An Approach to the Avian Emergency

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SUMMARY

Avian emergencies often induce undue confusion and stress on the attending veterinarian., yet basic principles and equipment are common to the emergency care of mammals and birds. This essay is a practical guide for approaching an avian emergency from first contact with, to stabilisation, of the patient. It is intended as a basic guide to the initial assessment and management of such cases. Preparation and planning are crucial in life and death situations and particularly so when faced with the potentially rapidly deteriorating health status of the avian patient.

The following document outlines an approach to the initial physical examination and assessment of birds with emphasis on prioritising diagnostic and therapeutic steps. Identifying and responding to respiratory and cardiac problems is discussed, as is the practical application of fluid therapy, oxygen supplementation and drug use.

In addition, emergency blood transfusions, their indications, methodology and complications, are addressed. As with other species, a growing trend towards pain management is evident in avian medicine and practical options to this end are mentioned. In many emergencies anaesthesia is required for a variety of reasons and a basic anaesthetic plan is given. Finally the important roles of husbandry, nutrition and ongoing monitoring in supporting any initial efforts are discussed.

INITIAL APPROACH, ASSESSMENT AND STABILISATION OF AN EMERGENCY CASE (INCLUDING RESUSCITATION)

<u>A Review Of The Unique Physiology Of Birds In Reference To Emergency Care</u>

The basic principles of emergency medicine apply to both birds and small animals, however anatomical, physiological, and behavioural differences between birds and mammals exist and must be considered (Kaufman 1992, Quesenberry and Hillyer 1994)
Of particular relevance to emergency care:

a) <u>Unique Respiratory Tract (Echols 1999)</u>

- Visible glottis.
- Trachea with complete tracheal rings and looped/convoluted nature in some birds.
- Non-expansile lungs which require a continual flow of air through them unlike mammals.
- Absence of a diaphragm.
- Presence of 8 air sacs involved during inspiration and expiration with the exchange of air with the lungs.

<u>Significance:</u>

- Intubating birds is performed via the glottis which is situated dorsally on the laryngeal mound on the floor of the pharynx (Curro, 1998; Lukasik, 2000)

- S Complete cartilaginous tracheal rings make accidental choking of birds difficult and also predispose the bird to tracheal injury secondary to endotracheal tube cuff overinflation (Echols 1999; Lukasik 2000).

- S The convoluted trachea of some birds can significantly increase dead space (Curro, 1998; Lukasik, 2000).

- S Gas exchange in birds is reliant on the movement of air through the lungs on inspiration and expiration. For this to occur there must be a patent airway, and a functional relationship between air sacs, lungs and the movements of the ribs, sternum and abdomen (Echols 1999). Restricting this movement externally by overenthusiastic restraint or positioning in sternal recumbency during anaesthesia may compromise normal respiration (Curro, 1998; Echols, 1999; Lukasik, 2000).

- S Birds die more quickly than mammals secondary to apnoea due to cessation of the constant oxygen exchange normally occurring in the avian lung, and also due to a higher metabolic demand (Harrison, 1986; Echols 1999).

- S Air sacs provide an alternate access point to the respiratory tract (Barnes, 1998).

b) Cardiovascular System

- S High resting heart rate compared with larger mammals (Sturkie, 1986; Verkest, 1994).

- S Excellent ability to withstand blood loss, in particular the flighted birds which utilise reflex peripheral vasoconstriction to preserve vital organ function much better than non-flighted birds and mammals (Abou-Madi and Kollias, 1992).

Significance:(Barnes, 1998)

- S High heart rates: may be difficult to assess rate and rhythm disturbance or murmurs.

- S Blood loss (relative to size) may not be as significant as in dogs and cats, and volume replacement may have more pronounced benefits.

c) Response To Stress

- S Birds often conceal serious illness until the point of decompensation (Pasco, 1985; Huff, 1993).

- S The response to stress is marked in avian patients and the much higher metabolic rates of birds means that they often suffer more rapid changes in condition and are more significantly affected by "stressors" (Harrison, 1986; Barnes, 1998). The handling, housing and environmental conditions provided by a veterinarian may dictate recovery or death (Harrison, 1986).

Significance (Barnes, 1998)

- S Efficient, thorough, and sensible assessment and stabilisation of avian emergencies is paramount.

- S Reduction of stressors (noise, temperature, handling) is important.

- S Careful patient monitoring and early corrective therapy are desirable.

d) Thermoregulatory Mechanisms

- S Birds are small animals with a high surface area to body weight ratio and hence are prone to hypothermia. Behavioural adaptations such as feather fluffing are important in thermoregulation.

Significance

- S Sick birds often suffer from hypothermia due to a disruption of normal thermoregulation. Keeping birds warm during hospitalisation will reduce stress on the bird and improve recovery by avoiding wastage of energy reserves of the bird (Kaufman, 1992).

- S Birds under anaesthesia also require thermal support to avoid hypothermia which will occur more readily than in the dog and cat (Echols, 1999).

e) Other

- S Many other differences exist and some will be mentioned in the relevant sections.

