe assessment)
  - Monitor performance of those involved
  - Ensure the plan is re-evaluated
Post Crisis- What happens after all that?

* After care:
  - for the patient
    Transfer to ICU/ HDU
    ?death – Coroner’s office needs to be notified; all equipment to left insitu; paperwork must collected & not altered
  - Debrief for the pt
    Follow up of events, allergy testing required, difficult airway notice
  - for the relatives
    Has pt sustained significant morbidity from event?
    Has the pt died? Surgeon never breaks the news alone
  - for the staff
    ensure counseling is offered; appropriateness i.e. don’t go to the pub!
    Critical Incident Stress Debriefing is necessary if pt died
Post Crisis Care

* Contact must be made to a senior colleague for medical & nursing staff
  * May be head of department; if pt died DON/DCS must be contacted
* What about the next patient on the list?
  * Deserve a fresh team & equipment
  * Unthinkable could happen whereby next pt suffers or dies as a result of undetected equipment fault or an overstressed team
* Equipment & Medication
  * If implicated must be isolated for examination
* Administrative details
  * Medical record for accuracy & completeness (cannot alter previously documented record but can annotate & add to)
  * Prepare personal statement of events as well
  * Incident reporting – Hospital; AIMS; TGA (if meds)
* Court? Hospital will generally complete for nursing staff
  * Relevant medical records copied & reviewed; hospital admin notified
Prior Preparation Prevents Poor Performance!
Anaphylaxis
Anaphylaxis

- IgE mediated reaction to an antigen producing potentially life threatening skin, respiratory & cardiovascular system responses
- Signs & symptoms caused by the release of histamine, serotonin plus other vasoactive substances
- Massive vasodilation & fluid shifts
- Incidence ranges from 1 in 4000 to 1 in 25,000 (worldwide)
- 1 in 5000 – 10,000 in Australia
- NMBAs induce approx. 50-60% of reactions
- Once anaphylaxis is diagnosed, essential to provide pt with proper documentation & suggest wearing a “Med-Alert” ID band
- Diagnosis based on Mast Cell Tryptase [MCT]
  - Enzyme released from activated mast cells
  - Levels begin to rise within 30mins of reaction & remain high for approx. 6hr
  - Intradermal testing can also be effective in determining causative agent

(Currie et al., 2005; Langpoklkpm et al., 2014; Sadlier et al., 2013)
**Common Culprits**

- **Muscle Relaxants**
  - Rocuronium – approx. 56%
  - Suxamethonium – 21%
  - Vecuronium – 11%
  - Pancuronium – low risk
  - Cisastricurium appears relatively safe for use in those with previous reaction to Roc or Vec

- **Antibiotics**

- **Latex**

  (Langpoklkipam et al., 2014; Sadlier et al., 2013)
Latex Reactions

* Foods containing latex
  * **High**
    * Avocado, Banana, Chestnut, Kiwi
  * **Moderate**
    * Apple, Carrot, Celery. Melons, Papaya, Potato, Tomato
  * **Low/undetermined**
    * Apricot, Cherry, Citrus fruits, Fig, Grape, Lychee, Mango, Nectarine, Passion fruit, Peach, Pear, Persimmon, Pineapple, Strawberry, Buckwheat, Rye, Wheat, Coconut, Hazelnut, Walnut, Castor bean, Chick pea, Peanut, Soybean, Dill, Oregano, Sage, Peppers (Cayenne, Sweet/bell pepper), Shellfish, Sunflower seed

http://latexallergyresources.org/latex-cross-reactive-foods-fact-sheet#sthash.omZHy2an.dpuf

(American Latex Allergy Association, 2015)
Signs & Symptoms

* [in the awake pt]
  - warmth (axilla & groin)
  - feelings of anxiety & panic
* [remember our pts are usually unconscious]
  - erythematous/urticarial rash
  - dyspnoea
  - hypotension
  - bronchospasm
  - hypoxaemia, cyanosis
  - oedema
    - (face, neck, soft tissues, laryngeal)
  - arrhythmias, cardiac arrest

(Currie et al., 2005; Langpoklkpam et al., 2014; Sadlier et al., 2013)
Immediate Management

* Stop administering triggering agent (if known)
* Inform surgeon
* Call an emergency
* Administer 100% O2 & maintain airway
* Administer adrenaline (one minijet – 1mg in 10mL)
* Commence rapid fluid resuscitation
  * volume expanders most advantageous (crystalloids will only assist)
* Commence adrenaline infusion (1mL/min of 6mg/100mL)
  * Titrate against BP & P
* COVER ABCD
  * Airway/ circuit obstruction must be excluded
  * Treat as though cardiac arrest – minus the compressions!

