Anaesthetic Emergencies

Peter Best

South Tamworth Animal Hospital
Anaesthetic emergencies

- General anaesthesia poses minimal risk to most patients when performed by a capable anaesthetist using appropriate protocols and proper monitoring. However, it is vitally important that the anaesthetist remembers that every anaesthetic procedure has the potential to cause the death of the animal.
Anaesthetic emergencies: Prevention is better than cure

Fundamentals:

• Understanding Respiratory, Cardiovascular system and nervous system physiology and pathophysiology to enable knowledgeable patient monitoring and support of organ function are key to minimizing anaesthetic risk and assuring a good outcome

• Understanding the pharmacology of drugs used

• Understanding anaesthetic and monitoring equipment
understanding pathophysiology

31st May 1916 Battle of Jutland
6784 British killed and 3039 Germans

'Spinal anaesthesia is the ideal form of Euthanasia in war surgery'
Admiral Sir Gordon Taylor
Lessons from history

understanding pathophysiology

Some 44 years later: the Korean war

"The only contraindication to this (spinal) form of anaesthesia is ignorance, because it provides unsurpassed relaxation, rapidity of action, and quick recovery with a wide margin of safety".

• Hypovolaemic and shocked patients are in part protected from the deleterious consequence of their injury because of sympathoadrenal system activation.

• Local anaesthetics applied to the spinal cord block not only the somatic nervous system but also the sympathetic nervous system thus giving rise to a profound vasodilation especially in the presence of shock or hypovolaemia.

• The necessity of providing adequate fluid loading to patients who are about to receive spinal anaesthesia with local anaesthetics is now recognised as an integral part of anaesthetic management.
"Then let it be said that intravenous anaesthesia is also an ideal method of euthanasia. It was the consensus of all civilian surgeons concerned that, considering all the hazards of patient, anaesthetist and anaesthetic, open drop ether still retains the primacy!"

Halford, F.J.
A Critique Of Intravenous Anaesthesia In War Surgery
Anesthesiology, 4, 67-69 1943
“Intravenous Anesthesia With Pentothal Sodium In The Case Of Gunshot Wound Associated With Accompanying Severe Traumatic Shock And Loss Of Blood: Report Of A Case

Adams, R.C and Gray H.K. Anesthesiology 4, 70 - 73, 1943
Lessons from history

**pathophysiology**

Case synopsis

26-year-old woman suicide

a 12 bore below and left of the left breast

“...A portion the left side of the thorax had been blown away and compound comminuted fractures of ribs 6, 7, 8 and 9 had been sustained.... The spleen, a portion of stomach and a portion of the left lung were projecting from the wound of exit. There was a large laceration of the diaphragm through which all these intra-abdominal structures also protruded”.
Case synopsis

On admission: morphine and \( \text{O}_2 \) and blood

Induced using 25 mg increments (0.5 mg kg/min)

Required 2.5 mg/kg for induction

Surgery 25 mg increments TFX • lasted 1 h 45 min

Total dose received 400 mg

Recovered in an oxygen tent

• (normal dose 4 – 8 mg kg\(^{-1}\))
- Lessons from history

- **Case synopsis**
  - + 25 days
  - empyema pocket drainage left sub-lumbar space
  - 400 mg thiopental needed in the first 10 minutes alone

- Pathophysiology
"We think this case supports the belief that pentothal sodium may safely be administered intravenously for anaesthesia to patients who are in a state of shock from trauma, provided their low tolerance for this and similar drugs is recognised and administration is conducted accordingly".

Adams, R.C and Gray H.K.
Lessons from history

Shock greatly diminishes the effective circulating blood volume, decreases cardiac output, decreases the volume of distribution and increases the plasma concentration of an intravenously administered drug.

Small drug doses can have a big effect and for a lot longer time than in a normal patient.

