Raptor Emergency and Critical Care: Assessment and Examination

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ABSTRACT: Raptors are commonly presented with traumatic injuries and therefore need emergency stabilization. Triage is key to a successful outcome. History may be minimal, but field guides can help determine signalment. Raptor physiology, temperament, and presentation status make it challenging to evaluate respiratory, cardiovascular, neurologic, and musculoskeletal systems. Priority should be given to emergency stabilization, with a visual evaluation preceding manual restraint for physical examination, which should then proceed in a stepwise manner. The suggested minimum database should be tailored to the individual veterinary clinic but can be accomplished with minimal time and cost. Further diagnostics should be based on suspected or common diagnostic differentials in the affected system.

Medical management of birds of prey can be rewarding and challenging. In contrast to small animal medicine, the harsh physical constraints of the wild preclude release of many injured raptors. For example, amputation of any part of a single limb in a raptor renders the patient nonreleasable. Thus initial assessment of release potential is a priority when evaluating critically ill or injured raptors. Cost, rehabilitation, and the ability to not only repair injuries but also provide the animal with adequate flight and hunting capabilities subsequent to repair must be considered. Guidelines issued by the federal government mandate that specific criteria be met in order for a raptor to be eligible for release1 (see Prognosis of Raptor Injuries, p. 443). Clinicians should communicate with local wildlife officials within 24 hours of presentation of any wild raptor to ensure that appropriate guidelines are followed and that the raptor has the best chance for continued rehabilitation and eventual release.

This article provides guidelines for assessment and initial treatment of critically ill raptors. Basic raptor medicine has been covered elsewhere.2,3 Presentation,
handling, and examination are discussed as well as assessment of commonly affected systems that require emergency treatment. Common diagnostic differentials requiring emergency care are discussed, including appropriate diagnostics and therapeutics.

TRIAGE

Rapid assessment of patient needs allows for treatment of critical, life-threatening injury or illness first. Triage requires decision making based on presentation. Injuries precluding release or placement into a reproductive or education program dictate euthanasia of the animal. This dogmatic philosophy allows conservation of resources, time, and energy for patients with the best chance for release into the wild.

HISTORY AND PRESENTATION

History of critically ill wild raptors, however minimal, may be key to determining diagnostic differentials. When and where the raptor was found and whether it was given food or medications guide initial assessment and communications with wildlife officials. Field identification guides can be used to determine signalment, including age, sex, preferred diet, and daily activity rhythm. Injured raptors may have such specific histories as vehicular trauma, gunshot, or suspected poisoning. In retrospective studies of raptors in Florida, Iowa, and California, most were presented for traumatic injuries,\(^4\) and most of these injuries were related to human activity (e.g., car, building, or power-line collisions; gunshot wounds; trapping). Other significant reasons for presentation of raptors included emaciation or poor nutrition (with undetermined disease etiology), toxicoses, infectious disease, and orphaning. These reasons for presentation demonstrate the need for avian emergency and critical care in the majority of raptor patients.

VISUAL EXAMINATION

As historical and signalment information is gathered, the bird should be placed in a warm (80˚F to 90˚F), quiet, dark area to minimize stress. Many raptors are so debilitated at presentation that a complete physical examination may be life threatening. In these cases, emergency treatment and stabilization should be instituted first. Before handling, visual evaluation of the major body systems determines whether to initiate immediate stabilization therapy or physical restraint for examination and sample collection to obtain a minimum database. Assessment of the airway and breathing should include observation of respiratory rate and depth. Posture, awareness, and external abnormalities (including feather placement) that may be difficult to properly examine while attempting restraint should be evaluated before handling.

MINIMUM DATABASE

The minimum database for each raptor care facility is determined individually and is often based on economics. A recommended baseline includes packed cell volume (PCV), total solids, and an estimated white blood cell (WBC) count. Table 1 provides reference ranges of these parameters in selected raptors. A WBC estimate can be determined by obtaining the average number of WBCs in the erythrocyte monolayer per \(40 \times\) (high dry) field and multiplying this by 2000. Prior to release, but after triage, all raptors should receive at least one fecal parasite examination as well as a full fundic ophthalmologic examination.

