3.8 EMERGENCY MEDICINE

S.Unwin
History and Presentation

Signalment:
Medical Hx:
Usual/recent diet
Food and fluids taken in the last few days
Recent sinking of eyes
Duration/frequency/appearance of vomiting/diarrhoea
Time when urine was last passed
Possible contact with people with an anthropozoonotic disease (e.g., TB)

EMERGENCY?
Hydration state – assessing 5-12% dehydration
Temp – outside 35-39°C
Auscultation/palpation – fluid sounds/pain/arrhythmia etc.
Responsiveness – physical vs. psychological issues?

AIRWAY?
Allow initial physical exam?
Y
N
Begin CPR procedure to gain a patent airway.
WARNING: even an unresponsive chimp or drill may bite by instinct!!

BREATHING
N
Y
1. After achieving a patent airway, one must determine whether the animal is breathing, and whether this breathing is effective. If not: CONTINUE BREATHING TECHNIQUE.

CIRCULATION?
Y
N
Look for signs of circulation – normal breathing, coughing, or movement. If these signs are still absent, begin chest compressions. If the animal has signs of circulation, DO NOT begin chest compressions. Doing so may cause the heart to stop beating. REFER TO CPR CHART.

Initial Physical Examination

Drugs (Emergency) Therapy

To Quarantine.
To Monitor.
General anaesthetic in 2-3 days.

1. Place IV Catheter
2. Fluid Therapy (see relevant section)
3. Adrenaline required? Intramuscular injection is no longer recommended. Attempt IV administration, intravenous intratracheal, sharing with sterile water (see drug dosage chart).
4. Initial required? If sedative/anaesthetic unavailable, use Dexamethasone sodium phosphate 12mg/kg IV.
5. Check blood glucose levels – only administer IV dextrose if hypoglycaemic.
6. O2 aminophylline if necessary

POST MORTEM THERAPY
Oxygen: 40% for 24 hours if possible
Fluids: 1.5 times maintenance levels
Broad-spectrum Antibiotics (Methicillin-resistant Staphylococcus aureus, 10mg/kg)
Methylprednisolone (15-30mg/kg) or dexamethasone (5-15mg/kg) IV every 6 hours for up to 72 hours post resuscitation

Other therapy required?
Fluids – Oral?
Analgesics
Antibiotics
Antiemetics
Other

RESUSCITATION成功?
Y
N

Full Examination
Including sample collection and testing

Results/ Prognosis

FOLLOW UP/ PLAN. ASSIGN MONITORING/ PRIMARY CARGIVER. DETERMINE REGULARITY OF RECHECKS. WRITE EVERYTHING DOWN!!
Emergency medicine is a constantly changing field. These notes are designed to form the basis of emergency treatment at your facility, but they are NOT COMPLETE. The information presented here by necessity is a mixture of domestic and zoo animal protocols, and human therapy recommendations.

During an emergency it is very important that you remain calm. Animals can sense your unease, but cannot understand what is happening and you cannot verbally tell them. Your body language is very important. Be calm, yet deliberate in your actions.

It is recommended you read the companion notes on primate fluid therapy. These notes contain:

- Suggested emergency box contents
- Emergency medication dose rates (also refer to the Formulary)
- Cardiopulmonary resuscitation- based on canine and human (adult and infant) protocols
- Hyperthermia-induced cardiac arrest in monkeys: limited efficacy of standard CPR - published paper abstract
- IV access technique – web published veterinary notes (canine)
- Pneumothorax
- Severe wounds
- Haemorrhagic gastroenteritis
- Hypoglycaemia
- Seizures
- Appendix – Management of the trauma patient intergrated approach – Web published veterinary notes
**EMERGENCY DRUG BOX**
This is in addition to an anaesthetic box – both of which are on hand for all procedures

Anicath I/V catheters – size 14g, 18g, 22g, 26g (x1 of each)

Catheter stoppers with injection port x 2

Surgical spirit

Cotton wool

Hepflush (Heparinised saline for catheters)