(Currie et al., 2005; Langpoklpam et al., 2014; Sadlier et al., 2013)
Further Care

* Patient can always relapse hence
  * Admission to ICU/HDU
  * ?ventilated
  * Continue adrenaline infusion
  * Take bloods for testing (if not done so already)
  * Counsel patient & relatives
  * Arrange for allergy testing
  * Reschedule surgery when appropriate

(Currie et al., 2005; Langpoklpam et al., 2014; Sadlier et al., 2013)
Massive Blood Loss
**Massive Blood Loss**

- Replacement of total blood volume in less than 24 hour or replacement of blood at greater than 1mL/ kg/ min

- Signs & Symptoms:
  - hypovolaemic shock
  - usually obvious blood loss but can be hidden
Management

* ABC with 100% O2
* Stop the bleeding (by applying direct pressure, clamp arterial supply)
* Call an emergency
* IV access (large bore cannulas, central line)
* Vital monitoring (arterial & central line required)
* Fluid resuscitation (increasing circulating volume using colloids & bloods if available)
* Order blood products (warn pathology of need – sense of urgency must be felt)
* ? Initiate Massive Transfusion Protocol [MTP]
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values to aim for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>&gt;35 °C</td>
</tr>
<tr>
<td>Acid-base status</td>
<td>ph &gt;7.2, base excess &lt;–6, lactate &lt;4 mmol/L</td>
</tr>
<tr>
<td>Ionised calcium (Ca)</td>
<td>&gt;1.1 mmol/L</td>
</tr>
<tr>
<td>Haemoglobin (Hb)</td>
<td>This should not be used alone as transfusion trigger; and,</td>
</tr>
<tr>
<td></td>
<td>should be interpreted in context with haemodynamic status, organ &amp; tissue</td>
</tr>
<tr>
<td></td>
<td>perfusion.</td>
</tr>
<tr>
<td>Platelet (Plt)</td>
<td>≥ 50 x 10^9 /L</td>
</tr>
<tr>
<td>PT/APTT</td>
<td>≤ 1.5x of normal</td>
</tr>
<tr>
<td>Fibrinogen</td>
<td>≥ 1.0 g/L</td>
</tr>
</tbody>
</table>

Mortality is high in massive transfusion and its aetiology is multifactorial, which includes hypotension, acidosis, and coagulopathy. You must note of the lethal triad—patients with acidosis, hypothermia and coagulopathy have the highest mortality.

NBA (2012)
* National Standard 7: Blood & Blood products
* Conservative treatment regarding blood & blood products
* RBC transfusion should not be dictated by a haemoglobin ‘trigger’ alone, but should be based on assessment of the patient’s clinical status. In the absence of acute myocardial or cerebrovascular ischaemia, postoperative transfusion may be inappropriate for patients with a haemoglobin level of >80 g/L
* Patients should not receive a transfusion when the haemoglobin level is ≥100 g/L. In postoperative patients with acute myocardial or cerebrovascular ischaemia and a haemoglobin level of 70–100 g/L, transfusion of a single unit of RBC, followed by reassessment of clinical efficacy, is appropriate
* The administration of rFVIIa may be considered in the perioperative patient with life-threatening haemorrhage after conventional measures, including surgical haemostasis, use of anti-fibrinolytics, and appropriate blood component therapy have failed

ASQSHC (2012)
Cell Saver

- Collect anticoagulated blood
- Wash RBCs
- Separated by centrifugation
- Reinfusion
- Remove platelets, clotting factors and plasma proteins
Malignant Hyperthermia
Malignant Hyperthermia

- Rare, autosomal dominant muscle disorder (acute hypermetabolic state)
- Pharmacogenetic disorder (will occur after contact with anaesthetic agents)
  - Majority have defect in the ryanodine receptor type 1 [RYR1] gene (autosomal dominant inherited disorder of skeletal muscle)
  - Ryanodine, is a large protein molecule covering the sarcoplasmic reticulum, which regulates calcium release
  - Excessive amounts of calcium are released when MH triggered which leads to skeletal muscle contraction, heat production, O2 consumption, increase CO2 production, release of more calcium, acid production & more heat
  - Cell membrane disruptions lead to K, phosphate, Mg & myoglobin leakage into extracellular fluid (this leads to increases in serum levels which is picked up in ABG & FBC)
- Prevalence 1 in 3,000 to 1 in 50,000
- Approx 98% of cases occur intraop; 1.9% occurs postop
- Mortality is 15% (decreased significantly)
- Postulated that delayed onset could be due to decreased skeletal muscle & increased pain following surgery
Triggers

* Anaesthetic Triggers
  * Inhalational agents
    * Isoflurane, Sevoflurane, Desflurane, Halothane, Enflurane, Ether, Cyclopropane
  * Depolarising Muscle Relaxants
    * Suxamethonium
* Non Anaesthetic Triggers
  * Certain myopathies (King Denborough)
  * Emotional Stress
  * Heat stroke
  * Neuroleptic Malignant Syndrome
  * Strenuous exercise
  * Trauma
Signs & Symptoms

- Masseter muscle rigidity
- Sudden unexplained rise in ETCO2
- Hypercarbia in spontaneously breathing pt
- Unexplained ↑ HR, RR; unstable BP
- Acidosis
- Hyperthermia (increases 1-2°C every 5 mins)
- Ventricular arrhythmias
- Hypoxaemia, hyperkalemia
- Myoglobinuria (dark coloured urine)
- Mottled cyanotic skin
- Generalized muscle rigidity
  followed by rhabdomyolysis if mistreated