HANDLING AND PHYSICAL EXAMINATION

Proper handling and examination of critically ill rap-
tors are key to successful outcome. Having all equipment ready prior to examination and/or sample collection facilitates a thorough yet rapid physical examination. In raptors younger than 6 weeks of age, imprinting is a concern; thus visualization of humans at the time of physical examination is discouraged. An initial weight (accurate to the gram) can be used to assess patient condition, recovery, and hydration and to calculate doses of emergency drugs.

In emergency situations, clinicians must limit patient stress and proceed to stabilization before performing major procedures or even extended handling. The patient’s condition may require proceeding in a stepwise fashion, with the patient handled for a short time, treated, and returned to the hospitalization area. Working in a quiet, darkened area and covering the eyes of the raptor with a towel will reduce the stress of physical examination.

Recognition and neutralization of the patient’s beak and talons are required for successful physical examination and minimizing risk of injury to the handler, examiner, and raptor. Protective equipment, including heavy leather gloves to protect the hands and arms of the handler and goggles for eye protection, are appropriate when dealing with raptors weighing over 100 g.

Carefully monitored isoflurane anesthesia is a safe and effective means of restraint in fractious, painful, or even dyspneic raptors. General anesthesia allows for a complete physical examination, diagnostic sampling, and therapy without undue patient or handler stress. A recommended anesthetic protocol would include pre-oxygenation as necessary and an oxygen flow rate of 1 to 1.5 L/min/kg, with isoflurane administered via face-mask at 4% to 5% for induction and reduced to 2% to 2.5% or lower as needed to maintain appropriate respiration for the species.

**RESPIRATORY SYSTEM**

Respiratory and cardiovascular systems are given priority in evaluating a patient’s status. Should respiratory or airway problems be suspected, an initial visual examination is performed. Observation from a distance or without raptor awareness of human presence may circumvent the instinctual behavior of hiding illness. The respiratory rate should be measured prior to handling (Table 2). Primary diagnostic differentials for dyspnea in wild raptors include trauma (rib, femur, or humeral fractures or dislocations; air sac ruptures; pneumoperitoneum contusions; pulmonary hemorrhage; edema),

### TABLE 1
Biochemical and Hematologic Data for Selected Raptors*

<table>
<thead>
<tr>
<th>Parameter (count/level)</th>
<th>American Kestrel</th>
<th>Red-Tailed Hawk</th>
<th>Great Horned Owl</th>
<th>Bald Eagle</th>
</tr>
</thead>
<tbody>
<tr>
<td>White blood cell (10³/µl)</td>
<td>8.6 ± 0.9</td>
<td>16 ± 2</td>
<td>6.0–8.0</td>
<td>12.8 ± 4.8</td>
</tr>
<tr>
<td>Packed cell volume (%)</td>
<td>NA</td>
<td>44.6 ± 2.6</td>
<td>43.3 ± 2.9</td>
<td>44 ± 4</td>
</tr>
<tr>
<td>Total protein (mg/dl)</td>
<td>3.1 ± 0.1</td>
<td>4.3 ± 0.5</td>
<td>5.1 ± 0.6</td>
<td>3.5 ± 0.8</td>
</tr>
<tr>
<td>Albumin (mg/dl)</td>
<td>0.9 ± 0.2</td>
<td>1.34 ± 0.41</td>
<td>1.27 ± 0.35</td>
<td>1.09 ± 0.18</td>
</tr>
<tr>
<td>Potassium (mmol/L)</td>
<td>6.9 ± 0.7</td>
<td>4.9 ± 0.6</td>
<td>2.8</td>
<td>3.0</td>
</tr>
<tr>
<td>Sodium (mmol/L)</td>
<td>158 ± 0.6</td>
<td>151 ± 0.5</td>
<td>156</td>
<td>156 ± 4</td>
</tr>
<tr>
<td>Chloride (mmol/L)</td>
<td>NA</td>
<td>125 ± 3</td>
<td>122</td>
<td>120 ± 3</td>
</tr>
<tr>
<td>Glucose (mg/dl)</td>
<td>428 ± 6.7</td>
<td>424 ± 9.2</td>
<td>356</td>
<td>302 ± 25</td>
</tr>
<tr>
<td>Calcium (mg/dl)</td>
<td>7.9 ± 0.1</td>
<td>10.19</td>
<td>10.19</td>
<td>9.94 ± 0.45</td>
</tr>
<tr>
<td>Phosphorus (mg/dl)</td>
<td>2.4 ± 0.1</td>
<td>2.6 ± 0.2</td>
<td>4.34</td>
<td>3.03 ± 0.51</td>
</tr>
<tr>
<td>Uric acid (mg/dl)</td>
<td>18.5 ± 1.1</td>
<td>8.3 ± 1.4</td>
<td>13.7 ± 10.8</td>
<td>5.07 ± 3.33</td>
</tr>
</tbody>
</table>


NA = not available.