Elastoplast 2.5cm

Tissue glue

Monoject needles – pink (18g) x5
Yellow (20g) x 5

Syringes – 1ml, 2ml, 5ml, 10ml, 20ml – at least 2 of each size

(minimum drug levels)
*Article I.*  
Diazepam 5mg/ml x 2ml x 10 vials
Adrenaline 1:100 1mg/ml x1ml x 20 vials
Dopram v injection 25ml x 1
Atropine (atrocare) 25ml x 1
Frusenide 5% 10ml x 1
Dexadreson 50ml x 1
Solumed 8ml x 6 vials
Water for injection 100ml x 1

Dose chart (see table 1)
<table>
<thead>
<tr>
<th>Drug</th>
<th>Trade Name</th>
<th>Dose</th>
<th>Reason</th>
<th>5Kg</th>
<th>10Kg</th>
<th>25Kg</th>
<th>50Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADRENALINE 1:1000 = 1mg/mL</td>
<td>Adrenaline – can dilute</td>
<td>0.1mg/kg (0.01- 0.2mg/kg) 0.01mg/kg</td>
<td>CARDIAC ARREST – give IV asystole/ fibrillation</td>
<td>0.5mL</td>
<td>1mL</td>
<td>2.5mL</td>
<td>5mL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ANAPHYLAXIS – give IM</td>
<td></td>
<td>0.05mL</td>
<td>0.1mL</td>
<td>0.25mL</td>
<td>0.5mL</td>
</tr>
<tr>
<td>ATROPINE 0.6mg/mL</td>
<td>Atropine</td>
<td>0.04mg/kg</td>
<td>CARDIAC ARREST, asystole, vagally induced arrhythmias</td>
<td>0.33mL</td>
<td>0.66mL</td>
<td>1.66mL</td>
<td>3.33mL</td>
</tr>
<tr>
<td>GLYCOPYRROLATE 200ug/mL</td>
<td>Robinul</td>
<td>(5-) 10ug/kg</td>
<td>CARDIAC ARREST asystole, vagally induced arrhythmias</td>
<td>0.25mL</td>
<td>0.5mL</td>
<td>1.25mL</td>
<td>2.5mL</td>
</tr>
<tr>
<td>LIDOCAINE 20mg/mL</td>
<td>Xylocaine 2% Lignocaine 2%</td>
<td>1-5mg/kg slowly then infusion at 25-100ug/kg/min</td>
<td>Ventricular arrhythmias/ ventricular fibrillation</td>
<td>0.25-1.25mL</td>
<td>0.5-2.5mL</td>
<td>1.25-6.25mL</td>
<td>2.5-12.5mL</td>
</tr>
<tr>
<td>PROPRANOLOL 1mg/mL</td>
<td>Inderal can dilute in saline</td>
<td>0.02-0.08mg/kg/kg slowly</td>
<td>ARRHYTHMIAS supraventricular tachycardia</td>
<td>0.1-0.4mL</td>
<td>0.2-0.8mL</td>
<td>0.5-2mL</td>
<td>1-4mL</td>
</tr>
<tr>
<td>VERA PAMIL 2.5mg/kg</td>
<td>Securon</td>
<td>0.05mg/kg slowly</td>
<td>Supraventricular tachyarrhythmias</td>
<td>0.1mL</td>
<td>0.2mL</td>
<td>0.5mL</td>
<td>1mL</td>
</tr>
<tr>
<td>ISOPRENAline 1mg/mL</td>
<td>Sezentrine</td>
<td>0.04-0.1ug/kg/min infuse to effect</td>
<td>BRADICARDIA/ AV BLOCK</td>
<td>To effect</td>
<td>To effect</td>
<td>To effect</td>
<td>To effect</td>
</tr>
<tr>
<td>FRUSEMIDE 5% 50mg/mL</td>
<td>Lasix 5%</td>
<td>(1-) 2 (4) mg/kg</td>
<td>OEDEMA/ DIURESIS</td>
<td>0.2mL</td>
<td>0.4mL</td>
<td>1mL</td>
<td>2mL</td>
</tr>
<tr>
<td>DEXTROSE 5-50% 50- 500mg/mL</td>
<td>Dextrose/glucose</td>
<td>0.25-0.5g/kg slowly</td>
<td>HYPOGLYCAEMIA not by peripheral vein if &gt;10% solution</td>
<td>1.25mL</td>
<td>2.5mL</td>
<td>6.25mL</td>
<td>12.5mL</td>
</tr>
<tr>
<td>DOXAPRAM 20mg/mL</td>
<td>Dopram V</td>
<td>(1-) 5 (10) mg/kg</td>
<td>RESPIRATORY STIMULANT</td>
<td>1.25mL</td>
<td>2.5mL</td>
<td>6.25mL</td>
<td>12.5mL</td>
</tr>
<tr>
<td>METHYL-PRED SUCCINATE 125 or 500mg</td>
<td>Solu-medrone</td>
<td>30mg/kg</td>
<td>SHOCK/ ALLERGY/ CEREBRAL OR SPINAL OEDEMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIAZAPAM 5mg/mL</td>
<td>Diazapam/ vallium/ pamlin</td>
<td>0.5mg/kg</td>
<td>SEIZURES</td>
<td>0.5mL</td>
<td>1mL</td>
<td>2.5mL</td>
<td>5mL</td>
</tr>
</tbody>
</table>
CARDIO PULMONARY RESUSCITATION – A B C D E

