RAPTOR NUTRITION AND EMACIATION MANAGEMENT

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Outline

- Nutritional needs for raptors
- GI specializations
- Needs with stress/illness
  - Hypermetabolism
  - Emaciation
- Evaluation of nutritional status
- Emaciation management
- Nutritional support – calculations and protocols
- Refeeding syndrome

Raptor Nutritional Needs

- The exact nutritional requirements for birds (other than poultry) are not known.
- Energy is fundamental - derived from Fat, Carbohydrates and Protein.
- Wild raptors eat when they are hungry, primarily to fulfill their daily caloric requirement. The natural diet of a raptor is high in protein, high in fat and low in carbohydrates.
  - Protein 17-20%
  - Fat 2-28%
  - Carbohydrates 2%

Raptors eat 2-5 times more protein per kilogram of body weight, and have higher nitrogen excretion when compared to granivorous birds.

Fat

- Fat = Energy
  - Fat represents the major source in terms of gross energy, being approximately twice as energy dense as protein or CHO.
  - Therefore when there is a significant energy deficiency, fats should be considered as the primary energy source.
- The ability of birds to store lipids (in the form of triglycerides) as an energy source is far greater than any other vertebrate. Triglycerides are stored (not CHOs), because they require no additional water.

Protein

- Proteins provide amino acids for cell and organ function.
- Protein can be utilized for energy, but it is mainly used for tissue repair, white and red blood cell production, maintenance of blood proteins (albumin, fibrinogen, antibodies) and enzyme production.
- Composed of 22 amino acids.
  - Of the 22 , 10 are considered essential as they can't be produced in the body and must be supplied in diet.
  - They are: arginine, histidine, isoleucine, leucine, lysine, methionine, tryptophan, threonine, phenylalanine, and valine.

Brief Glucose Info

- Carbohydrates provide glucose.
- In normal situations, raptors have little glucose in their diets.
- Some research has indicated that glucose solutions fed to debilitated raptors may hasten their death. (Dobbs, 1983).
- In psittacines and granivorous species, glucagon (instead of insulin) may play more of an important role in carbohydrate metabolism. However, in raptors, it appears that insulin may be more important in maintaining blood glucose levels.
- Erythrocytes depend primarily on fatty acids as an energy sources and NOT glucose.
- Raptors can maintain fasting blood glucose levels WNL much longer than granivorous species.

More Glucose

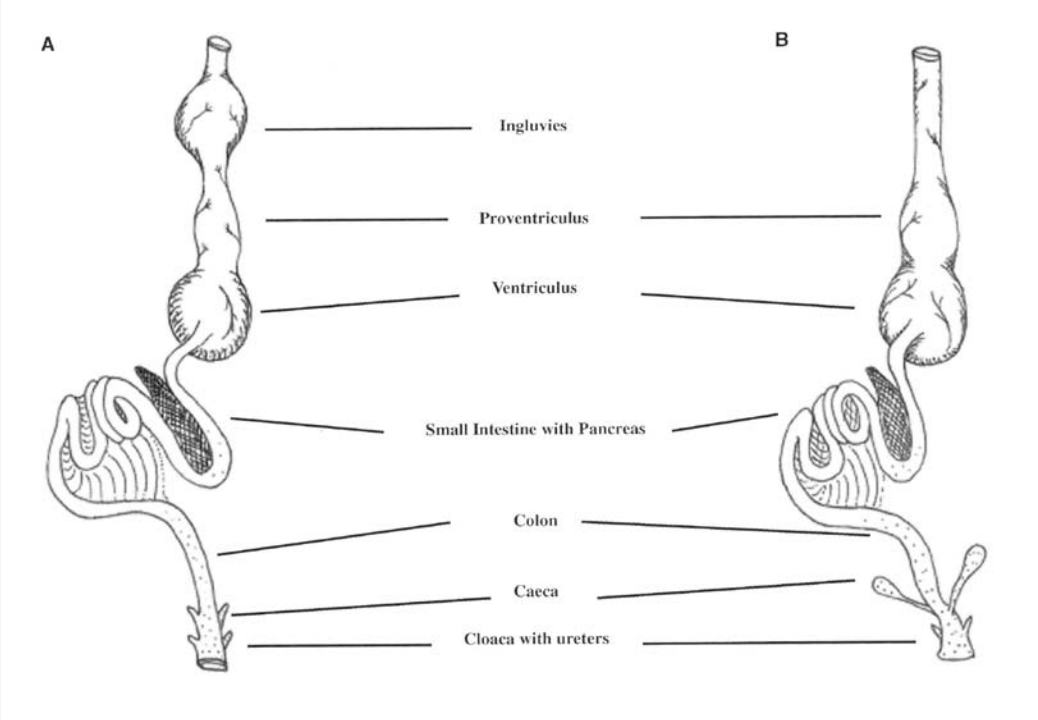
- Raptor blood glucose levels are quite variable.
  - Healthy birds usually > 150mg/dl. Up to 800 can be normal.
  - Hyperglycemia – seen with acute stress.
  - Hypoglycemia – lethargy, weakness or inability to stand (starvation).
    - Seizures can occur if glucose level falls below 80mg/dl.