The dose of all intravenous anaesthetics is the same: Slowly to effect.
Understanding pathophysiology is fundamental in dealing with an anaesthetic emergency and for administering an anaesthetic in an emergency.
Anaesthesia Crisis

Hypothermia
Hypoxia
Hypo/hypertension
Hypovolaemia
Underventilation
Anaesthetic Depth
Dysrhythmias
Hypo/hyperkalaemia
Hyponatraemia
Machine malfunction
Renal function
Transfusion problems
Recovery problems
Air embolism
Sepsis, SIRS, MOF

Coagulopathy
Pleural space disease
Lung disease
Tamponade
Volume overload
Pulmonary oedema
Surgeon
Knowledge & experience
Analgesia/pain
Stress response
Toxins, drugs
Shunt
Allergy
Anaphalaxis
Arrest
Useful monitors

- Trained staff
- Pulse oximeter (SpO₂)
- Capnograph (ETCO₂)
- Oesophageal stethoscope (HR)
- ECG
- Non-invasive Blood pressure (mm Hg)
- Agent monitoring (F₁ and ET anaesthetic %)
- Manometer in patient breathing system (cm H₂O)
- Thermometer
Anaesthetic emergencies: Learnt and practiced response

- knowledge of appropriate responses to an anesthetic emergency is essential
- understand why emergencies arise and how they may be prevented
- Learn, modify, change, train, improve
Errors, Incidents and Accidents in Anaesthetic Practice

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SUMMARY

Human error is a pervasive and normal part of everyday life and is of interest to the anaesthetist because errors may lead to accidents. Definitions of, and the relationships between, errors, incidents and accidents are provided as the basis to this introduction to the psychology of human error in the context of the work of the anaesthetist. Examples are drawn from the Australian Incident Monitoring Study (AIMS). An argument is put forward for the use of contemporaneous incident reporting (eliciting relevant contextual information as well as details of use to cognitive psychologists), rather than the use of accident investigation after the event (with the inherent problems of scant information, altered perception and outcome bias). A classification of errors is provided. “Active” errors may be classified into knowledge-based, rule-based, skill-based and technical errors. Different strategies are required for the prevention of each type and it may now be useful to place more emphasis in anaesthetic practice on categories to which little attention has been directed in the past. “Latent” errors make an enormous contribution to problems in anaesthesia and several categories are discussed (e.g. environment, physiological state, equipment, work practices, personnel training, social and cultural factors). An approach is provided for the prevention and management of errors, incidents and accidents which allows clinical problems to be categorized, the relative importance of various contributing factors to be established, and appropriate preventative strategies to be devised and implemented on the basis of priorities determined from the AIMS data. Accidents cannot be abolished; however, an understanding of the factors underlying them can lead to the rational direction of resources and effort to prevent them and minimise their effects.
Planned and practiced response for emergencies
Accidents, errors and incidents

- An incident is an unintended event that potentially could lead to harm and reduces the safety margin.
- An accident is an adverse or negative outcome.
- An error is a flawed plan or action where some aspect of performance deviated from the ideal. It does not imply blame.
- Accidents are often products of unlikely co-incidents, and prevention is difficult.
- Errors are largely systematic, relatively easy to predict and prevent.
Errors

Consider the chain of events:

GOAL ----> 
INTENTION ----> 
PLAN -----> 
ACTION -----> 
OUTCOME
Errors

Example:

GOAL ----> Prevent unwanted births

INTENTION ----> Surgical ovariohysterectomy

PLAN ----> Pre-anaesthetic exam, check anaesthetic machine, prepare for anaesthesia, analgesia and sterile surgery

ACTION ----> Pre-anaesthetic exam, check anaesthetic machine, administer GA, monitor, analgesics, surgery, recover

OUTCOME ----> Noted rise in HR & BP during ovarian ligament traction (an incident)
Classification of Problems in anaesthesia

- Latent errors (contributing factors)
- Active errors
- Factors minimising adverse events
- Outcomes
Latent error: example
Types of active errors

- Knowledge based
- Rule based
- Skill based (slips and lapses)
- Technical

Goal → Intention → Plan → Action → Outcome
Types of active errors

• Running out of oxygen during an anaesthetic is a rule based error since there was a failure to follow the plan for “Anaesthetic Machine Check” to be carried out prior to every anaesthetic.