BASIC GOALS OF AVIAN EMERGENCY CARE

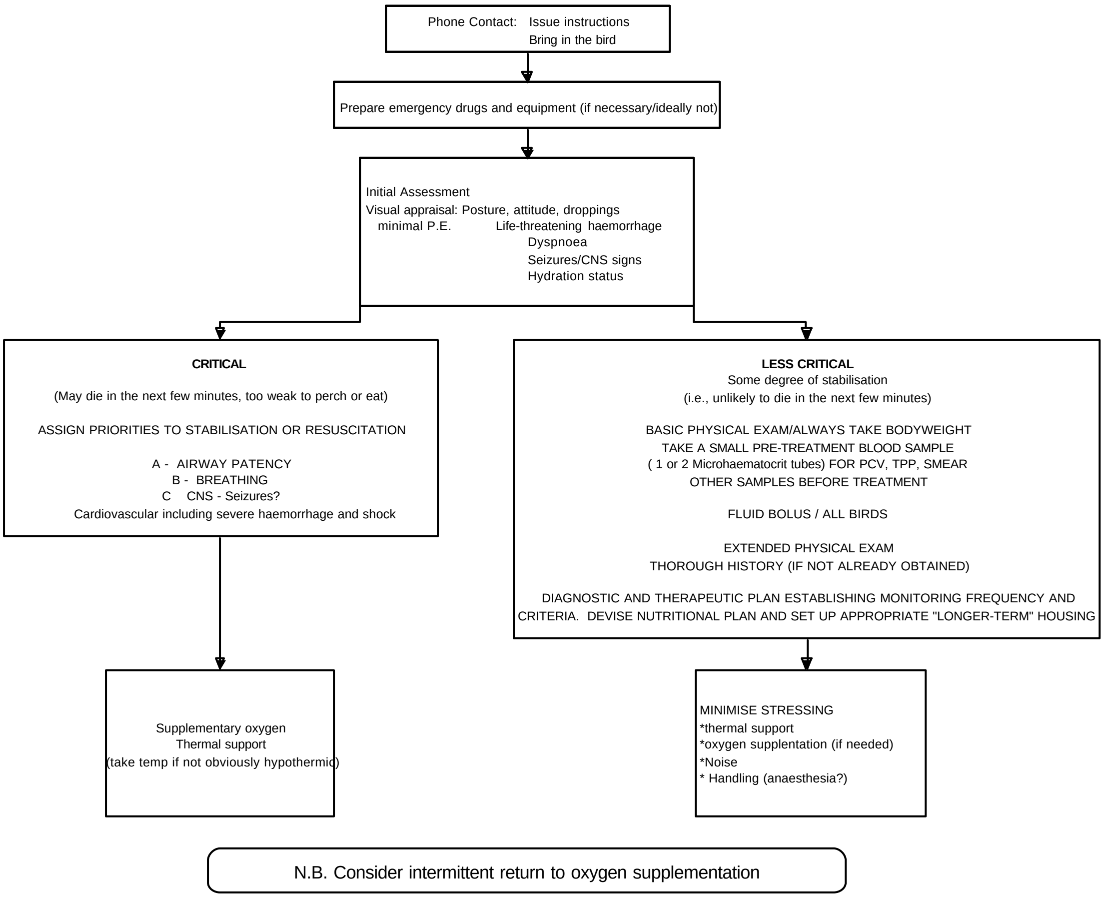
In approaching avian emergencies some basic goals exist. These include:

- Preparation and planning:
  All equipment and medications should be gathered prior to performing any procedure, and a plan for that procedure and potential complications should be devised (Jenkins, 1987).
- Minimum restraint and handling time to minimise stress (Barnes, 1998).
- Careful and accurate assessment and patient monitoring.
  Often therapy is provided in an optimal rather than a maximal capacity.

AN APPROACH TO SEQUENCING OF ASSESSMENT AND CARE

First contact with an emergency case may be made either over the phone or upon presentation in the consultation room. If possible, some basic advice to concerned owners should be given. It is wise to always assume the worst and advise that the bird be brought in to the clinic based on an "all sick birds are urgent" approach (Pasco et al 1983). The bird should be brought into the clinic in its cage (if possible) without cleaning the cage or removing toys. The water bowl should be emptied (but not cleaned) and brought in. The normal food, especially if grain/pellets etc and any medications should also be presented to the veterinarian (Pasco et al, 1983). All of these things can provide clues to the basic husbandry of the bird, potential nutritional problems, gastrointestinal tract, and urinary system function (Redig, 1992). If necessary assembling drugs and equipment for the arrival of the patient should be done.

Flow Diagram of Initial Assessment and Treatment



IMMEDIATE ACTION PLANS FOR CRITICAL PATIENT CONDITIONS

Some conditions require immediate action on the part of the veterinarian. These include:

Dyspnoea or Rapid Breathing

How is dyspnoea recognised? Dyspnoea is difficult, laboured breathing often accompanied by abnormally exaggerated respiratory movements and increased respiratory rate (Echols, 1999).

This can be seen as 'tail bobbing' in some affected birds.

Response: O_2 supplementation (oxygen cage, face mask) until stablilised / often 10-15 minute interval which may require repeating between handling (Kaufman, 1992).

OR

If apnoea has occurred or if dyspnoea is severe consider:

- Access an airway → ET tube placement / consider an upper respiratory tract obstruction interfering with this (Kaufman, 1992; Redig, 1992).
  → Insertion of an air sac tube into the caudal thoracic air sac. This may be the best response (in all cases). (Red rubber feeding tube inserted with haemostats or a large bore needle e.g. 18ga hypodermic) (Redig, 1992; Quesenberry and Hillyer1994).

  → Tracheostomy possible (if obstruction cranial to tracheostomy) (Echols, 1999).

- Provide O_2 via intermittent positive-pressure ventilation (Echols, 1999).

→ 100% O_2 in an intermittently closed-off non-rebreathing circuit.
→ Deliver 1 breath each 4-5 seconds with < 15-20cm/H_2O pressure.
Flow rate ≈ 1L/min (→ 3L/min).

OR

If desperate, "mouth to beak" resuscitation can be used directly or via a closed hand; however zoonotic risks exist (Kaufman1992; Redig, 1992). Stimulating the glottis or squeezing the sternum may provoke a respiratory response (Redig, 1992). Sternal massage (dorsal and ventral motion) may promote some air movement through the respiratory tract (Echols, 1999).

*Following resuscitation the underlying problem must be addressed: Relieve obstructions, restore normal breathing mechanisms (e.g. aspirate ascitic fluid), treat primary or secondary lung disease (Jenkins, 1987). It should be noted that fracture of pneumatic bones if open can cause respiratory distress and prior to surgery these should be covered by a bandage coated in a water soluble cream such as "Silvazine" Smith and Nephew (Jenkins, 1987).

Cardiac Arrest

Detection via stethoscope auscultation, ECG doppler monitoring, or absence of peripheral perfusion as detected via mucous membrane colour, arterial pulses, cold extremities.

Response: O_2 supplementation + IPPV as previously described (Kaufman, 1992; Redig, 1992).
Radical volume expansion via IV/IO fluids (Kaufman, 1992; Quesenberry and Hillyer, 1994; Jones, 2001) .
Cardiopulmonary resuscitation over sternum (compressions as quickly as possible).
Drugs – IV, intratracheal, intracardiac Epinephrine.
0.5 – 1.0mL/kg of 1:1000 Epinephrine (Echols, 1999).

Ongoing fluid therapy is essential to support cardiovascular function; please refer to "Fluid Therapy" section. Resuscitation once the heart has stopped is often unsuccessful (Echols, 1999).

Severe Haemorrhage

Detection of external bleeding is obvious if careful inspection is carried out. Also consider the possibility of internal haemorrhage.