Gut Specilizations

- The raptor gut is a fairly simple system with a poorly developed ventriculus (little need for grinding) and a relatively underdeveloped large bowel/ceca (no fermenting).
- However, a functional raptor GIT is very metabolically demanding (energy and moisture dependent).
- The GIT is adapted to facilitate flight by minimizing weight and length when compared to mammals.

Species Differences

- The GIT is variable among avian species, including between Falconiformes and Strigiformes.
- Species requiring rapid acceleration and maneuverability to capture prey in flight, (accipiters), have the lightest digestive tracts, while raptors not relying on rapid flight, (buteos), have heavier digestive tracts relative to body size.
- Strigiformes – no crop.
- Falconiformes – most have a well developed crop.



Falconiformes

Strigiformes

Feces and Casts

- Raptor stool should be formed with black fecal center, surrounded by watery white urates.
- Emerald green feces can be normal due to unused bile, possibly in the morning before feeding, when the GIT is empty.
- Lime green feces suggest alterations in motility and absorptive processes – often seen with lead toxicity, but also with aspergillosis, coccidian, or anaerobic GI infection.
- All raptors produce casts - the regurgitated "indigestible" parts of the carcass (feather, fur, bones).
- Formed in the ventriculus.
- The volume, appearance and timing of casting varies according to the diet fed and the individual animal.
- Owls often regurgitate one pellet per eaten prey.
- Hawks/falcons often eat more than one meal before casting.

Klaphake and Clancy, 2005

Samples

Balanced Diet

- All agree that a nutritionally balanced diet is one that provides fresh, whole prey from a variety of sources (laboratory rodents, fish, day-old chicks, quail).
- Rats are probably the most nutritional laboratory rodents, especially young rats due to their high vitamin E content.
- Day-old chicks have often been considered to be an inadequate diet for raptors. However, studies have shown that they are nutritionally adequate and may be an ideal diet. Occasionally supplementing with quail or rats is acceptable for most raptors.

Energy Sources from Whole Prey

- Mice & Fish
  - 80-90% protein
  - 2-20% fat
  - < 2% CHO
- Frozen fish should not be kept any longer than 1 month frozen and should be defrosted in boiling water. Vit B should be supplemented.

Nutritional Needs with Stress/Illness?

- Because of their high metabolic rates, birds are unable to function on energy reserves for extended periods of time.
- It is important of differentiate between a critically ill or a starving patient.
- Malnourished (starving) patients are in a hypometabolic state while critically ill patients are often in a hypermetabolic state.

Definitions

- **Emaciation –** excessive leanness; a wasted condition of the body.
- **Starvation –** long-continued deprival of food and its morbid effects. Loss of body weight, decreased muscle power and endurance occur early.
- **Glycogenolysis –** the splitting of glycogen in the liver or muscle, yielding glucose-1-phosphate.
- **Glucogenesis –** formation of glucose by the breakdown of glycogen.
- **Gluconeogenesis –** the synthesis of glucose from noncarbohydrate sources, such as amino acids, propionate and glycerol. Primarily occurs in the liver and kidneys. Simulated by cortisol and glucagon.
- **Lipolysis –** the splitting up or decomposition of fat.

Hypermetabolism

- Illness and stress cause a hypermetabolic state in animals and humans.
- When an animal is physiologically stressed, lean body mass is the preferred energy source. Results in increased body protein catabolism.
- Energy requirements are increased by 30-50% to sustain tissue repair, inflammatory processes and immune system effectiveness.
- Release of catecholamines, glucagon and glucacorticoids (cortisol in mammals and presumably corticosterone in birds) increases the rate of gluconeogenesis and glycogenolysis (further increasing the metabolic rate.) (Labato, 1992.)
- Hypoalbuminemia occurs because the liver is now producing more acute-phase proteins.

Starvation and Hypometabolism

- Starvation is associated with a gradual decrease in the metabolic rate, resulting in hypometabolism.
- During starvation, the patient attempts to maintain normal blood glucose by increasing hepatic glycogenolysis , increasing gluconeogenesis and decreasing glycogen stores.
- Glycogen reserves are usually depleted within 24 hrs of a fast.

Prolonged Starvation

- When glycogen stores are depleted, amino acids are mobilized from muscle and fatty acids are mobilized from adipose tissue.
  - Both are degraded further to provide glucose and glycerol respectively for gluconeogenesis.
- This catabolic mechanism is triggered by low levels of insulin from lack of food intake that, in turn, causes a rise in glucagon levels.
- This hormone combination increases lipolysis, thereby increasing ketone bodies which results in a mild acidosis.
- Eventually, starvation also effects the visceral protein mass and the function of vital organs.
- Respiratory function may decline, as well as cardiac mass and output. (Parrish, 2005)

What is Emaciation?