GOAL --> INTENTION --> PLAN --> ACTION --> OUTCOME
PROTOCOL
CHECKING AN ANAESTHETIC MACHINE BEFORE USE

- GASES
- ROTAMETERS
- VAPORISERS
- PRE-CIRCUIT LEAKS
- EMERGENCY OXYGEN BUTTON
- PATIENT BREATHING SYSTEM SELECTION
- PATIENT BREATHING SYSTEM
- SCAVENGER SYSTEM
- MONITORS
Errors and accidents: example

Systematic error:
Repeated hypothermia in patients undergoing anaesthesia in winter

Accident:
Hypotension and bradycardia requiring resuscitation in a 9 year old 3kg dog undergoing bilateral repair of multiple pelvic fractures. Rectal temp noted 31.8°C
Errors and accidents: example

Systematic error:

Hypothermia (cont)

Solution:

Warm air blankets in all surgeries and radiant heating lamps over induction tables
Errors and accidents: example

Systematic error:

Repeated upper airway obstruction in patients anaesthetised for dental procedures because pharyngeal throat packs had been inadvertently left in situ after extubation

Accident:

Fortunately a cardiac arrest never eventuated, but several dogs passed gauze swabs after 1-2 days

Solution:

1) All dental patients have a pharyngeal placed with a long tie of bright tape attached.. Always!

2) All dental patients have their oropharynx examined with a laryngoscope prior to recovery
Prevention is Important
But what about..... Disasters!
Human error

80% of serious incidents in complex systems where humans and machines interact involve human error.
Crisis in Practice

• Rapidly evolving complex event

• Tightly coupled situation

• One false move can lead to catastrophe
Tightly coupled and Complex systems are inherently dangerous!

- Charles Perrow “Normal Accidents” 1984

- High complexity in a system means that if something goes wrong it takes time to work out what has happened and to act appropriately.

- Tight coupling means that one doesn’t have that time.

- A tightly coupled system needs centralised management, but a highly complex system can’t be managed effectively in a centralised way because we simply don’t understand it well enough; therefore its organisation must be decentralised.
The Kegworth UK aircraft disaster 1989 – 47 dead
The aircraft was a British Midland 737-400, G-OBME, on a scheduled flight from Heathrow Airport to Belfast, Northern Ireland, having already flown from Heathrow to Belfast and back that day. After taking off from Heathrow at 7:52pm, Flight 092 was climbing through 28,300 feet to reach its cruising altitude of 35,000 feet when one of the fan blades on the left engine suddenly ruptured.

While the pilots did not know the source of the problem, a pounding noise was suddenly heard, accompanied by severe vibrations. In addition, smoke poured into the cabin through the ventilation system and a smell of burning entered the plane. Several passengers sitting near the rear of the plane noticed smoke and sparks coming from the left engine.

The flight was diverted to nearby East Midlands Airport at the suggestion of British Midland Airways Operations.

After the initial blade fracture, Captain Kevin Hunt had disengaged the plane's autopilot. When Hunt asked First Officer David McClelland which engine was malfunctioning, McClelland replied: 'It's the le... it's the right one'. In previous versions of the 737, the air conditioning ran through the right hand engine, but on the 737-400 it ran through both. The pilots had been used to the older version of the aircraft and did not realize that this aircraft (which had only been flown by British Midland for 520 hours over a two-month period) was different. When they smelled the smoke they assumed it was coming from the right engine; this led them to shut down the working right engine instead of the malfunctioning left engine. (They had no way of visually checking the engines from the cockpit, and the cabin crew did not inform them that smoke and flames had been seen from the left engine.)

When the pilots shut down the right engine, they could no longer smell the smoke, which led them to believe that they had correctly dealt with the problem. As it turned out, this was simply a coincidence: when the autothrottle was disengaged to shut down the right engine, the fuel flow to the left engine was reduced and the excess fuel which had been igniting in the jet exhaust disappeared; therefore, the ongoing damage was reduced, the smoke smell ceased, and the vibration reduced, although it would still have been visible on cockpit instruments. The pilots, however, did not consult the vibration detectors because these instruments, on previous planes they had flown, were notoriously unreliable.