3 biggest signs to look out for
If all 3 together can only be MH

Early
Due to hypermetabolism

Middle

Late
Rhabdomyolysis

- Disintegration of skeletal muscle fibres with excretion of myoglobin into the urine
  - Myoglobin accumulates in the renal tubules as cannot be cleared from kidneys
  - This can lead to renal failure & the need for dialysis
- Inflammatory response
- Compartment syndrome
  - Swollen, inflamed muscle causes fascial compression
- DIC
  - From activation of coagulation system
If not managed appropriately

Hyperthermia

Skeletal muscle damage

Renal failure

Cardiac arrest

Death
- Call an emergency & for malignant hyperthermia kit
- Discontinue use of anaesthetic agents & hyperventilate with 100% O2
- Stop or expedite surgery
- Allocation of tasks will occur swiftly
- *Change anaesthetic machine ASAP/ change breathing circuit & CO2 absorber*
- Administer Dantrolene 2.5mg/kg IV up to 10mg/kg
- Administer Sodium Bicarbonate (based on ABG) to correct hyperkalemia
- Insertion of arterial & central lines & large bore IVCs
- Insert temp probe & treat hyperthermia (turn off warming blanket, use refrigerated fluids, gastric, rectal & bladder lavage with cold saline)
- Cease hyperthermia treatment once temp reduced to 38°C
- Maintain urine output at 2mL/kg/hr
Dantrolene

- skeletal muscle relaxant which inhibits calcium release
- administered as an IV push

**DOSING**
- initial acute dose: 2.5mg/kg
  
  70kg x 2.5mg = 9 vials
- 12 vials cost $932
- subsequent doses may be needed: 1mg/kg

- ampoule contains 20mg of dantrolene sodium with 3mg of mannitol in powder form

- reconstitute with 60mL of sterile water for injection (preferable at room temp or warm)

- you need as many people as you can to assist in mixing and drawing up
  
  - new formulation where freeze drying process has been altered
    
    [Dantrium IVTM]
- needs to be protected from light & used within 6hrs

**Mhanz recommends**

Minimum of 24 vials
Larger or remote minimum 36
Reconstituted Dantrolene
What Should Be In My MH Kit?

- Dantrolene vials
- Sterile H2O 100mL x 10
- 50mL syringes x5 & needles
- ?new disposable circuit
- ?ventilator bellows & CO2 canisters
- Gastric lavage kit
- Sodium bicarbonate 8.4%
- On call pharmacy number
- List of hospitals close to you with Dantrolene supply

- Refrigerator
  - Cold IV Saline (for lavage & groin & axilla cooling)
    *NOTE: do not use Hartmanns due to K contained
  *for aid in mixing best use room temp fluids

- Extras
  - Dextrose 50% (0.5mg/kg with insulin)
  - Insulin (Actrapid 100U/mL)
  - N/Saline 100mL bags x 2
  - Frusemide
  - Art & Central line kits
Difficult Airway Management
Difficult Intubation

* Relatively common however true incidence unknown
* Approximately 50% unanticipated
* Study in 2005 (recovered 4000 AIMS cases)
  * 52% unanticipated
  * 37% major physiological changes
  * 22% SpO2 fell below 90%
  * 19% oesophageal intubation noted
  * 14% CICV
  * 4% required emergency transtracheal intubation
* Obesity, mobility & mouth opening most common anatomical contributing factors
Potential Complications of an Ineffective Airway Assessment & Traumatic Intubation

- Panic!
- Aspiration
- Subglottic Stenosis
- Inability to ventilate
- Inability to intubate
- Hypoxia
- Death
Management

* When anticipated
  * Another skilled assistant (preferably an anaesthetist)
  * Difficult intubation trolley in the room
  * Having a plan B, C, D etc

* Unanticipated
  * Call an emergency, for skilled assistance & difficult intubation trolley
  * Maintain oxygenation at all times
  * Have someone feel for pulse & call out SpO2
  * If you can ventilate by facemask
    * Consider waking the patient up or maintaining anaesthesia & try to intubate
    * Try basic manoeuvres first (head & neck position, BURP, bougie, different blade)
    * If these fail, consider – LMA (if this is successful can you proceed or attempt intubation via LMA), blind nasal, retrograde, lighted stylet
  * If you cannot ventilate – consider Sugammadex (16mg/kg) if available, if not available then transtracheal airway required
Take Home Message

Patients don’t die from lack of ventilation
They die from lack of oxygenation!
So what have we learned from managing a crisis?

Achieving positive patient outcome involves:
- Swiftly identifying the presenting crisis
- Developing pre-learned management plans
  - Having plans B, C, D etc
  - Effective communication
- Providing opportunities for mock scenarios to ‘practice’ these situations
Any questions???
References

References