- A patient is considered emaciated when it has lost at least 1/3 of its normal body weight and appears abnormally thin, whether due to malnutrition, disease or some other factor.
- Emaciation is caused by a lack of nutrients (starvation) irrespective of the cause.

Effects of Emaciation

- Increased protein breakdown in response to illness or injury depletes the body of its protein stores, thereby affecting wound healing, immune and cellular functions, cardiac and respiratory functions.
- Reduced food intake results in significant intestinal atrophy.
- Malnutrition has been associated with increased rick of wound related complications. (Orosz, 2008)
  - T-cell impairment,
  - Alteration of granulocyte function,
  - Would healing is delayed.

Dehydration

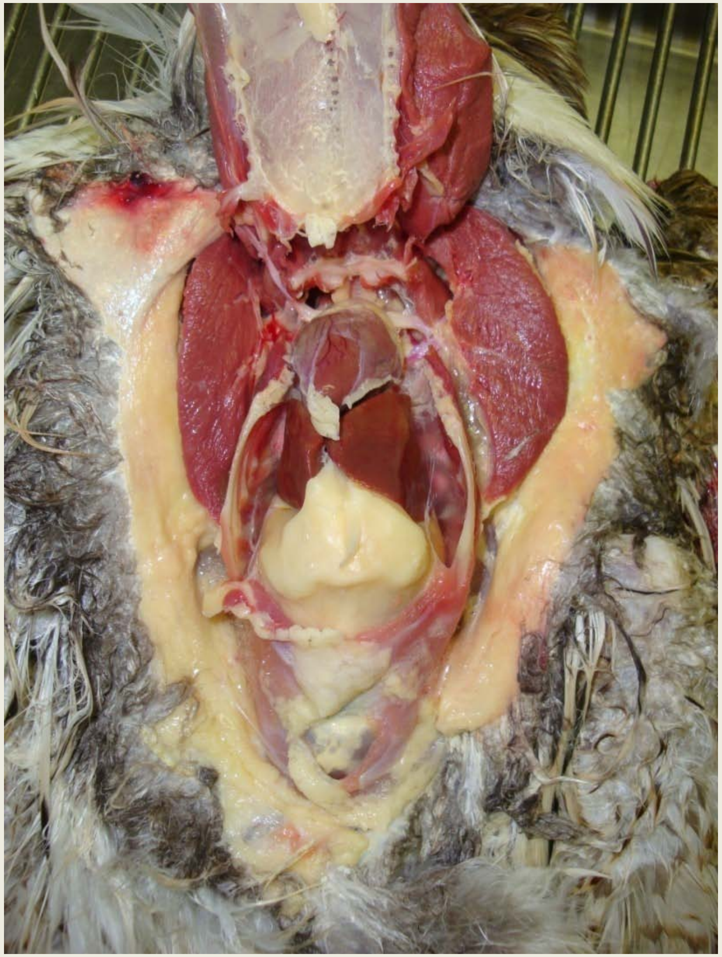
- Most patients presented to wildlife centers are at least 5% dehydrated.
- Malnourished and emaciated raptors are usually more severely dehydrated, up to 12%.
- In addition to the typical circulatory complications seen with dehydration, severely dehydrated raptors will sometimes become obstipated with uroliths in the urodeum.
- Always monitor for fecal/urate production.

Emaciation Cases at WCV

- Although many raptors presented to WCV are in poor physical condition, few are truly emaciated.
- In 2007, 340 raptors were admitted to WCV.
  - 5.3% had emaciation as the primary or secondary syndrome.
  - 77.8% died.
- In 2008, 304 raptors were admitted
  - 10.2% had emaciation as the primary or secondary syndrome
  - 96.8% died.

Physical Exam

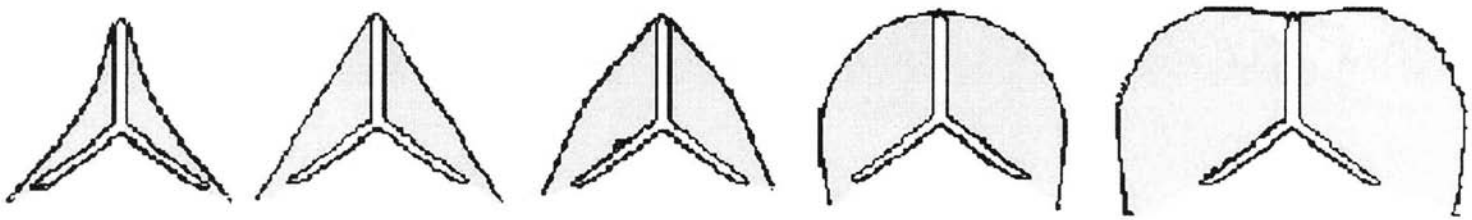
- Used to assess body condition, especially body muscle and fat.
- Palpate the abdomen for abdominal fat.
- Palpate the pectoral muscle mass in relation to the keel.
- The pectoral muscles may also be atrophied from lack of use.
- Different avian species have naturally different shapes, but in general, the pectoral shape in raptors is fairly uniform.
- Even obese animals can be malnourished.