During the final approach to the East Midlands Airport, more fuel was pumped into the damaged engine to maintain speed, which caused it to cease operating entirely and burst into flames. The flight crew attempted to restart the right engine by windmilling, using the air flowing through the engine to rotate the turbine blades and start the engine, but the aircraft was by now flying too slowly for this. The captain managed to keep the now-gliding aircraft airborne long enough to avoid a crash landing in the village of Kegworth by pointing the nose up and stretching the glide, but just before crossing the M1 motorway, the tail hit the ground and the aircraft bounced back into the air and over the motorway, crashing on the opposite embankment and breaking into three sections.
Hudson river  New York 2009 aircraft crash. No loss of life
• Hudson river  New York 2009 aircraft crash.

• **Flight 1549** was a scheduled commercial passenger flight from New York City to Charlotte, North Carolina, that, on January 15, 2009, ditched in the Hudson River adjacent to Manhattan six minutes after departing from LaGuardia Airport.

• While on its initial climb out, the Airbus A320 struck a flock of Canada Geese which resulted in an immediate almost complete loss of thrust from both engines. When the aircrew determined that the aircraft would be unable to safely reach any airfield from its location just northeast of the George Washington Bridge, they turned it southbound and glided over the river into which they successfully ditched the airliner near the USS *Intrepid* Museum in midtown Manhattan about three minutes later. All 155 occupants safely evacuated the still virtually intact (although partially submerged and slowly sinking) airliner from which they were quickly rescued by nearby watercraft.

• The entire crew of Flight 1549 was later awarded the Master's Medal of the Guild of Air Pilots and Air Navigators. The award citation read, "This emergency ditching and evacuation, with the loss of no lives, is a heroic and unique aviation achievement."

An accident survey of 1,843 aircraft accidents from 1950 through 2006 determined the causes to be as follows:

- 53%: Pilot error
- 21%: Mechanical failure
- 11%: Weather
- 8%: Other human error (air traffic controller error, improper loading of aircraft, improper maintenance, fuel contamination, language miscommunication etc.)
- 6%: Sabotage (bombs, hijackings, shoot-downs)
- 1%: Other cause
Recovery from failure

- “Tightly coupled systems can survive failures, provided that the failure has been anticipated and provided for” Perrow 1984

but....(to err is human)

- The operators must avoid taking actions whose consequences have not been analysed

- The operators must respond correctly to all incidents and failures
Classification of emergencies

Stephen Covey “The Seven Habits of Highly Effective People”
Anaesthetic emergencies

- Rapidly evolving series of cascading events usually of increasing complexity
- Often exceeds ability of one person to process all aspects of the situation
- Tightly coupled situations: One false move can lead to catastrophe
Dealing with Crises

- Gut feeling, Intuition
- First principles
Intuition

- A $10 banknote folded in half, then half again, repeated a total of 100 times
- How thick would it be?
APPROXIMATELY THE SAME AS THE WIDTH OF THE KNOWN UNIVERSE:

43 billion light years

Intuition without knowledge is extraordinarily dangerous
Dealing with Crises

• Intuition & First principles

vs

• Learned and practiced algorithms and standardised procedures

  e.g. ABCD algorithm for cardiopulmonary resuscitation (CPR)
Is a “basic principles” approach suitable in an emergency situation?

• An exercise in first principles:
  • First principles:
    – Everyone reading this knows the alphabet
    – Everyone knows the months of the year,….

• Emergency situation:
  – Declare an emergency in which you have 2 minutes to deliver the correct answer without use of pen, paper or electronic device

• Emergency problem:
  – Next slide........
EMERGENCY !!!

- What are the months of the year in alphabetical order?