If an animal is breathing, its heart MUST be beating also.

A = Airway

The first step in animal CPR, after determining non-responsiveness, is to obtain a patent airway. You should not continue on, until this step has been achieved.

1. Carefully pull the tongue out of the animal's mouth
   WARNING: even an unresponsive chimp or drill may bite by instinct!!
2. Make sure that the neck is reasonably straight; try to bring the head in-line with the neck.
   WARNING: Do not hyperextend in cases where neck trauma exists.
3. Attempt 2 rescue breaths, by closing the mouth, and performing mouth-to-nose ventilations. If they go in with no problems continue to B-Breathing.
4. Reposition the neck and try step 3 again.
5. Visibly inspect the airway by looking into the mouth, and down the throat for foreign objects occluding the airway. Unlike human-CPR, rescuers may reach into the airway and remove foreign objects that are visible.
6. Intubate – or -
7. **Procedure of performing an emergency tracheotomy (Figure 1)**

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**Figure 1.** Procedure for performing an emergency tracheotomy. After Plunkett 1993 Emergency Procedures for the Small Animal Veterinarian. WB Saunders.

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B = Breathing

After intubation, ventilatory assistance is the same as humans. Bag-Valve resuscitators are the normal instrument of choice (if you can get one donated), however a demand-valve power-resuscitator should work fine. Some animals will not tolerate a mask of any kind, so use high-flow blow-by on breathing animals in respiratory distress.

1. After achieving a patent airway, one must determine whether the animal is breathing, and whether this breathing is effective. If not:
2. Carefully pull the tongue out of the animal’s mouth and check colour.
3. Make sure that the neck is reasonably straight; try to bring the head in-line with the neck. 100% oxygen administration, OR -
4. Ventilate the animal by closing the mouth, and performing mouth-to-nose ventilations. If they do not go in with ease go to A-Airway
5. Ventilate at 20-30 breaths per minute. Note that if supplemental Oxygen is available, and the animal is breathing on its own, use a high-flow blowby.
6. Proceed to C-Circulation, while continuing respiratory support as necessary

C = Circulation

This is the final step of CPR and should only be initiated after the airway and breathing steps have been completed. Make sure that there are no major (pooling/spurting blood) points of bleeding. Control as necessary. If a spinal injury is suspected, DO NOT tilt the head back when attempting to open the airway. Instead, place your fingers on the jaw on each side of the head. Lift the jaw forward. This keeps the head and neck from moving. Look for signs of circulation -- normal breathing, coughing, or movement. If these signs are still absent, begin chest compressions. If the animal has signs of circulation DO NOT begin chest compressions. Doing so may cause the heart to stop beating.