### TABLE 2
Normal Avian Respiratory and Heart Rates Based on Weight*

<table>
<thead>
<tr>
<th>Weight (g)</th>
<th>Heart Rate (beats/min)</th>
<th>Respiratory Rate (breaths/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>206–600</td>
<td>40–80</td>
</tr>
<tr>
<td>200</td>
<td>178–500</td>
<td>35–65</td>
</tr>
<tr>
<td>500</td>
<td>147–300</td>
<td>20–50</td>
</tr>
<tr>
<td>1000</td>
<td>127–350</td>
<td>15–40</td>
</tr>
<tr>
<td>1500</td>
<td>117–200</td>
<td>20–30</td>
</tr>
<tr>
<td>2000</td>
<td>110–175</td>
<td>19–30</td>
</tr>
</tbody>
</table>

foreign body inhalation, aspiration pneumonia (more commonly found in nestlings), aspergillosis, and bacterial infection.8 Auscultation incorporates the dorsal aspects of the bird to evaluate the lung fields and the ventral aspects to evaluate the heart and cranial and caudal thoracic air sacs.9 Radiographic evaluation is reserved for stable patients. If signs of respiratory distress (openmouthed breathing, tail bobbing, coelomic hyperinflation) are apparent on visual examination, oxygen supplementation should be considered; because of the nature of raptors, treatment is usually accomplished using a heated oxygen cage. If signs indicate an upper respiratory obstruction (tracheal obstruction, fungal granuloma), the patient may require an air sac catheter to circumvent the obstruction. Raptors with suspected impact trauma should be carefully monitored in the first 24 to 36 hours after presentation as pulmonary function can deteriorate.8 If pulmonary edema is suspected, aggressive therapy (e.g., fluids, oxygen, thermal support, diuretics) should be initiated.

CARDIOVASCULAR SYSTEM

Evaluation of the circulatory system, especially in cases of shock, dehydration, and hypothermia, is more difficult in birds than in mammals.10 Indications of shock in birds are nonspecific and may include depression, weakness, rapid respiration, and decreased capillary refill time (CRT). An elevated respiratory rate may occur as the patient attempts to compensate for metabolic acidosis.10 Oral mucous membranes in raptors may be pigmented, hindering assessment of CRT and mucous membrane color. Eversion of the vent may provide a more accessible mucous membrane. Vascular perfusion can best be determined using basilic vein turgidity; the vein should refill immediately after depression.10 The accompanying deep radial artery (Figure 1) or metatarsal artery as it crosses the dorsal surface of the tibiotarsal–tarsometatarsal joint may also be used to assess pulse quality and rate. Absence of a peripheral pulse may reflect cardiac asystole, severe peripheral vasoconstriction due to cold or hypovolemia, or hypotension. Weak, thready pulses may be a sign of shock, often the result of decreased stroke volume and peripheral arteriolar vasoconstriction.11 Clinical signs of hypothermia in birds include fluffing, huddling, trembling, and shivering.12

Although birds may lose up to 30% of their blood volume with few clinical consequences,13 evaluation of hemorrhage is a priority. Obtaining a PCV and total protein is recommended to assess the severity and etiology of the anemia. In avian species, the PCV takes about 24 hours to equilibrate following hemorrhage.14 Thus this blood parameter is most useful prognostically and diagnostically 48 hours after blood loss. If outward hemorrhage is apparent, fluid replacement should be considered in the form of crystalloids, colloids, or blood products. Inapparent hemorrhage into the coelom or air sac system may be addressed via coelomocentesis. Hemorrhage is associated with metabolic acidosis in birds, and fluid therapy should be modified accordingly.15