Most people cannot complete this task in under 2 minutes. If you have, congratulations, but would you still be willing to risk a life in an emergency using first principles alone?
Conclusion:

- In an emergency, relying on first principles or intuition without knowledge are likely to produce a poor outcome.
- Best choice in an emergency is to utilise learned and practiced algorithms and/or standardised procedure response.
Undesirable responses in crises

- Chaotic and noisy
- Superficially and calm but ineffective
Inappropriate thinking strategies

• Frequency gambling
• Coning of attention
• Confirmation bias or mindset
Declaring an Emergency

- Early recognition
- Prompt declaration
- Call for assistance
- Allocate tasks
Minimising errors and accidents

Adopt standardised protocols:

- Cleaning and maintenance
- Checking anaesthetic machine
- Preparation for patient anaesthesia
- Anaesthetic record
- Protocol for anaesthetic emergencies
Algorithm for Problems during Anaesthesia

• For anaesthetised spontaneous ventilating patient:
  – AB COVER CD A SWIFT CHECK

• For anaesthetised mechanically ventilated patient:
  – COVER ABCD A SWIFT CHECK
AB COVER CD A Swift Check

- A Airway
- B Breathing
- C Circulation & Colour
- O Oxygen supply, Oxygen analyser
- V Ventilation, Vapouriser
- E Endotracheal tube, eliminate machine
- R Review monitors and equipment
- C Circulation
- D Drugs
AB COVER CD A Swift Check

- Be Aware of Air (embolism, pneumothorax), Allergy and Anaphlaxis

- SWIFT CHECK

  Of patient, surgeon, process, response and environment
AB COVER CD A Swift Check

- Correlate monitored variables with patient’s clinical situation
- Question the surgeon about what is being done
- Check pre-operative assessment
- Check the medical record and current medications
Effective implementation

The AB COVER CD A Swift Check mnemonic should be encouraged as the basic check list every person monitoring an anaesthetic employs throughout the period of anaesthesia and recovery!
Examples: Hypoxia

Response: AB COVER CD A SWIFT CHECK

Recognition:
- SpO2 < 90%, PaO2 < 60mmHg
- Cyanosis, Tachycardia, increased respiratory effort initially

Causes: Hypoxic gas mix, Poor perfusion, lack of ventilation, poor gas exchange, anaemia

Treatment:
- Eliminate machine causes
  - If you have gas analysis check the inspired oxygen concentration
  - Follow the oxygen line from high pressure gas line, anaesthetic machine, common gas outlet port, correct patient breathing system, connected to ET tube, correctly placed ET tube, exhaust valve, scavanger
- Improve cardiac output
  - Decrease depth of anaesthesia
  - IV fluid bolus
  - Positive inotrophes if needed
- Improve alveolar ventilation
  - Gently assisted or artificial ventilation (note decreases cardiac output)
- Improve tissue oxygenation
  - Increase inspired oxygen concentration (95%)
  - Transfuse in PCV < 20%
  - Increase cardiac output
Examples: Hypotension

Response: AB COVER CD A SWIFT CHECK

Recognition:
- Mean arterial blood pressure < 60mmHg, systolic arterial pressure < 80mmHg
- Poor or undetectable pulse
- Pale or muddy mucous membranes (d/d peripheral vasoconstriction)

Causes: Excessive anaesthetic depth, blood loss, dehydration, vasodilation, poor venous return to the heart (what is the surgeon doing?)

Treatment:
- Check no Hypoxia
- Decrease anaesthetic depth
- Improve cardiac output
  - Decrease depth of anaesthesia
  - IV fluid bolus 10ml/kg rapidly
  - Positive ionotrophes if needed
- Maintain tissue oxygenation
  - Maintain PCV > 20% and TPP > 35gm/L
Examples: Hypoventilation

Response: **AB COVER CD A SWIFT CHECK**

Recognition:
- Reduced rate and or tidal volume.
- Difficulty maintaining anaesthesia
- Increased HR and BP
- Elevated ETCO2

Causes:
- Excessive depth of anaesthesia
- Inability to expand the chest
- Airway obstruction