For guenons and mangabeys, and babies of other species, including the apes, the human infant protocol can be adapted:
1) Make sure animal is on a hard surface lying on their back.
2) Landmark – Create an imaginary line between the animals nipples. Take your index finger and put it on the centre of the line. On the same hand use your middle finger and your ring finger and place them beside your index finger which is on the imaginary line. These two fingers will be what you use to perform the chest compressions. (see figure 2)

Fig 2. Method of chest compression in a baby/ small primate during CPR
3) Perform chest compressions with the two fingers on the animals chest. Use your free hand to secure the infants head and to tilt the head back to open the airway. 20 cycles of 5 chest compressions to 1 breathe (puff). Make sure the compressions are about 2 compressions / second. It might seem fast but it’s needed for proper circulation. Make sure each compression is 0.5 to 1 inches in depth.

**For larger monkeys and chimpanzees, the following can apply:**
1. Make sure animal is on a hard surface lying on their back.
2. Simultaneous chest compressions and ventilation every 2-3 compressions
3. 80-120 chest compressions per minute
4. Compress chest in a ‘coughlike manner’ causing approximately 30% displacement of the chest wall
5. Application of a counter pressure device (bandages etc) to the caudal half of the patient may be of benefit

**For gorillas, the adult human protocol can apply:**
1. Make sure animal is on a hard surface lying on their back.
2. Perform chest compressions:
3. Place the heel of one hand on the breastbone -- right between the nipples.
4. Place the heel of your other hand on top of the first hand.
5. Position your body directly over your hands. Your shoulders should be in line with your hands. DO NOT lean back or forward. As you gaze down, you should be looking directly down on your hands.
6. Give 15 chest compressions. Each time, press down about 2 inches into the chest. These compressions should be FAST with no pausing. Count the 15 compressions quickly: "a, b, c, d, e, f, g, h, i, j, k, l, m, n, off."
7. Give the animal 2 slow, full breaths. The chest should rise.
8. Continue cycles of 15 chest compressions followed by 2 slow, full breaths.
9. After about 1 minute (four cycles of 15 compressions and 2 breaths), re-check for signs of circulation.
10. Repeat steps 11 and 12 until the animal recovers –then place in the recovery position.

**D = Drug Therapy**

1. Place IV Catheter
   - <6.5kg, 20 GA needle
   - 6.5-10 kg, 18 GA needle
   - 11-15 kg, 16 GA needle
   - 16-21 kg, 14 GA needle
   - >21 kg, 2 or more 14 GA needles.
2. Fluid Therapy (see relevant section)
3. Adrenaline required? Intracardiac injection is no longer recommended. Attempt IV admin, but if unsuccessful, attempt intratracheal, diluting with sterile water (see drug dosage chart).
4. Steroid required? If solumedrone unavailable, use Dexamethasone sodium phosphate 4-10mg/kg IV.
5. Check blood glucose levels – only administer IV dextrose if hypoglycaemic.
6. DO NOT use sodium bicarbonate unless MEASURED bicarbonate OR CPR attempts last longer than 15-20 minutes. Dose = 1-1.5 mEq/kg (about 1mL/kg)

E = Extra – post-resuscitation therapy

a. Oxygen: 40% for 24 hours if possible
b. Fluids: 1.5 times maintenance levels (see fluid therapy notes)
c. Antibiotics – administer broad spectrum antibiotics
d. Methylprednisolone succinate (15-30mg/kg) or dexamethasone (5-15 mg/kg) IV every 6 hours for up to 48 hours post resuscitation
e. Avoid dextrose solutions postresuscitation as they seem to affect patients neurologic status adversely.

Hyperthermia-induced cardiac arrest in monkeys: limited efficacy of standard CPR
Eshel G, Satar P, Radovsky A, Stezoski SW
Aviat Space Environ Med 1997; 68:415-20
Abstract