Evaluation of Nutritional Status

- Evaluation of the musculature covering the keel (the contour of the pectoral muscles) can be used to help determine a patient's Body Condition Score (**BCS**).
- A 1-5 scale:
  - BSC 1: the contour is concave (emaciated),
  - BCS 2: the contour is a "triangle,"
  - BCS 3: the contour is convex,
  - BCS 4: the contour is a semicircle,
  - BCS 5: there is "cleavage."
- A BCS of 3-4 should be considered a healthy weight.
- A 10% change in weight is reflected by a decrease/increase in BCS of 1. Remember that BCS reflects changes in body composition better than does just looking at weight changes.

BCS



Body Condition Scores

Representation of transverse section of the sternum and pectoral musculature.

Kenneth Welle, DVM

Diagnostics

- If the patient is stable enough for diagnostics, the initial ones should be:
  - Total protein
  - PCV
  - Glucose
  - Electrolytes

Total Protein

- Typically performed using a refractometer.
- However, most accurately measured by plasma electrophoresis.
- Reference range is 3.5 to 5.5 g/dl (birds).
- Hypoproteinemia – often from poor nutrition, also due to protein loss through GIT or kidneys.
- Hyperproteinemia – may be due to dehydration or an infectious process.
- In **humans**, the single best nutritional test for predicting outcome appears to be serum albumin. (Orosz, 2008.)

Albumin

- Critical for maintenance of colloid oncotic pressure (COP), substrate transport, buffering capacity, wound healing and free-radical scavenging.
- In metabolic stress, albumin synthesis becomes a low priority.
- 18-24 hours of fast can cause a decrease in albumin synthesis by as much as 50%.
- In humans and animals, hypoalbuminemia and decreased COP have been found to be associated with increased morbidity and mortality. Serum albumin levels less than 2.0 g/dl have been positively correlated with increased morbidity and mortality in humans. (Mazzaferro, *et al*, 2002.)
- Although clinical trials have not been done in birds, and serum albumin levels vary among avian species, it is recommended to maintain albumin concentration at or above 2.0 g/dl.

Problems with Refractometer

- There have been major discrepancies between biuret and refractometric results for TP reported for avian samples.
- Values are frequently inaccurate due to interference by high concentrations of other refractive compounds in plasma such as chromagens, lipids and glucose.
- Studies in chickens, turkeys and ducks have shown good correlation between biuret and refractometry TP values.
  - Possibly because these species tend to have lower blood glucose values than most psittacines and smaller birds. (Harr, 2002).
- Recent research claims refractometry can be used to accurately measure total protein concentration in **nonlipemic** plasma samples from some psittacine species. (Cray, *et al*, 2008)

Importance of Electrolytes

- Emaciated patients often have acid-base disorders.
- Patients become hypoglycemic and acidemic quickly as a consequence of neuroendocrine activity (with hypermetabolism).
  - The increased adrenal steroids results in glucose intolerance in tissues, despite hyperinsulinemia. (Orosz, 2008)
- Low albumin levels may reduce the buffering capacity of the blood.
- Investigations using the I-stat blood analyzer at the Al Safa Falcon Clinic, has shown that alkalosis, not acidosis is seen in the majority of critically ill and stressed falcons. (McKinney, 2003)

Typical Emaciation Presentation

- Often young raptors during migration that have not learned to hunt prey successfully or in birds facing harsh winter conditions.
- BCS 1/5.
- Some may have chronic injuries.
- Severe hypoproteinemia and associated hypovolumia and hypotension.
- Anemia.