Treatment:
- Check you are administering oxygen (Hypoventilation always causes hypoxia unless O2 enriched inspired gas mixture is administered)
- Compress the rebreathing bag and deliver a positive pressure breath: inflate the chest check there is no airway obstruction, or disconnect.
- Apnoea on induction: Manually ventilate 2-4x per minute, not to often or the PaCO2 will fall and the apnoeic threshold exceeded
- Reduce anaesthetic depth
- Reposition ET tube or patient
- IPPV
Mouth gags are a risk factor for cortical ischaemia in cats

Updates in the American Heart Association guidelines for cardiopulmonary resuscitation and potential applications to veterinary patients

Barbara L. Maton, DVM and Sean D. Smarick, VMD
Latest on CPR

Which is the correct hand position?
Latest on CPR

• Be selective.
  – Acute arrest: Yes
  – Chronic underlying disease: result of many slowly developing derangement until cumulative effect is catastrophic: No

• ABC (human arrest is usually MI - use CAB)
  – Right lateral recumbency, preferably head down
  – Continuous chest compressions 100-120/min. Do not stop (at most 10 sec interruptions)
  – IPPV but don’t stop chest compressions
  – Between breaths allow lungs to fully deflate (to FRC)
  – Dog < 15kg cardiac pump 3rd-6th rib lower third chest
  – Dog > 15kg thoracic pump 7th-8th rib at widest chest
  – Internal cardiac massage after 2-5min esp. big dogs
Latest on CPR

- Chest compressions
  - Permit complete elastic recoil between each compression
  - In dog VF model after 30 min manual CPR
    - 120 beat/min successful defibrillation in 12/13
    - 60 beat/min successful defibrillation in 2/13

- Ventilation
  - 2 per 30 chest compressions
  - Permit chest to return to FRC after each breath.
  - 20-25 breaths/min.
  - Max Pressure 20mm Hg.
  - 100% O₂ (later give an antioxidant to reduce neurological sequellae at 24 hours)
Latest on CPR: drugs

- **Adrenalin**
  - 0.1mg/kg (0.1ml/kg 1:1000) iv
  - Then maintenance 0.1ug/kg/min (1ml 1:1000 to 1L Hartmann’s soln, infuse at 1ml/10kg/min)

- **Vasopressin**
  - Vasoconstrictor 0.8 u/kg iv
  - Asystole, VF, VT & PEA (pulseless electrical activity)
  - Superior to adrenalin for VT in animals

- **Anti-arrythmics**
  - Lidnocaine 2-4mg/kg. VT or relapsing VF after CPR
  - Amiodarone 5mg/kg IV over 10 mins. Shock resistant VT & VF, AF, narrow complex SVT.

- **Do not use:** Ca, glucose, atropine, HCO3
Latest on CPR: drugs

• Administration of drugs
  – IV, followed by saline chaser, elevate arm 10-20 sec
  – IV is best IO (Intra-osseous administration) is good,
  – IT (intra-tracheal) is last resort. Double dose except adrenalin 10x dose and dilute in 5-10ml sterile water.
  – IC (intra-cardiac) not recommended

• IV Fluids
  – Only shock doses if pre-arrest hypovolemia
  – Euvolemia:
    • Crystalloids D 20ml/kg bolus  C 10ml/kg bolus
    • Hetastarch  D 5ml/kg bolus  C 2.5ml/kg bolus
    • 7.5% saline D 2-4ml/kg

• Hypothermia. 33-34oC is OK post-arrest

• Success =Team work. Requires leaning and practice
Latest on CPR: outcomes

- **ETCO\(_2\)**
  - In dog arrest model
    - If ETCO\(_2\) < 15mm Hg 94% unsuccessful
    - If ETCO\(_2\) > 15mm Hg 86% successful
  - In cat arrest model
    - If ETCO\(_2\) > 20mm Hg 90% successful
  - In man
    - If ETCO\(_2\) < 10mm Hg improve CPR technique
    - If ETCO\(_2\) 35-40mm Hg indicates possible return of spontaneous circulation