Response: Initially the goal is to arrest the haemorrhage.
For wounds this may be achieved by direct pressure and pressure bandaging (Pasco et al, 1983; Kaufman, 1992). For beak and feet/nail injury haemostatic agents (silver nitrate, ferrous sulfate, thromboplastin)can be employed (Jones, 2001).
For exposed vessels: electrocautery or ligation (Kaufman, 1992).
For broken and bleeding retained "blood feather" stumps treatment is via removal of the residual rachis and calamus. This is done by grasping the base of the feather rachis with haemostats and gently pulling it out while pushing the surrounding skin inwards (Kaufman, 1992). This technique may result in abnormal feather growth secondary to damage of the follicles and owners should be warned of this (electrocautery of the feather stump is an alternative).
In severe cases of blood loss (as detailed in the emergency transfusion section) blood transfusion may be indicated. Before this stage is reached volume expansion with fluids such as lactated Ringers Solution should be instituted.

Seizures

Give Valium 0.5mg/kg IV initially (Redig, 1992).
Attempt to identify underlying cause e.g. trauma, toxicosis.

OXYGEN SUPPLEMENTATION

Oxygen support combined with other therapies such as fluid delivery and thermal support provides a method of dramatically improving a bird's condition without directly treating the underlying problem. The benefits of such treatments "cannot be over emphasised" (Kaufman, 1992)

Indicators for instituting oxygen supplementation include signs of respiratory dysfunction (deviation from a regular respiratory rate with “normal” effort), cardiac disease, shock, post-surgery recovery, pre-induction and in cases of perceived handling stress including all wild birds and most ill birds (Kaufman, 1992; Quesenberry and Hillyer, 1994; Jones, 1996;Echols, 1999)

Oxygen can be considered a vital nutrient for all cells and is required for aerobic production of cellular energy/ATP. Although the exact benefits of oxygen therapy are not well defined in the avian patient (Quesenberry and Hillyer, 1994; Jones, 2001) it is reasonable to assume that in some cases oxygen delivery to cells would be improved by increasing the inspired O_2 concentration. Birds however, are extremely efficient utilisers of inspired oxygen (Jones, 2001) therefore significant decompensation of normal mechanisms of oxygen delivery to cells must exist. These variables include:

- Inspired concentration of O_2.

O_2 air
↓
O_2 blood
↓
O_2 tissues

- Ventilation of lung components involved in gas exchange, therefore airway patency, respiratory mechanism, CNS control of respiratory muscles is required
- Presence of a functional surface area of lung for gas exchange (consider pulmonary disease, presence of fluid in lungs, thickening of blood/gas barrier)
- Cardiac output and adequate perfusion of lungs.
- Oxygen carrying capacity of blood namely the haemoglobin concentration and red cell count.
- Ability of cells to utilise oxygen.

(Jenkins, 1987; Orosz, 1992; Quesenberry and Hillyer, 1994; Barnes, 1998; Jones, 2001)

Several methods exist for providing supplementary oxygen. Some practitioners consider an oxygen chamber essential emergency care equipment (Harrison, 1986; Quesenberry and Hillyer, 1994; Jones, 2001). This has the advantage of providing a low stress enclosed environment for stabilising patients. Face mask delivery of oxygen from a non-breathing circuit with a flow rate of 1-3L/min is a further option – however handling stress may negate any benefit . (Quesenberry and Hillyer, 1994; Jones, 2001).

Ideally the inspired air should contain 40-50% oxygen however in the short term inspired concentrations of 100% oxygen are not detrimental. This can be assessed by oximetry of the environment in the chamber or approximated by providing relatively high oxygen flow rates to the chamber (depending on size). The primary objective is to provide an oxygen-rich atmosphere for the bird to breathe. In extreme cases of dyspnoea and in all cases of apnoea an air sac tube should be placed to provide immediate access to the caudal thoracic air sac and allow both oxygen delivery (1L/min O_2 from a closed non-rebreathing/bain system) and artificial ventilation (Quesenberry and Hillyer, 1994; Jones, 2001) .

Monitoring oxygen concentration of blood can often be difficult without arterial blood gas analysis. Human pulse oximetry devices are not calibrated for avian patients but may be useful to identify trends in oxygen saturation (Barnes, 1998;Echols, 1999).

Humidifying the inspired air may assist in preventing dehydration of smaller birds and neonates, (Abou-Madi and Kollias, 1992) and may moisten the respiratory tract epithelium easing symptoms of respiratory disease (Orosz, 1992). A dish containing water placed near a heat source within the cage, may achieve this (Echols, 1999). Alternatively, purpose-built humidifiers can be used. Ideally 70% humidity should be achieved (Quesenberry and Hillyer, 1994) as monitored by a ‘wet-dry’ thermometer. Human “humidicribs” can be used successfully as a chamber for oxygen therapy and humidification of inspired air.

FLUID THERAPY AND EMERGENCY BLOOD TRANSFUSIONS

Fluid therapy in the avian emergency is pivotal to stabilisation and recovery. In the initial phases of treatment the greatest benefits are derived from expanding blood volume and supporting cardiovascular function (Orosz, 1992; Jones, 2001) as well as assisting correction of acid-base , electrolyte and toxic effects (endogenous and exogenous) by dilution and enhanced renal perfusion (Bond et al, 1993; Degernes, 1998) During the later stages of treatment and recovery, maintaining hydration status will reduce stress on the bird and improve recovery by supporting normal metabolic activity (Huff, 1993).

Severely ill birds, and those which have suffered serious trauma rapidly develop dehydration ,often from decreased intake (Kaufman, 1992; Huff, 1993; Jones, 2001). In the normal bird total daily water is derived from ingested water(as drunk and in food) and metabolic water (Abou-Madi and Kollias, 1992)Depressed birds are frequently uninterested in food and water and dehydration follows as maintenance requirements are not met.

Neonates and young birds suffer more serious and rapid effects of dehydration because they lack resilience to altered environmental conditions, like high temperatures, and dry air, that behaviour and greater energy reserves provide in the adult (Abou-Madi and Kollias, 1992). Also juveniles have a greater proportion of total body water, meaning that more body mass can be lost as dehydration continues than occurs in the adult. The clinical consequences of this can be severe and are related to hypovolaemia, i.e. cardiovascular collapse.
Below are the primary indicators for administering fluids:

Why give fluid therapy?	1. Volume Depletion	Haemorrhage - External second to trauma or blood feather damage - Internal related to trauma or vascular accident
		Anaemia - Decreased production increased destruction of erythrocytes (transfusion?)
		Other Fluid Loss (Plasma Water) - Dehydration - Exudation - Vomiting - Diarrhoea

2. Shock (By definition a deficiency of 0_2 delivery to cells)
→ - hypovolaemic
- cardiogenic
- vasculogenic

3. To correct electrolyte and acid/base distrurbances

(As discussed by Harrison, 1986; Kaufman, 1992; Orosz, 1992; Bond et al, 1993; Jones, 2001 and Degernes, 1998).