Snowy Owl 08-2445

TP: 0.6mg/dl; **PCV**: 16%; **Glu**: 101mg/dl

Emaciation Management Priorities

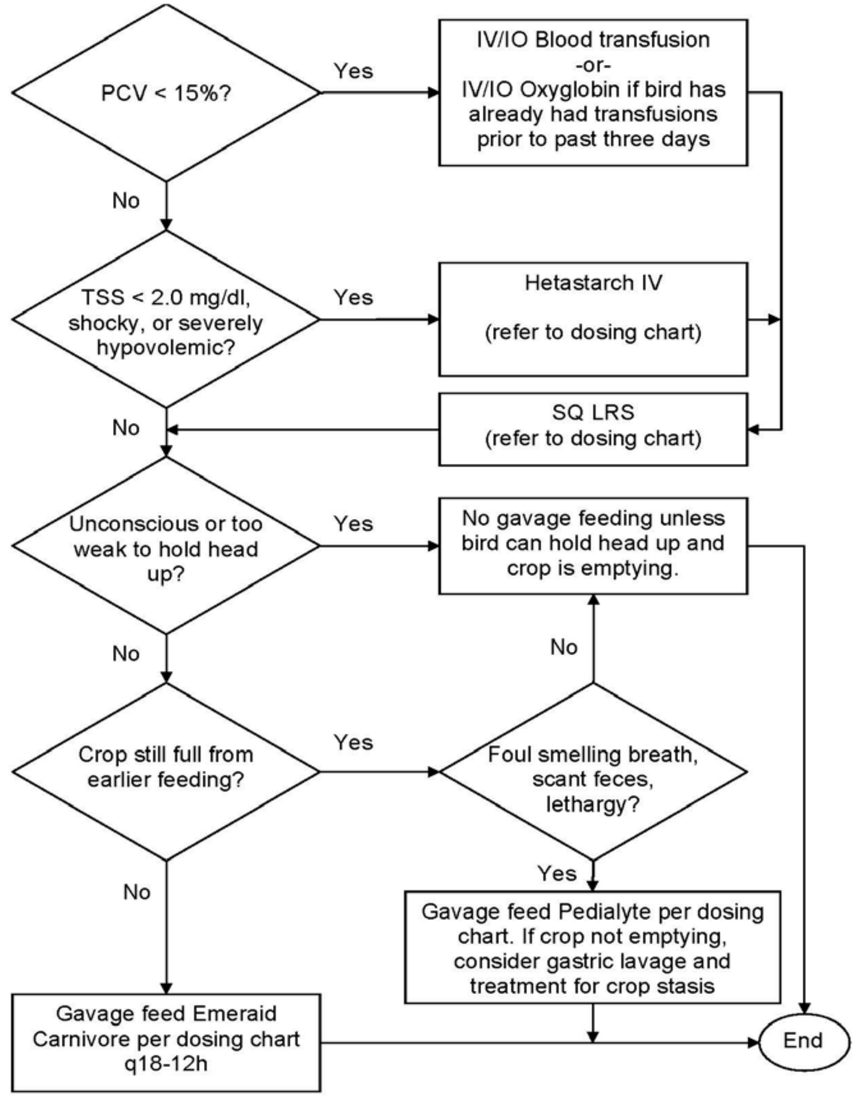
1. Rehydrate (place IO catheter)
2. Improve oncotic pressure
3. Provide calories
4. Initiate alimentation

- Without good hydration and sufficient energy, the GIT won't function and the result can be sour crop and death by entotoxemia.

Decision Flowchart

Scott Ford, DVM

Figure 1: Sample Treatment Decision Flowchart (< 24 Hours Post-Admission)



Rehydration

- The choice of fluid administered to critically ill raptors is important.
- Lactated Ringers solution is alkalinizing, while 0.95 saline is acidifying.
- Can gavage D5W or saline/D5W (1:1 ratio) SC for a little glucose and to start to stimulate the GIT. (Scott Ford, DVM)
- By assessing the sodium ion levels, plasma pH, partial pressure of carbon dioxide and bicarbonate levels, clinicians can give insights into the acid-base status of the patient.

The Fluid Formula

1. **Maintenance** Fluid Requirement
   - Weight (kg) x Maintenance Rate for the species (ml/kg)
   - = Volume in ml or cc
2. **Fluid Deficit** (Rehydration)
   - % Dehydration x Body Weight (gms)
   - = Volume in ml or cc
3. **Ongoing Losses**
   - Volume in ml (estimation of loss)
4. **Daily Fluid Requirement**
   - 1 + 2 + 3 = volume of fluids in ml to be given

Hetastarch

- **Colloids**
  - Large molecular weight substances that are restricted to bloodstream,
  - Ideal for animals in shock and hypoproteinemic,
  - Must be given IV or IO.
  - Examples:
    - Hetastarch
    - Oxyglobin
    - Whole blood or plasma
- **Indications**
  - If TP is < 2.0 mg/dl and the patient is emaciated
- **Dose**
  - 15ml/kg IV q8hrs.
  - Infuse it slowly at about 5-10cc/min. Any faster and may see reactions like head-shaking and tachypnea.
- If the TP is < 1, the prognosis is poor regardless of how aggressive you treat.

Heat

- Hypothermia is very common with debilitated and emaciated raptors.
- Peripheral vasodilation from external heat may exacerbate hypovolemia, further lowering body core temperature, and may aggravate acidosis, if it exists.
- Use of warmed IV fluids and a heated intensive care unit will simultaneously elevate core and peripheral body temperature efficiently.