NEUROLOGIC SYSTEM

Neurologic evaluation, especially changes in mentation and level of consciousness, may be difficult in wild raptors because of instinctual stoic attitudes or death feigning responses.16 Common neurologic presentations of wild raptors include head, spinal, peripheral nerve, or ocular trauma; seizures; and toxicosis. A consistent neurologic examination protocol should be followed in order to observe subtle abnormalities. Observational examination includes assessment of mentation, attitude, posture, and gait. A normal bird perches with the head erect, wings folded, and legs hip width apart. Physical examination protocol includes assessment of
symmetry in muscle tone, strength, and activity in all limbs along with palpation of the spine and cranial vault. Close attention is given to the eyes and ears as hemorrhage in or around these structures may indicate head trauma. A positive menace response may be observed as a movement of nictitans rather than closure of the eyelids. The following contribute to difficulty in evaluating the pupillary light response: striated iridial muscle; restraint-induced increases in sympathetic tone; and incomplete septa between the bony orbits of the eyes, causing a mimicked consensual light response in some raptors. Thus the pupillary light response should not be relied on as a sole determinant of neurologic function or prognosis.

Central or Peripheral Nerve Trauma
While cranial trauma may be obvious (e.g., bruising; bleeding; overt damage to the eyes, mouth, beak, ears, cranium), less obvious lesions (e.g., bruising of the eyelids, internal ocular damage, fractures of the skull or orbits) may also be present. Primary peripheral nerve damage is less common than fracture or dislocation but should be considered when a raptor presents with a dysfunctional limb. Radiographs are indicated once the patient is stabilized. Birds that remain obtunded or neurologically dysfunctional for more than 48 hours without radiographic abnormalities have a guarded prognosis for release.

Ocular Trauma
Ocular trauma is a common finding in raptors; 25% presented to veterinarians have some form of ocular lesion. A significant number of these lesions are located in the posterior segment and may not be detected without a complete ophthalmologic examination. Any visual compromise in a raptor may hinder its hunting ability and thus prevent its release. In emergency situations, assessment of the anterior chamber, cornea, globe, conjunctiva, and adjacent regions is recommended. Fluorescein staining is recommended in cases of suspected corneal damage. Normal lens opacities may be present in juvenile raptors. On stabilization, a full fundic examination of every raptor should be performed to assess function and retinal integrity. Many excellent resources are available for guidance in treating ophthalmologic conditions in raptors. Release of raptors with a single functional eye is controversial, particularly in diurnal species, which appear to be more dependent on vision for hunting.

Seizures
Avian seizures are characterized by a short period of disorientation with head and body ataxia followed by loss of perching ability. Raptors may present in an intermittently rigid trancelike state with generalized muscle stiffening, shaking, and muscle contractions. During the ictal phase, hyperactivity, continued twitching, and poor depth perception may be apparent. In birds, involuntary limb or body motions, such as tremors or seizures, are common clinical signs associated with primary or secondary damage to the brain. Central nervous system trauma and toxicosis (pesticide or heavy metal) are primary diagnostic differentials for raptors experiencing seizures. However, other diagnostic differentials for seizures include metabolic disturbances (e.g., hypocalcemia, hypoglycemia), severe hepatic dysfunction, or central nervous system lesions of infectious or parasitic etiology.

While stopping the seizure is of primary concern, the clinician should next attempt to elucidate the etiology and then alleviate the cause of the seizure. Thus, in addition to the recommended minimum database, plasma or serum chemistry and electrolyte tests are indicated in patients experiencing seizures. Radiographic examination may also be indicated on patient stabilization to further investigate cases with clinical signs indicating trauma, heavy metal toxicity, or nutritional deficiency. Seizures may be controlled by administering diazepam or phenobarbital.

Toxicosis
Clinical signs of toxicosis in raptors may differ from those observed in mammals. Commonly encountered toxicoses in wild raptors are caused by organophosphates, carbamates, and heavy metals such as lead, zinc, and mercury. However, many other toxicoses have been reported in raptors, and appropriate steps should be taken prior to disposal of any raptor to determine whether there was a toxic insult. General treatment of suspected toxicoses includes emptying gastric and crop contents; administering activated charcoal to prevent further absorption of the intoxicant; and supportive care, including fluid and thermal support. In raptors with suspected toxicosis, serum chemistries are recommended as kidney and liver damage are possible sequelae of heavy metal, petroleum product, or pesticide exposure.