FLUID THERAPY

Emergency Fluid Therapy/Initial Response

It is widely accepted that critically ill birds may be assumed to have a 5-15% level of dehydration (Kaufman, 1992; Orosz, 1992; Huff, 1993; Echols, 1999; Jones, 2001).This combined with the clinically proven benefits of fluid therapy in birds is good indication to treat all birds with an initial fluid bolus (Harrison, 1986; Orosz, 1992; Redig, 1992; Degernes, 1998). This will be detailed shortly.

Generally, several fundamental questions need to be answered before administering fluids. These include:

- How much fluid is required and over what duration?
- What type of fluid is optimal?
- How can this be delivered in the best interests of the patient and within practical limitations?
- How can the fluid/hydration status of the bird be monitored throughout the treatment period?
- What are potential complications and additional considerations?

These questions will be addressed in relation to the two main aims of fluid therapy.
1) Initial Fluid Boluses 2) Maintenance Fluids/Ongoing Therapy

This is not intended as a detailed discussion of the finer points of fluid therapy but rather as a basic practical guide. A wide scope for adaptation of methods and fluid selection exists.

1) Initial Fluid Bolus

How much fluid? / Over what duration?

Several suggestions have been made in the literature. Two alternatives exist:

- Give 2-3% of ideal body weight as an initial fluid bolus in mL (Kaufman, 1992; Redig, 1992).

This should ideally be given over two to three minutes, or at a moderate rate (Kaufman, 1992; Degernes, 1998).

- Refer to pre-calculated bolus dose charts for a given species (Harrison, 1986)

What Type Of Fluid Is Optimal?

An isotonic crystalloid fluid which has a similar composition to plasma.
Usually lactated Ringer's Solution is suitable (Harrison, 1986; Kaufman, 1992; Degernes, 1998).

Route of Delivery

Fluid boluses need to be delivered directly to the circulation in order to act quickly in emergency situations. Both IV and IO routes offer good access to the peripheral circulation. Intraosseous administration has been shown to match the performance of IV administration in terms of absorption of fluid given/with very minimal differences (Degernes, 1998).

With experience, IV fluids can readily be given using a fine needle or butterfly catheter and syringe into the right jugular vein (Quesenberry and Hillyer, 1994; Jones, 2001). The ulnar, medial metatarsal and basilic veins are all reported sites for injection however these are more likely to be complicated by haematoma formation - "blown vein"(Jones, 2001).

In preparing for an IV injection the jugular can be located more easily if the feathers are wet on the right side of the neck (Harrison, 1986). Alcohol is used to swab the skin and the needle is introduced carefully while a handler restrains the bird.

Needle selection is based on the size of the bird (Harrison, 1986; Orosz, 1992).

Larger birds e.g. Macaw/Cockatoo	< 25-26ga ¾ inch
Medium birds e.g. Cockatiel	< 26-27ga ¾ inch
Small birds e.g. Finch/Budgie	< 27-30ga

Isoflurane may be employed to reduce handling stress, particularly in larger birds (Harrison, 1986).

For practitioners with limited experience, the intraosseous route is preferred. This is particularly the case if repeated boluses and ongoing therapy are expected. Advantages include faster, easier placement of needle (Degernes, 1998; Echols, 1999) good access to peripheral circulation, (even in very small birds) and presence of a capillary rich space which does not collapse with hypovolaemia (Orosz, 1992; Quesenberry and Hillyer, 1994; Degernes, 1998). Generally anaesthesia is not required, nor is any special equipment. The IO line can remain functional for up to 72 hours and is often more stable than IV lines (Huff, 1993). However after this time many birds show signs of pain on injection (Quesenberry and Hillyer, 1994). Most preparations given IV can be given via this route including fluids, blood, parenteral antibiotics, parenteral nutrition colloids, glucose and drugs for cardiovascular resuscitation Exceptions are alkaline agents and strongly hypertonic agents which may be cause pain on delivery (Quesenberry and Hillyer, 1994).

The two recommended sites are the distal ulnar and the proximal tibia (Orosz, 1992; Quesenberry and Hillyer, 1994; Jones, 2001). The distal ulnar is generally preferred. In preparation the feathers are plucked from the distal carpus with a surgical scrub of the area using alcohol and iodine performed.

In medium-large birds an 18-22ga 1.5-2.5 inch spinal needle is chosen, and in smaller birds and juveniles a 25-30ga hypodermic needle is used (Kaufman, 1992; Orosz, 1992; Quesenberry and Hillyer, 1994). Using sterile technique the needle is inserted into the middle of the end of the bone ventral to the dorsal condyle of the distal ulnar. The needle is advanced with rotation into the medullary cavity parallel to the bone. There should be little resistance. Once placed, a small volume of bone marrow may be aspirated which may be useful for analysis (Quesenberry and Hillyer, 1994). The needle can be secured by taping and/or suturing the hub to the skin. Superglue can also be used. The wing is then bandaged using a standard figure- of-eight pattern. An intraosseous catheter should be flushed with minimal volumes of heparinised saline four times daily to maintain patency (Kaufman, 1992).

Complications of IV or IO Bolus Fluid Dosing

The fragile nature of avian veins and their small size make laceration of the jugular or other veins a more likely consequence than in larger mammalian species.
This also means that haematoma formation is more likely, particularly at sites used repeatedly (Quesenberry and Hillyer, 1994).

Testing the patency of an IV needle or catheter by “drawing back” may not be possible in some birds with small, easily collapsible veins / resistance to flow is often a better indicator (Bond et al., 1993).

Secondary cellulitis and bacterial infection can occur in both IV and IO injection sites. Of particular significance is iatrogenic bacterial contamination of the medullary cavity which should be avoided by careful asepsis and management (Degernes, 1998).

Intraosseous fluids can cause intramedullary inflammation and pain. This may be related to excessive pressure on delivering the fluids (too rapid an infusion) or the chemical properties of the fluid e.g. hypertonic solutions.

Hypodermic needles used for intraoesseous catheterisation may become blocked by cortical bone; if this is the case a second needle may be inserted through the original hole (Degernes, 1998).

It should be noted that when using this bolus type therapy within 30 minutes 75% of the fluid given (isotonic crystalloids) will have moved out of the circulation and into the interstitial fluid compartment . Therefore continuous infusion (if possible) or repeated fluid doses may be required to avoid relapse of hypotension and hypovolaemia (Redig, 1992). Clearly the advantages of an intraosseous catheter are evident.

When giving fluids repeatedly, careful monitoring for signs of "fluid overload" should be done. These include dilution anaemia, hypoproteinemia, bradycardia, cardiac dysrhythmias, agitation, coughing, dyspnoea, ascites, polyuria, increased respiratory rate and collapse (Bond et al, 1993; Jones, 1996).