ACC units

- Many Avian Critical Care units are designed to provide heat and oxygen without regard to humidity. Warm moist air is probably better at safely and effectively reversing hypothermia, possibly because of reducing evaporation from the extensive internal respiratory surface area.
- Heat and humidity can be provided by placing a pan of hot water covered by a rubber grill inside the ACC unit. The patient can be carefully placed on the grill and monitored carefully for overheating such as panting.

Oxygen

- 100% oxygen can be supplemented for short periods of time (less than 12 hrs), but 40% oxygen is standard.
- However, remember that birds that are severely anemic or in circulatory shock need adequate volume expansion and red blood cell replacement in order for improved tissue oxygenation to occur.

Antibiotics

- If bacterial sepsis is suspected, antibiotics such as Ceftriazone 75-100 mg/kg IM or Ceftazidime 50-100 mg/kg may be given directly IV or via IV fluids.

When to Initiate Nutritional Support?

- Indications for nutritional support include:
  - Reduced oral intake or total anorexia greater than 3 days duration,
  - Weight loss of 5-10% of body weight,
  - Trauma, surgery, systemic disease,
  - A decrease in serum albumin and/or a severe or ongoing loss or protein.
- Must have functional GIT.
- Must correct patient's fluid and acid-base deficits first.
- Enteral feeding can generally be started within 24-48 hours after the patient is adequately hydrated.

Goals of Nutritional Support

- To halt protein catabolism and promote protein synthesis.
- To provide a highly nutritious diet that is easily digestible, quickly absorbed and readily utilized by the patient, with maximum efficiency, minimal adverse affects and minimal stress/discomfort.

What Nutritional Support to Give?

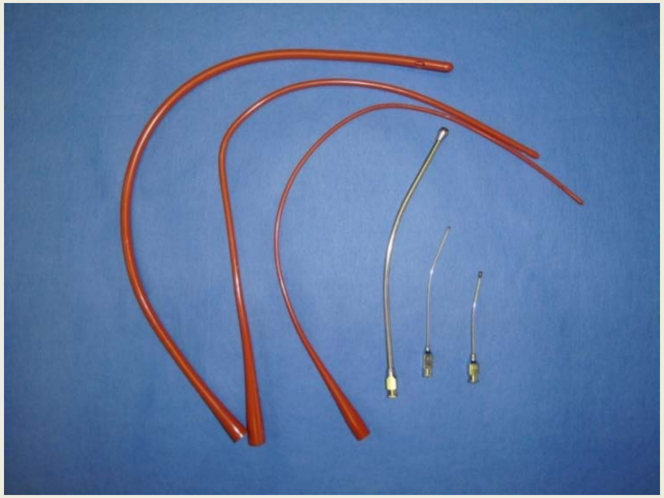
- An elemental diet (one that has more easily digestible short chain components) is going to be easiest for the digestive tract to assimilate.
- Many commercial diets available.
  - Lefaber's Carnivore Care (very simple components and high kcal/ml)
  - Hill's a/d
  - Eukanuba Maximum Calorie diet
- NOTE:
  - Important to ensure that birds given enteral nutrition are adequately hydrated, because many products are hyperosmolar and will contribute to dehydration if fluid requirements are not met. (Quesenberry *et al.*, 1991.)

Glutamine

- Glutamine has been considered to be a conditionally essential AA in the catabolic state.
- It is mobilized from muscle cells to provide the preferred energy source for lymphocytes, hepatocytes and intestinal mucosal cells. (Orosz, 2008)
- Patients with increased energy and protein needs may improve more rapidly with glutamine supplementation.
- May help protect enterocytes during refeeding (emaciation and hypermetabolism), resulting in decreased bacterial production.
- 2kg/ton of feed (<u>poultry dose only</u>).

Where to Give Nutritional Support?

- The gut is the safest and more natural route for administering nutrients.
- Best accomplished with enteral feeding.
  - Red rubber,
  - Metal gavage tubes.



How to Calculate Nutritional Requirements?

- There are three categories of energy requirements: basal, maintenance and daily.
- The basal energy requirements or **Basal Metabolic Rate** (BMR) is the minimum amount of energy necessary to maintain the body at rest (the energy to stay alive).
- The **Maintenance Energy Requirement** (MER)is the BMR plus the additional energy needed for normal physical activity, digestion and thermoregulation.
- The **Daily Energy Requirements** is equal to the MER plus any additional energy needed for growth, tissue repair, molting or to store extra energy.

Basal Metabolic Rate

- An estimate of BMR for birds is based on metabolic scaling.
- **BMR = K (Wt_{kg} $^{0.75}$)**
  - Non-passerine birds: K = 78
- The K factor is a theoretical constant for kcal used during 24 hours for various species of birds (mammals and reptiles).
- **MER** is estimated as **1.5 x BMR**.