- **Survival**
  - Overall dogs 6% and cats 7%
  - Anaesthetic vs non-anaesthetic associated deaths 47% survival vs 2%
CARDIOPULMONARY RESUSCITATION

Appropriateness: acute healthy heart vs chronic unhealthy heart

ABC still best sequence for most dog & cat arrests as these are likely. PEA, asystole, commonly associated with respiratory pathology and hypoxia. In man, most common arrest is VF requiring CAB

Airway: Inguatate, tracheal catheter, tracheostomy

Circulation: Don't stop! (pause < 5 sec only for ECG rhythm analysis or defibrillation shock)
- External cardiac compression (ECC). Allow complete thoracic recoil between compressions
  - Cardiac pump: over widest part of chest
  - Thoracic pump: 100 beats/min
- Internal cardiac compression (ICC)
  - If thorax is open, when ECC fails (2 minutes), when ECC futile
  - 'Chronic' arrests, in dogs > 18 kg, if ECG unavailable

Breathing: Return to FRC after each breath. 20-25 breaths/min. Max Pressure 20mm Hg. 100% O2

Drugs: IV or IT x3. Hold leg up 60-90 sec. Give chaser

Drugs: adrenalin (epinephrine)
- Dose: 100 µg/kg IV (30 µg/kg IT)
- Produces greatest P A, V, CBF, CoF, refibililation rate, mortality rate

Drugs: vasoressin (ADH: octreline vasoressin).
- 40 IU in H. Sapiens. 8 to 10 IU/kg dogs and cats
- 2 doses of 0.8 IU/kg
  - stimulates vascular SMV1 receptors, not deranged by hypoxia & acidemia, greater "go-home" rate in H. Sapiens
  - Pulseless electrical activity (PEA) eg VT, non-perfusing rhythm. "shockresistant" VF, VT

Drugs: Amiodarone
- 5.0 mg/kg IV or IO over 10 minutes, repeat dose 2.5 mg/kg IV after 3-5 minutes
- For shock & vasoressin resistant VF, ventricular tachycardia

Drugs: Magnesium (Mg²⁺)
- 1.0 mmol kg⁻¹ over 10 minutes
- Ventricular arrhythmias refractory to epinephrine & vasoressin

Drugs: Lidocaine
- 1.4 mg/kg IV for VF

Drugs: Fluids
- only if resuscatee is hypovolaemic
- Crystalloids: dogs: 20 ml kg⁻¹ IV cats 10 ml kg⁻¹ IV
- Hetastarch: dogs: 5 ml kg⁻¹ IV cats 2.5 ml kg⁻¹ IV
- 7.5% saline improves survival rates

Electrical defibrillation
- External: Monophasic: 2 - 5 Joules kg⁻². Biphasic 30% less (better survivals)
- Internal: Monophasic: 0.1 - 0.5 Joules kg⁻¹
- Lowest energy setting, then step dose up after each unsuccessfully shock
- Cardiac massage inter discharge for 2 minutes

Follow Up
- Oxygenation. SpO₂
- Ventilation. Monitor ETCO₂. If ETCO₂<10mm Hg improve CPR technique
- Fluids & urine output
- Inotropes & antiarrhythmics
- Analgesics, warmthor 34°C, antibiotics, position
- Neurological sequelae, i.e. diazepam
- Monitor, TIC
CPR Protocol

Latest Recommendations

For free copies
www.stah.net.au

CARDIOPULMONARY RESUSCITATION

Appropriateness: acute healthy heart vs chronic unhealthy heart
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- Allow complete thoracic recoil between compressions
- Cardiac pump over 5-7th rib 110-130 beats/min
- Thoracic pump over widest part of chest 100 beats/min
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      - Hetero血
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    - 7.5% saline: Improves survival rates

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  - Fluids & urine output
  - Inotropes & antiarrhythmics
  - Analgesics, warmth or 34°C, antibiosis, position
  - Neurological sequelae, i.e. diazepam
  - Monitor, TLC
Everyone can drive...

But it's how you drive that counts!