It should be noted that all fluids should be warmed to 38°-39°C (up to 42°C) using a hot water bath, incubator or microwave oven. This assists in warming the hypothermic patient and reduces cardiovascular stress (Abdou-Madi and Kollias, 1992; Degernes, 1998; Echols, 1999). Of particular importance in neonates and cases of shock.

2) Fluids for Maintenance

Following initial fluid boluses a more calculated approach to fluid therapy should be taken. How Much Fluid is Required? Over What Duration?

Essentially fluids should provide the following:

- Replacement of fluid deficit.
- Maintenance requirements.
- Support of expected, ongoing losses.

Fluid deficit is often difficult to quantitate. The best approach is to combine both subjective and objective criteria knowing that most birds if seriously ill will have an assumed level of 10% dehydration (Harrison, 1986; Redig, 1992; Bond et al, 1993; Huff, 1993; Jones, 2001). Some authors document ranges from normal to 15% or 20% dehydration in very sick birds (Echols, 1999).

Criteria for evaluating hydration status become important in ongoing monitoring situations:

Subjective Criteria/Dehydration	Objective Criteria
Skin turgor decreased.	Elevated PCV.
Increased filling time of peripheral arteries and veins (for example the normal filling time of ulna A + V is 0.5sec and if this is > 2sec a level of dehydration > 7% can be assumed).	Elevated TPP. NB: If PCV >0 5 consider significantly dehydrated. NB: beware chronic illness in birds is often accompanied by anaemia and emaciated birds may be hypoproteinemic.
Dull sunken eyes.	
Dry/tacky mucous membranes and stringy mucous at back of throat.	Mildly elevated plasma urea.
Depression.	Increased serial body weight following therapy may indicate improving hydration status.
Weakness.	
History of illness	
Anuria/low urine production.	

Deficit = % dehydrated x BWT (g) → Deficit expressed in mL (Harrison, 1986; Jones, 2001). Maintenance fluid requirements for birds are identical to those for dogs and cats, a volume of 50mL/kg/day is generally accepted. It should be noted however that neonates may have a requirement of two to three times this figure (Huff, 1993). Similarly very small birds such as finches may have a requirement of much more than 50mL/kg/day. Degernes(1998) suggests a possible maintenance requirement of 250mL/kg/day for these birds.

Expected losses such as loss via diarrhoea or vomiting can be factored into the maintenance volume by assigning a 1.2-1.5 times maintenance requirement for sick birds.

Maintenance fluids should be delivered each day in full. Initially fluid deficits should be corrected by aiming to replace the deficit over a 48 hour period so that half of the deficit is given with maintenance fluids on Day 1 and the other half on Day 2 (Harrison, 1986; Orosz 1992; Quesenberry and Hillyer, 1994; Degernes, 1998).

What Type of Fluids are Suitable?

- Isotonic crystalloids with a balanced electrolyte profile are desired, high Na and Cl content is avoided e.g. 0.9% saline.
- Lactated Ringers Solution with the addition of 0.1-0.3 mEq/kg/day of KCl is a good choice (Jenkins, 1987; Abou-Madi and Kollias, 1992; Degernes, 1998).

- Plasmalyte is a further alternative.

Route

- Oral, subcutaneous, IV and IO routes of administration are options / Combination therapy is possible.
- When an intraosseous catheter has been placed for bolus fluid delivery the IO route is a sensible choice.
- Selection of an appropriate route depends on the cause and severity of illness or injury, the compliance of the patient and personal preferences.

ROUTE	INDICATIONS	LIMITATIONS	METHOD
Oral	For maintenance fluid delivery or correction of mild dehydration. For delivery of high caloric fluids e.g. glucose. Good in patients with voluntary drinking and those which are perching and standing.	Relatively slow absorption. In cases of GIT disease gut motility must be assessed (will limit absorption). Not indicated for very dehydrated animals or anorectic patients. Hypertonic solutions may dehydrate. Not indicated for vomiting birds, seizuring birds, shock cases.	Voluntary intake. Via gavage tube feeding often in food. Usually only 5-10mL/kg at increasing intervals while checking for crop emptying (should take < 3-4 hours).
SC	For maintenance fluids or mild dehydration.	In severely dehydrated and "shocky" birds peripheral vasoconstriction limits absorption (some debate exists). Can only give non-irritant isotonic fluids. Maximum volume of 50mL/kg given before ventral abdominal pooling and other consequences e.g. inhibited absorption.	S/C injection following alcohol swab of skin – 25-27ga needle. 3 main sites: • Inguinal skin fold • Propatagial fold (wing web) • S/C zone between scapula "interscapular" 1-2mL per site/small bird. 5-10mL per site/large bird.
IO	Rapid volume expansion. Treatment of shock. When veins are collapsed. When IV methods are not practical.	Bony case cannot expand if very rapid fluid administration is given causing pain and leakage. Duration < 2 hours. Alkali and strongly hypertonic solutions are not advised.	Previously discussed.
IV	Rapid volume expansion. Treatment of shock. Can use hypertonic solutions.	Complications discussed previously. Catheter maintenance of patency and position may be difficult.	Previously described.

BLOOD TRANSFUSIONS

The use of emergency blood transfusions in avian patients has been questioned by some authors (Abou-Madi and Kollias, 1992; Quesenberry and Hillyer, 1994;). Quesenberry (1994) suggests that haemorrhagic shock might not occur in birds and referenced studies showing that pigeons responded better to lactated Ringers Solution than blood transfusion. This combined with the tolerance to blood loss, particularly in flighted birds (Abou-Madi and Kollias, 1992; Redig, 1992; Quesenberry and Hillyer, 1994;), challenges the use of transfusions in all but the most critical cases. The counter argument is that "one-off" homologous or heterologous transfusions can be life saving and may be performed as easily as giving other fluids (Jenkins, 1987; Kaufman, 1992; Redig, 1992). The relatively high risk of fatal transfusion reactions with repeated transfusions, particularly in heterologous transfusions, and particularly when repeated less than three weeks apart, is indication to avoid more than one transfusion unless proper cross-matching has occurred (Altman, 1983; Abou-Madi and Kollias, 1992; Kaufman, 1992). Cross-matching requires washing donor cells with phosphate buffered saline and incubation at 40°C for 30 minutes before addition of recipient serum. Agglutination and haemolysis indicate a reaction (Altman, 1983; Bond et al, 1993). Less rigorous matching (i.e. unwashed red cells) is reported to be unreliable (Altman, 1983).