**Background:** Successful resuscitation from heatstroke cardiopulmonary arrest has been only partially explored and the data covering the post resuscitation pathophysiology leading to secondary arrest is, in most cases, insufficient. **Hypothesis:** Following heatstroke-cardiopulmonary arrest, successful resuscitation may be achieved by standard CPR with surface cooling and administration of glucose. We ponder the sequence of early circulatory responses and the pathophysiological changes following successful resuscitation. **Methods:** We exposed 12 pigtail monkeys to total- body hyperthermia (cerebral T 42°C) until cardiac arrest ensued. Standard external CPR with surface cooling and glucose 5% IV were administered for up to 30 min. Control group A (n = 6) was compared with experimental group B (n = 6), which received additional steroid, glucagon and hypertonic glucose during CPR attempts. **Results:** No significant differences were found between the outcome of the two groups. The 30-min CPR attempt succeeded in restoration of spontaneous circulation (ROSC) in 8/12 monkeys - 5 animals from group A and 3 in group B. The animals in whom resuscitation was unsuccessful had significantly prolonged periods of rectal temperature exceeding 42.5°C (p < 0.05), and significantly higher rectal temperatures at the end of 30 min of CPR and cooling (p < 0.05). All the resuscitated animals later rearrested at 158 ± 68 (95-228) min after ROSC; pulmonary edema occurred in 6/8 animals. **Conclusions:** We conclude that experimentally- induced heatstroke can be transiently reversed by standard resuscitative procedures, but is followed by a delayed, irreversible, secondary shock state, which could not be prevented by the treatment we employed. We were, however, able to document in detail the pathophysiologic processes involved in the resuscitation, and the irreversible shock one sees after "successful" CPR.
**Pneumothorax**

Much of the protocols in this section is based on Plunkett (1993) – Emergency procedures for the small animal veterinarian.

**Diagnosis:**
May or may not have a history of trauma. Dyspnoea, open-mouthed breathing, dullness on percussion, crepitation, cyanosis, diminished lung sounds, muffled heart sounds, hyperresonance with chest percussion.

**Prognosis:**
Guarded

**Treatment:**
A closed chest pneumothorax is often tolerated better by animals than by humans, however it is still an EMERGENCY SITUATION. Here is the technique for reducing a tension pneumothorax which must be done IMMEDIATELY:

a. Lay the animal lateral with the pneumothorax up
b. Find the 8th intercostal space
c. Using an 18 gauge needle, insert the needle on the caudal (inferior) margin of the 8th intercostal space at the dorsal third of the chest wall
d. Using a stop-cock or other venting technique, reduce the pleural tension

The pneumothorax is now ‘open’ and can be treated as followed

a. Oxygen administration
b. Bilateral thoracocentesis, possible chest tube placement (see below). Use sterile technique (clip and scrub site, wear sterile gloves, use sterile equipment).
   Depending on the degree of distress and the volume of air removed from the chest, a chest drain usually is not placed unless thoracocentesis has been performed twice.
c. Stabilization for shock/ minimise stress
d. Place an IV catheter – measure PCV and TP.
e. Treat the cause of the pneumothorax – IV fluids, corticosteroids for shock etc.
f. Administer antibiotics
g. If possible, keep the animal separated for at least 3-4 days to monitor.

**Chest Tube Placement.** Use of a chest drain will depend greatly on the ability of the animal to remove it and the increased possibility of infection. I have included tube placement here for completeness, but this would usually be an unrealistic option in primate species.

a. Clip, scrub, prep the seventh intercostal space on animals side Marcaine or lidocaine nerve block
b. Pull the skin forward, incise skin with scalpel blade (approximately 2cm long incision).
c. Make a small hole in the intercostals muscles.
d. Advance the chest tube (DO NOT USE A FOLEY CATHETER) through the hole into the chest with curved haemostats.
e. Suture the chest tube to intercostals muscles and skin.
f. Place a pursestring suture in the skin around the placement site to improve security.
g. Apply antibiotic dressing (eg. Betadine) and occlusive dressing.

**Severe wounds (inc. wound dehiscence)**
Deep wounds in primates are often left, and the animal placed on antibiotics – these usually heal well. The animal must however be closely monitored for signs of septicaemia and other complications. Lacerations on sexual swellings should be left alone until swelling reduces if closure is deemed appropriate. Lacerations on other parts of the body should be closed when the wound is still clean, or allowed to heal by second intention, depending on whether it is felt that sutures / tissue glue etc will cause the animal to pick at the wound. All sutures should be buried (intradermal).