Organophosphate and Carbamate Toxicity
In birds, clinical signs of organophosphate toxicity and carbamate toxicity are similar. Classic signs observed in mammals (salivation, lacrimation, urination, defecation [SLUD]) are seldom reported in birds. Neurologic signs are usually the most obvious and include ataxia, an inability to fly or stand, paresis of the limbs, flaccid paralysis, and rigid or clenched talons, progress-
ing to muscle fasciculations, tremors, tonic-clonic convulsions, and seizures. Gastrointestinal (GI), respiratory, and cardiovascular signs are less commonly encountered but include dyspnea, moist rales, tachypnea, diarrhea, anorexia, crop stasis, and bradycardia. In addition to general toxicosis treatment, seizures should be controlled (see Seizures section).

**Heavy Metal Toxicity**

Clinical signs of heavy metal toxicity include neurologic signs such as a generalized weakness, depression, incoordination, opisthotonos, or an inability to fly. The GI system is also commonly affected, with signs ranging from regurgitation and vomiting to diarrhea and bile-stained (bright green) droppings. Diagnosis of heavy metal toxicity should be confirmed via heavy metal blood determination or radiographs. In addition to general toxicoses treatment, chelation therapy and/or removal (via endoscopy, laparotomy, or medical management) of heavy metal objects found in joints or the GI tract is indicated on patient stabilization.

**MUSCULOSKELETAL SYSTEM**

Fractures, dislocations, penetrating wounds, and degloving injuries are common in raptors. In recumbent patients, temporary fracture stabilization and wound care should be delayed until the patient is stable. In stable patients, immobilizing fractures and bandaging wounds involving the coelom, especially the air sacs, should be given priority until a definitive treatment plan can be pursued. Avian wounds easily desiccate and should be bandaged. Wet-to-dry bandages are indicated for contaminated wounds. Excessive application of antibiotic ointment should be avoided as this may oil flight feathers, decrease the patient’s ability to thermoregulate, and interfere with healing. Topical application of steroid-containing preparations is contraindicated due to immunocompromising effects and life-threatening drug reactions.

**REFERENCES**


**About the Authors**

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**ARTICLE #3 CE TEST**

The article you have read qualifies for 1.5 contact hours of Continuing Education Credit from the Auburn University College of Veterinary Medicine. *Choose the best answer* to each of the following questions; then mark your answers on the postage-paid envelope inserted in *Compendium*.

1. Triage is primarily concerned with all of the following except
   a. timely patient care.
   b. rapid patient assessment.
   c. prioritization of patient needs.
   d. any trauma patient.
   e. patients other than raptors.

2. Which of the following irreparable problems precludes release of raptors into the wild?
   a. blindness
   b. amputation of any limb
   c. injuries that preclude perching upright
   d. injuries that preclude ambulation without injury
   e. all of the above

3. Which of the following factors must be considered on initial assessment of injured raptors?
   a. ability to repair injuries
   b. the bird’s ability to find, catch, and consume prey
   c. the bird’s ability to fly
   d. cost of treatment
   e. all of the above

4. Facts to obtain or determine that may guide initial assessment when a raptor patient is presented include
   a. where the raptor was found.
   b. whether the raptor was given food.
   c. whether the raptor was given medication.
   d. species identification.
   e. a, b, and c

5. Most raptor deaths are related to
   a. human activity.
   b. infectious disease.
   c. emaciation/poor nutrition.
   d. unknown causes.
   e. undetermined etiology.

6. Proper raptor hospitalization should not include
   a. warmth (80°F to 90°F).
   b. noise from dogs, cats, and the hospital staff.
   c. quietness.
   d. darkness.
   e. oxygen therapy.
7. Specific abnormalities of raptors that may be more easily noted on visual examination include
   a. respiratory rate/depth.
   b. feather placement.
   c. posture.
   d. awareness.
   e. all of the above

8. Evaluation of the cardiovascular system in raptors should include
   a. pulse rate and quality in the metatarsal or deep brachial artery.
   b. basilic vein refill and/or turgidity.
   c. oral or vent (cloacal) mucous membrane color.
   d. oral or vent (cloacal) CRT.
   e. all of the above

9. Primary differentials for raptors with dyspnea do not include
   a. trauma.
   b. foreign body inhalation.
   c. aspiration pneumonia.
   d. aspergillosis.
   e. eclampsia.

10. Common neurologic presentations of wild raptors do not include
    a. trauma to the spinal or peripheral nerves.
    b. seizures.
    c. toxicosis.
    d. ocular trauma.
    e. idiopathic epilepsy.