An approach to emergency transfusions may be:

- Consider 'one off' transfusion if PCU 15-20/TPP <25gl and always if this state has arisen acutely (Kaufman, 1992; Redig, 1992; Quesenberry and Hillyer, 1994).
- Donor blood can be homologous or heterologous and cross matching is probably unnecessary acutely (Jenkins, 1987; Kaufman, 1992; Redig, 1992; Quesenberry and Hillyer, 1994). .
- Blood is taken from the jugular or brachial vein and collected in a heparinised syringe. 10mL/kg BWT is a safe volume to take however the donor bird should receive 10-30mL/kg BWT IV fluids and injections of iron dextran and B vitamin complex IM (Kaufman, 1992).
- Blood is delivered to the recipient as per the administration of a fluid bolus (see previously) either IV or IO routes. Iron dextran and B vitamin complexes may also stimulate erythrogenesis in the recipient (Abou-Madi and Kollias, 1992; Kaufman, 1992).
- It should be noted that the blood volume of birds is estimated at 10% BWT (with a range of 10=30%) and a healthy bird can lose up to 30% of this volume without serious clinical signs (Bond et al 1993; Quesenberry and Hillyer, 1994;).
- Transfer of blood borne viruses, bacteria and parasites is a further concern (Kaufman, 1992).

THERMAL SUPPORT AND HOUSING

Providing a warm, safe, stress free environment will enhance the recovery of many avian patients. A large proportion of debilitated and 'shocky' birds are suffering challenge to their normal thermoregulatory ability.

It is always important to assess the thermal status of the bird to prevent hyperthermia or exacerbation of disease, as may occur, for example, in obese birds and birds with head trauma respectively. In these cases 24-25°C may be optimal (Echols, 1999).

Behavioural signs indicating thermal status (may or may not be evident):

Heat stress-hyperthermia	Hypothermia
• Feathers slicked down. • Wings held away from body. • Increased respiratory rate (NB: no sweat glands).	• Ruffled feathers (piloerection). • Wings close to body. • Decreased respiratory rate. • Trembling/shivering.

Objective measure

Body temperature (as assessed by cloacal thermometer)
normal range 39.4 - 41.1°C (Pasco, 1985) 41.6 - 44.4°C (Barnes, 1998)

Hypothermia may have life threatening consequences, and, if required, heat should be provided and monitored by a thermometer within the cage/enclosure Generally most birds benefit from an environmental temperature of 29.5 - 32°C (Pasco, 1985; Redig, 1992; Quesenberry and Hillyer, 1994). Unfeathered birds or neonates may require higher temperatures approaching 34-36.5°C (Quesenberry and Hillyer, 1994; Echols, 1999).Many potential heat sources exist including heat pads, aquariums in heated water baths, cages with internal elements, heated rooms and light bulbs (blue, green 25-40 watt recommended by Pasco, 1985).

Warming can be thought of on three levels(Barnes, 1998):

a) Passive - Blankets, shivering.
- Suitable for stable adult birds.

b) Active - Hot water bottles, heat lamps, heat pads etc.

c) Core - Warmed IV or IO fluids.
- Peritoneal, crop, vent lavage with warmed fluids.
- Warming inspired air.

In cases of shock, a relapse may occur when rewarming the bird secondary to peripheral vasodilation and movement of blood out of the major vessels. This so-called "rewarming shock" can be avoided by focusing initial efforts on core rewarming and active rewarming of the body before the limbs (Harrison, 1986; Jenkins, 1987; Redig, 1992).

Housing for sick birds should be located away from drafts and noisy areas, particularly caged dogs and cats. If able to perch, a perch and wire cage may be appropriate with easily accessible food and water. Wire cages should be avoided in preference for smooth sided enclosures without perches for birds which may flap or are disoriented, (Quesenberry and Hillyer, 1994). Often birds with fractures or partial paralysis will use their beak to stabilise themselves in a wire cage, and provision should be made for this. Isolation from other birds should be considered if an infectious process is suspected.

Food and water should always be available to sick birds, and if unable to perch a variety of foodstuffs should be spread out on the cage floor. Grit should be removed and thick paper or non-woven towel should be used as flooring (Pasco, 1985).

Heat pads and cages with in-built elements should always be insulated by a layer of towels between the heat source and the bird. These devices are potential causes of hyperthermia and burns, and as such some practitioners prefer hot water bottles or heated rooms (Pasco et al, 1983; Quesenberry and Hillyer, 1994).

EMERGENCY ANAESTHESIA AND ANALGESIA

A thorough discussion of avian anaesthesia is beyond the scope of this essay however the following is a brief example of a typical anaesthetic plan.

Isoflurane gas is the most commonly used agent in avian anaesthesia (Redig, 1992; Barnes, 1998; Echols, 1999). It has been shown by clinical experience to be reasonably safe even in moderately debilitated birds and is often used to reduce handling stress (Redig, 1992). Several injectable agents can also be used but don't offer the rapid control over anaesthetic depth, rapid recovery and safety of isoflurane. Propofol has a narrow safety margin and should not be used in birds (Orosz,1992).

Pre-Anaesthetic Period (Often very short in emergency cases!)

Fluids: To support cardiovascular system, to prevent dehydration, to correct fluid loss and haemorrhage during surgery. Benefits extend into 'normal' birds hence consider a fluid bolus (as previously described) prior to all surgery. Hypoglycaemia related to illness or fasting may be corrected partially by giving parenteral LRS + 2.5% dextrose (50:50).

Oxygen: Pre-oxygenate for 5-10 minutes to avoid a hypoxic episode on induction.

Fasting: To avoid hypoglycaemia limit fasting to 1-3 hours (pre-op). The crop should be palpated and emptied if full, to avoid regurgitation and aspiration.

Thermal support

Induction

Usually a mask induction with 3-5% isoflurane.

Intubate and carefully inflate cuff (preventing tracheal injury). All but the very smallest of birds should be intubated.

Use abdominal air sac intubation if upper respiratory tract obstruction is evident.

Maintenance

1.5-2.5% isoflurane is typical but this is highly variable based on the patient's condition, procedure and species variation.

Oxygen should be provided at a flow rate of > 660mL/kg/min (1-3L/min usually) for both mask or ET tube. This is delivered via a 'bain' system (non-rebreathing system).

The patient should not be positioned in sternal recumbancy for extended periods as this may inhibit respiratory movements, the head should be elevated at all times to prevent regurgitation.

Surgical fluid rates of 10mL/kg/hour (warm fluids).

Surgical preparation of skin involves plucking feathers around the site followed by gentle alternating alcohol and iodine scrubs. Alcohol should be used sparingly to avoid hypothermia.