**Prognosis:**
Excellent unless internal injuries, severe haemorrhage, or other injuries are present.

**Treatment:**
a. Control haemorrhage with pressure bandages if necessary.
b. Give antibiotic injection as soon as possible – for deep and dirty wounds, should be on antibiotics for 5-10 days.
c. Carefully assess the trauma patient before administering anaesthesia. Treat shock and life-threatening problems first
d. IF POSSIBLE – take radiographs – inject contrast media into bite wounds to follow their tracks and determine their depth.
e. Clip, scrub, flush, prep wounds. For deep contaminated wounds, consider using a dilute metronidazole (flagyl) or crystapen (penicillin) solution as the flush solution, otherwise flush with sterile saline or lactated ringers solution.
f. Explore wounds thoroughly, especially those over the chest and abdomen. If a wound perforates into the chest, then perform thoracocentesis.
g. Debride wounds thoroughly. Flush with large amounts of sterile saline/ LRS.

**(Near) drowning**

Diagnosis: By physical exam – Moist cough, cyanosis, dyspnoea, moistbronchovesicular sounds, epistaxis.

Prognosis: Guarded to poor.

**Treatment:**
a. Administer oxygen if possible. To reduce pulmonary oedema, if you have access to a nebuliser, administer the oxygen through the nebuliser filled with a 1:2 mixture of 100-proof vodka (or similar): sterile water.
b. Place an IV catheter
c. Furosemide IM, IV or PO (see table for doses) – diuretic.
d. Bronchodilators:
e. Aminophylline 2-8mg/kg SLOW IV, IM or PO q8-12h.
f. Albuterol 0.02-0.05mg/kg PO q8h
g. Terbutaline 0.01mg/kg SC q4h.
h. Dexamethasone sodium phosphate 4-8mg/kg IV
i. Administer broad spectrum systemic antibiotics
j. Severe nonresponsive dyspnoea may require sedation and positive pressure ventilation, extremely poor prognosis
k. Nitroglycerin ointment and ½ inch applied to a clipped area on the thorax or abdomen q4-6h, especially for pulmonary oedema (venous dilator).

**Haemorrhagic gastroenteritis**
An easy way in an animal with severe diarrhoea, to check for occult blood, is to ‘diff quik’ a smear and check for blood cells. If these are present, this indicates that there is a breakdown of the gastrointestinal lining, and antibiotics may be indicated. If at all possible, diagnose the cause of the diarrhoea. If obvious haemorrhage (dysentery), treat as follows:

a. LRS 30-60mL mL/kg until the PCV drops below 50% - see fluid therapy notes for use of oral fluids
b. Antimicrobial therapy (penicillins) – IF INDICATED
c. Corticosteroids (2-4mg/kg dexamethasone sodium phosphate IV or 5-10mg/kg prednisolone succinate IV) if in shock – and only within 2 hours on onset (their use remains controversial).

d. Salicylates with or without pectin (eg. Pepto-bismol), if no vomiting.
e. Nothing orally for 12-24 hours. Start on oral liquids after 12-24 hours, gradually introducing bland food (such as rice base/ bland baby food), then gradually switch back to regular diet.

**Hypoglycemia (covered in malnutrition notes also)**
Hypoglycemia is a serious, immediate life threat, and needs to be treated aggressively. As in humans, the results can be startling in how rapid a patient can recover (if at all) from severe hypoglycemia. 

a. Start LRS with D5 (LRS with 5% dextrose) IV Drip
b. Bolus 2-4ml/kg D50 (50% dextrose in water) or 20ml/kg D10 (10% dextrose in water)
c. Reassess the blood glucose levels if possible

**Seizures**
Although it is rare for an animal to require emergency care due to seizures, their treatment is the same as in humans: Mostly supportive. If possible, place a pad under the head to prevent trauma, and assure that there is no hazard from the environment to the patient. Do not stick ANYTHING in an animals mouth. If the animal sustains the seizure state for more than 5 minutes, then treat as Status
Epilepticus. The 2 main drugs used in Veterinary medicine for the cessation of seizures is Diazepam (Valium) and Phenobarbital.

- Diazepam 1mg/kg (can work IM, but very slow action)
  Note: you can also administer rectally, which works quite well
- Phenobarbital 60-120mg or 2-4 mg/kg