Adjust for Stress

- With growth, stress or disease, animals are in a hypermetabolic state and daily energy needs surpass maintenance.
- The amount of increased demand depends on the type of injury or stress and varies from 1 to 3 times the daily maintenance requirement.

Adjustments to maintenance for stress, as a multiple of MER

Factor	MER x
Starvation	0.5 – 0.7
Elective Surgery	1.0 – 1.2
Mild Trauma	1.0 – 1.2
Severe Trauma	1.1 – 2.0
Growth	1.5 – 3.0
Sepsis	1.2 – 1.5
Burns	1.2 – 2.0
Head Injuries	1.0 – 2.0

Daily Energy Requirement = MER x (type of stress)

Allometric Food Calculation

ALLOMETRIC FOOD CALCULATION

Doctor:	Daut	Student:	
Species:	RTHA	Number:	09-0129
Energy Constant (K):	78	Weight:	0.86 kg

Basal Metabolic Rate: 69.6576 Kcal/kg/day

Maintenance Energy Requirement: 104.4864 Kcal/kg/day

Energy Factor Required: 1

Calculated Daily Requirement: 104.4864 Kcal/day

Food A make:	Carnivore	**Food B** make:		**Food C** make:	
Food A kcal/ml:	2.00	**Food B** kcal/ml:		**Food C** kcal/ml:	
% of food **A**:	100	% of food **B**:		% of food **C**:	
Ml/day if only food **A**:	52.2	Ml/day if only food **B**:	#DIV/0!	Ml/day if only food **C**:	#DIV/0!

Proportional kcal/ml: 2.0000

Proportional daily volume: 52.24

Meals per day: 2

Volume per meal: 26.12159603 ml   Rounded Volume: 26.1

Meal Frequency: q. hours

Comments:

Max feeding estimates:

40 ml/kg:	34.40
5% BW	43.00

Energy constants (K):
- Passerine birds 129
- Non passerines 78
- Placental mammals 70
- Marsupials 49
- Reptiles 10

Energy factors (multiply by MER):
- Starvation: 0.2-0.7
- Hypometabolism: 0.5-0.9
- Elective surgery: 1.0-1.2
- Mild trauma: 1.0-1.2
- Severe trauma: 1.1-2.0
- Growth: 1.5-3.0
- Sepsis: 1.2-1.5
- Burns: 1.2-2.0

Foods:

Hills A/D = 1.3 kCal/ml
Iams Max Cal = 2.1kCal/ml
Trout chow = 1.9 kCal/ml
Nutri-cal = 5.37 kCal/ml
Exact Hand-feeding formula (1:2) = 1.12 kCal/ml
Emeraid carbo-boost = 2.0 kCal/ml
Emeraid nutri support= 1.53 kCal/ml
Emeraid Carnivore= 2.0 kCal/ml
Mazuri ferret diet = 4.17 kCal/g
Totally Ferret Active = 4.35 kCal/g
Oxbow Critical Care = 1.69 kCal/g = 0.65 kCal/ml (1 vol powder: 2 vol water)
Roudybush AA = 3.5 kCal/g = 1.17 kCal/ml (1 vol powder : 2.5 vol water)
Biolyte = 0.29 kcal/ml
Clinicare canine/feline = 0.92 kcal/ml

Calculations:

Protein: 4.29 kcal/g
Carbohydrate: 4.09 kcal/g
Fat: 9.29 kcal/g

Calculation

Example: 900mg adult red-tailed hawk presents with a fractured R humerus. BCS 2/5.

- Estimate MER as 1.5 x BMR.
- Stress factor = 1.5

Daily Caloric Needs:

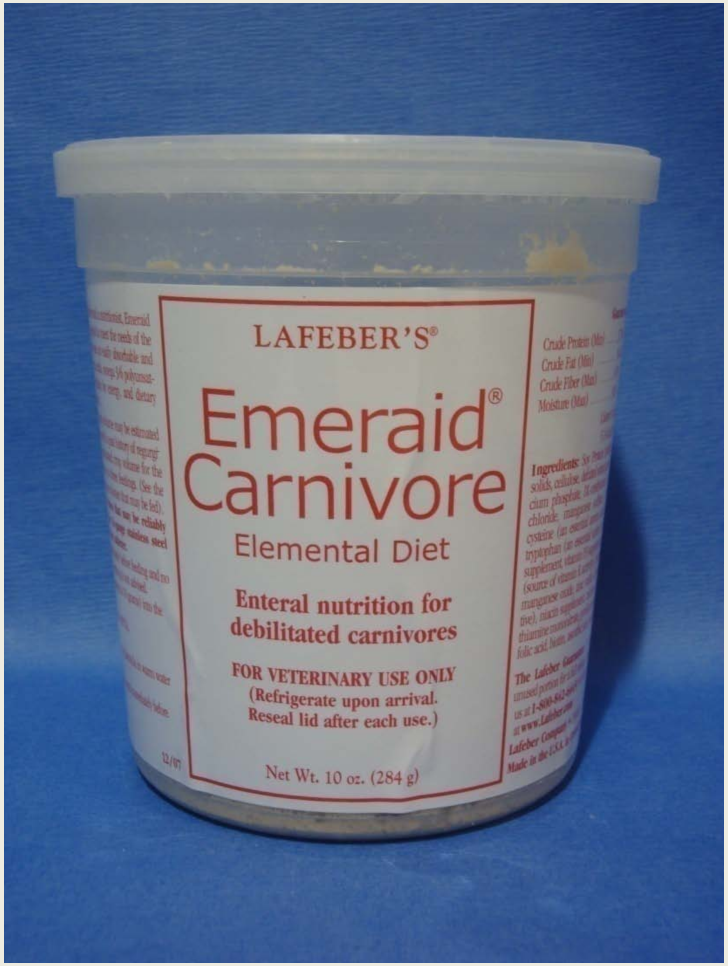
- BMR = $78(0.9^{0.75})$ = 72 kcal/day
- MER = 1.5 x 72 = 108 kcal/day
- Daily = 1.5 x 108 kcal/day = **162 kcal/day**

How Much Formula?

- If the energy content of the feeding formula is known, the exact caloric needs are divided by the calories per ml of formula to calculate the total volume of formula needed per day.
- **Example:**

  Carnivore Care = 2.0kcal/ml

  - 162 kcal/day ÷ 2.0 kcal/ml = 81ml needed daily.



Total Parenteral Nutrition

- Parenteral nutrition bypasses the digestive tract by supplying nutrients directly into the vascular system.
- Involves IV or IO administration of essential nutrients including AA, lipids, CHO, vitamins, electrolytes and minerals.
- Indications: GI stasis, regurgitation, GI surgeries, severe head trauma and diseases of malabsorption and maldigestion.

Refeeding Syndrome

- Is associated with metabolic/electrolyte disturbances that occur as a result of feeding a patient that has been starved or severely malnourished.
- During catabolism, as the body cell mass shrinks, the intracellular ions (potassium, phosphorus, magnesium) move in to the extracellular space and then excreted through the kidneys as they reach threshold.
- Refeeding causes a shift in the body from a catabolic state where protein is the primary energy source to an anabolic state where carbohydrates are the preferred energy source.

Refeeding Continued

- When patients are renourished, increased insulin secretions result in increased intracellular uptake of glucose along with phosphorus and other electrolytes, namely potassium.
- There is often a rapid shift of these ions from the plasma (where levels are often normal before feeding) to the expanding intracellular space, and the serum levels can fall dangerously low within 24-72 hours.
- Profound hypophosphatemia, hypokalemia and/or hypomagnesemia may result and lead to muscle weakness, intravascular hemolysis and possible cardiac and respiratory failure.

How to Avoid Refeeding Syndrome

- Refeed with formulations known to contain adequate levels of phosphorus, potassium and magnesium.
- Don't add extra energy to the caloric requirements.
- Consider refeeding a high-fat, low-carbohydrate diets to patients who haven't eating greater than 5 days.
- Monitor phosphorus, potassium, magnesium and PCV/TP at least daily, starting within 12 hrs of refeeding.
- Supplement electrolytes as needed.

Transition to Whole Food

- Should be gradual.
- Hydration and electrolyte abnormalities should be resolved.
- First solid meal should consist of 3-4 bite-sized pieces of mice or other whole prey (with the skin removed).
- If passes feces normally and no complications, add a little more each meal.
- Work up to several small meals daily, allowing the crop to empty between feedings.
- Eventually, whole mice or other whole prey may be offered.

Chopped Plate or Force Feed

- Offer a chopped plate with small pieces of mice.
- If the patient doesn't eat on own, you will need to force feed.

Recommendations

- Minimizing stress is critical with weak emaciated patients.
- Skip initial diagnostics if the patient is very weak.
- Place IO catheter and start warm hetastarch bolus with warmed crystalloids (fluid warmer is ideal if using CRI).
- Place in ACC chamber with low O2, heat and humidity.
- Monitor plasma electrolytes and manage with fluid therapy.
- With acidosis – consider supplementing with bicarbonate.
  - Generally 1mEq/kg of bicarb IV (then SC) can be administered at 15-30 minute intervals if no means are available to determine patient's bicarbonate level (maximum 4mEq/kg.)
- With alkalosis – 5% dextrose saline solution is more appropriate.
- Some diarrhea is expected in emaciated patients due to GI villous atrophy, and should be addressed as ongoing losses in fluid therapy calculations.
- Consider IV antibiotics if indicated or suspect sepsis.
- Start enteral gavage feeding once fully rehydrated.

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