Overhead heat lamps or other heating devices should be used.

Monitoring

Respiratory rate and character give the best indication of depth in birds. Normally birds should breathe at least once every 10-15 seconds however larger birds breathe more slowly and smaller birds more quickly (Echols, 1999). In general, slow shallow breathing indicates increasing depth, while faster deeper breathing indicates the patient is 'lightening up'. Heart rate although often difficult to monitor should be used in conjunction with other signs. The palpebral and foot withdrawal reflexes can indicate a light level of anaesthesia.

Consider some explanations for altered respiratory function:

Observation	Potential Cause
Tachypnoea	Patient is light. Pain response. Pulmonary haemorrhage. Overheating.
Dyspnoea	Poor ventilation particularly obstruction of trachea or ET tube with mucous plugs. Poor lung perfusion/cardiac dysfunction. Fluid or blood in lungs (oedema, haemorrhage). Air sac disorder.
Apnoea	Anaesthetic overdose. Poor ventilation/hypoxia. Hypothermia. Systemic causes and metabolic disturbances e.g. hypoglycaemia.

Recovery

Generally fully recovered in 30-60 minutes.

Inspect oral cavity at extubation.

Careful monitoring.

Offer food and water as soon as recovered.

± fluids, thermal support.

ANALGESIA

It is reasonable to assume that birds experience pain and this is demonstrated in responses like vocalisation, agitation, elevated heart and respiratory rates, body guarding and retracting the neck (Bauck, 1990; Barnes, 1998; Echols, 1999).

It has been proven that pain can contribute to immunosuppression, delayed wound healing and progression of disease processes (Barnes, 1998). Furthermore veterinarians have an ethical obligation to alleviate pain and suffering.

Options for pain management include sedation, anaesthesia, analgesia and potentially alternate therapies such as acupuncture (Bauck, 1990). As with mammals pre-emptive analgesia is desired (Barnes, 1998).

Information on analgesic selection and dose rates is limited as is knowledge of deleterious effects. Published dose rates include:

NSAID's

- Acetylsalicylic acid /ASA (Aspirin) 10mg/kg PO q 24 hours (Bauck, 1990; Echols, 1999)
- Flunixin 1-10mg/kg (Bauck, 1990)
- Potential adverse GIT disturbances are suspected.

OPIATES and OPIODS

- Morphine
- Butorphanol 1-2mg/kg up to 2-4mg/kg IM (Bauck, 1990; Barnes, 1998; Echols, 1999)
- In clinical trials cardiac and respiratory depression often associated with these drugs was minimal.

OTHERS

- Xylazine (short acting analgesic, longer acting tranquiliser).
- Xylazine + Ketamine 1mg : 5mg combination (Bauck, 1990).

NUTRITION

Providing hospitalised birds with appropriate nutritional support is an often overlooked, but very important, component of treating sick birds (Quesenberry and Hillyer, 1994).Birds in general have a low tolerance to reduced food intake because of a high basal metabolic rate and a low functional energy reserve (Huff, 1993; Jones, 2001). This combined with a hypermetabolic state, (as induced by stress or illness), places significant weight on appropriate nutrition .

As in devising feeding regimes for any species there is a hierarchy of requirements:

1) energy
2) protein
3) micronutrients

Dietary supplementation must provide all three of these elements to best meet the needs of the patient (Quesenberry and Hillyer, 1994).

Nutritional management of birds can be divided into two categories:

- Initial presentation of a severely emaciated and cachectic bird.
- Supplementary/supportive nutrition of the stabilised bird.

<u>1) Severely Debilitated and Cachectic Birds</u>

In these birds ruling out hypoglycaemia is a concern. Blood glucose analysis should be performed at the pre-treatment stage when sampling for PCV and TPP baselines. Levels of less than 100mg/dL are an indication of a hypoglycaemic crisis (Kaufman, 1992).

Treatment could include:

- Initial bolus of IV 5% glucose solution (Kaufman, 1992)
  NB: Dextrose should be avoided if acidosis is a concern (ill birds are commonly acidotic) because it is a strong acidifying agent (Harrison, 1986).
- Diluted 50:50 LRS and 5% dextrose maintenance fluid.
- Oral application of small volumes of karo syrup or 50% dextrose, for absorption across mucous membrane.

A further consideration for severely debilitated and emaciated birds is that gastrointestinal function may not be present until hydration status is corrected and the animal is stabilised (Abou-Madi and Kollias, 1992; Redig, 1992). Feeding these animals any sooner than 24-48 hours may also promote an already catabolic state (Abou-Madi and Kollias, 1992). Fluid therapy alone is recommended in these birds over this initial period (Redig, 1992; Huff, 1993).

Feeding hypertonic preparations can also exacerbate dehydration unless coupled with appropriate fluid therapy (Quesenberry and Hillyer, 1994; Jones, 2001).

<u>2) Supportive Nutrition</u>

Energy is perhaps the most important nutrient (aside from water) to consider when calculating a ration. If a bird will eat on a voluntary basis then food and water should be made available at all times. Both familiar and other 'tempting' foods should be offered along with fresh fruit and vegetables for psittacine birds (Pasco, 1985; Huff, 1993). If a bird refuses to eat, hand feeding or feeding by the owners may be attempted. Following this, enteral or parenteral nutrition must be provided by one of the following methods:

- Gavage tube (crop feeding).
- Oesophageal gastric tube (tube placed into oesophagus at the base of the mandible passing down through the crop into proventriculus).
- Duodenal catheter (foley catheter surgically placed in proximal duodenum).
- Total parenteral nutrition (TPN).

Details of each of these procedures are available in several other sources (Degernes, 1992; Qusenberry and Hillyer, 1994; Jones, 2001).

When tube feeding an estimation of the volume of a given supplement can be made using the following process:

- Calculate the basal metabolic requirement (Orosz, 1992; Huff, 1993; Jones, 2001)

$BMR = k (BWT^{0.075})$	k = 78	Non-passerines
(kcal/day)	k = 129	Passerines

Please note:

- Adjust BMR to maintenance energy requirement (typically 1.5-3 times the BMR in sick birds). Neonates will have a maintenance requirement 4-5 times higher (Echols, 1999).
- Knowing the energy density of the supplement calculate a volume in mL or weight to be fed per day.
- Refer to tables for species-specific volumes administered per feeding (Jones, 2001).
- Divide the volume into regular meals. Most birds are tube fed 2-4 times per day.

Commercially prepared powders and liquid food diets are commonly used because they have a reliable energy content, an appropriate composition of carbohydrate and protein, and because they are cheap and easy to prepare. Most hand feeding formulas are acceptable, as are human preparations which often contain a higher protein content. The food must be highly digestible, have a high nutrient value, and be lactose free (Huff, 1993; Quesenberry and Hillyer, 1994; Jones, 2001).

PATIENT MONITORING

Monitoring critically ill patients and responding to early signs of deterioration is particularly important in avian medicine. Often physiological 'normals' are unavailable, and because of this, assessing trends in recorded variables becomes important. Ideally, early in the treatment period there should be a deliberate effort made to define the monitoring criteria and if possible establish monitoring charts.

The criteria assessed may be directed by a specific condition or may be more general in nature. Below are some suggested variables which should always be considered:

- Body temperature.
- Body weight.
- Serial PCV and TPP, initially and each 6-12 hours until stabilised.
- Hydration status and peripheral perfusion.
- Heart rate and rhythm (general impression or ECG).
- Respiratory rate and effort/nature.
- Urine output – monitor size and consistency of droppings.
- Faeces.
- Dietary intake - Food
- Water
- Medications: Medication, date, time, dose, route.
- Fluid therapy or other therapeutics.

Appropriate monitoring will ensure that the hard work put into the initial treatment of the bird is not wasted.

Discussion

The material reviewed for this essay was relevant to the topic of emergency treatment of birds. There appears to be very good material available in reference to this topic. The preceding essay outlines a good general approach to this topic and may be particularly helpful for in-experienced veterinarians to highlight some basic principles and potentially establish a rational thought process in times of panic. Further detail is required on various pharmacological agents including vitamin therapy, antibiotic selection and other emergency drug protocols. The treatment of specific emergency conditions also requires further discussion, however this is beyond the scope of this paper.

Conclusion

Avian emergencies demand forethought and planning to ensure effective and efficient treatment. The physiology and unique anatomy of birds places some special demands on the veterinarian, however once these differences are appreciated therapeutics can be appropriately chosen. A logical approach to stabilisation and prioritising diagnostic and treatment efforts is essential, because avoiding stress in the avian patient and acting rapidly to correct abnormalities is often necessary. Oxygen supplementation, fluid therapy, heat and housing are important factors to optimise the recovery of all seriously ill avian patients regardless of aetiology.

Meeting the nutritional requirements of sick birds is a further aspect of supportive care. Birds are often very dynamic patients, which require close monitoring and evaluation of health status. Implementing and assessing a tailored monitoring program for individual cases will best achieve this.

References

Abou-Madi, N. and Kollias, G.V. (1992) Avian Fluid Therapy, In *Current Veterinary Therapy XI*, Eds. Kirk, R.W. and Bonagura, J.D., W.B. Saunders Co, Philedelphia.1154-1159.

Altman, R.B. (1983) Heterologous Blood Transfusions In Avian Species, *Proc. Assoc. Avian Vet.* pp28-32

Barnes, S.M. (1998) Managing the Avian Intensive Care Unit, *Proc. MASAAV. Avian Medicine and Surgery conf.* 1-24.

Bauck,L. (1990),Analgesics in Avian Medicine, *Proc. Assoc.Avian Vet*., pp239-244

Bond, M.W., Downs, D. and Wolf, S. (1993), Intravenous Catheter Therapy, *Proc. Assoc. Avian Vet.* pp221-225.

Curro, T.G. (1998) Anaesthesia of Pet Birds, In *Seminars in Avian and Exotic Pet Medicine*, 7:1 10-21.

Degernes, L.A., Davidson, D.S., Kolmstetter, C.,Flammer, K., Munger, L. (1992) Preliminary Report on the Use of Total Parenteral Nutrition in Birds, *Proc. Assoc. Avian Vet*., 19-20.

Degernes, L.A. (1994) Trauma Medicine, In *Avian Medicine:Principles and Practice*, Eds. Ritchie, B.W., Harrison, G.J. and Harrison, L.R., Wingers Publishing Inc., Lake Worth.417-433.

Degernes, L.A. (1998) Fluid Therapy and Parenteral Nutrition, In *Proc.Assoc.Avian Vet*, 55-60.

Echols, S. (1999) Avian Critical Care for the Veterinary Nurse/Technician, *Proc. MASAAV Avian Medicine and Surgery conference*.15-29.

Harrison, G.J. (1986), What to do until a diagnosis is made, In *Clinical Avian Medicine and Surgery*, Eds. Harrison, G.J. and Harrison, L.R.,WB Saunders Co, Philadelphia. 356-361

Huff, D.G. (1993) Avian Fluid Therapy and Nutritional Therapeutics, *Seminars in Avian and Exotic Pet Medicine*, **2**(1):13-16.

Jenkins, J.R. (1987) Emergency Avian Medicine, *Proc.First Intl Conf. Zoo. and Avian Vet* pp279-285

Jones,M.P (2001)Emergency Care and Nutritional support of the Avian Patient. *AAV Newsletter and Clinical Forum*.3-6

Kaufman, G.E. (1992), Avian Emergencies, *In Veterinary Emergency and Critical Care Medicine*, Eds Murtaugh, R.J. and Kaplan, P.M., Mosby Year Book Inc., St. Louis.453-463.

Lukasik, V.M. (2000) Avian Anaesthesia and Analgesia, *Proc. MASAAV Avian Medicine and Surgery Conference*.44-51.

Orosz, S.E. (1992) Supportive Care of tthe Hospitalised Patient, *Proc. Assoc.Avian Vet*., 458-462.

Pasco, W.J., Hickman, G and Levine,B. (1983), Emergency Care and Protocol for Pet Birds:The First 24 Hours, *Proc.Assoc.Avian Vet*. 231-246

Pasco, W.J. (1983) Care of the Sick Bird, *Proc. Assoc. Avian Vet*.243-246

Quesenberry, K.E. and Hillyer, E.V. (1994) Supportive Care and Emergency Therapy, In *Avian Medicine:Principles and Practice*, Eds. Ritchie, B.W.,Harrison,

G.J. and Harrison, L.R.,Wingers Publishing Inc., Lake Worth. 383-415

Redig, P.T. (1992) Management of Medical Emergencies in Raptors. In *Current Veterinary Therapy XI*, eds Kirk, R.D. and Bonagura, J.D., W.B SaundersCo, Philadelphia.1134-1138.

Sturkie, P.D. (1986) Heart and Circulation:Anatomy, Haemodynamics, Blood Pressure;Blood Flow, In *Avian Physiology*, Ed. Sturkie, P.D., Spring-Verlag, New York.130-162.

Verkest, K. (1994), Shock and Compensatory Mechanisms, Diagnostic Considerations, *Proc. Assoc, Avian Vet*., pp 155-158.