**Allergic Reactions and Anaphylaxis**

Allergic reactions are common in the pediatric population, especially with inquisitive puppies. A reaction can occur after vaccines, but more commonly insect bites such as red ants, bees or wasps are the culprit. Usually the puppy will go outside and come back in with a swollen face. Cats can also have allergic reactions, including severe allergic reactions such as anaphylaxis. It is suspected that cats may be allergic to BNP ointment and can suffer an anaphylactic reaction after it is placed in the eyes during surgical procedures. It is recommended to avoid its use in cats.

Allergic reactions are type I hypersensitivity reactions. Inflammatory mediators are released from mast cells and basophils. The most common mediators released are histamine, causing vasodilation, and bronchoconstriction, as well as prostaglandins and leukotrienes resulting in leaky capillaries and smooth muscle constriction.

Allergic reactions can be confined to local reactions, in which there may be facial swelling, hives, redness, etc. However, the reaction can progress to anaphylaxis, which is a severe systemic reaction characterized by hypotension and collapse.

How an animal exhibits an allergic reaction greatly depends on the species. Dogs tend to have a higher percentage of skin reactions such as hives, itching, facial swelling, etc. On the other hand, the most common sign of an allergic reaction in a cat is vomiting followed by respiratory distress due to bronchoconstriction. Dogs can show vomiting as well, but it is not as commonly seen as the skin signs.

Since local reactions are often mild and confined to a swollen face and hives, they can often be treated conservatively with Benadryl +/- a low dose of DexSP. This is assuming the heart rate and respiratory rate are normal and there is no evidence of hypotension or dyspnea.

Cats with anaphylaxis can get severe dyspnea due to bronchoconstriction as well as formation of upper and lower airway edema. They can also go into hypotensive shock. In dogs, there is an acute splanchnic congestion causing gastrointestinal signs and acute hypotensive shock. Treatment of anaphylaxis consists of rapid vascular access and intravenous fluids. Since they are in hypotensive shock, these patients may require both crystalloid and colloid therapy. Oxygen therapy needs to be instituted in animals exhibiting signs of shock, especially in cats that have bronchoconstriction. In cases of bronchoconstriction, bronchodilators may be needed. The most commonly used bronchodilator is terbutaline (0.01 mg/kg IV). In severe cases of anaphylaxis epinephrine will need to be administered. (0.01mg/kg of the 1:10,000 solution given slowly IV). As with all allergic reactions, antihistamines should be administered early in the course of therapy.

The most important point to remember is that an animal with anaphylaxis is dying of the hypotensive shock. Perfusion needs to be addressed with aggressive fluid therapy. This needs to be the first therapy. The use of steroids or antihistamines should be instituted as well, but not as the sole therapy.

**Hypoglycemia**

Hypoglycemic crises are seen in small breed puppies, especially the toy breeds. Although sometimes seen in kittens, it seems to occur more frequently in puppies. Hypoglycemia usually occurs in puppies less than 10 weeks old. The number one cause is owners not realizing that they need to feed the puppies more than twice a day. However, sometimes these animals will have underlying medical problems as well. The two most frequent conditions seen in hypoglycemic puppies and kittens are gastroenteritis and respiratory infections. These problems either make the puppies not want to eat, cause poor absorption of nutrients, or result in increased metabolic need requiring more than normal glucose ingestion.

Clinical signs of hypoglycemia include lethargy, weakness progressing to unresponsiveness, hypersalivation, hypothermia, and bradycardia. Initially they may have a little bit of twitching, but this can progress to tonic-clonic seizures and ultimately comatose.
Initial stabilization requires an IV access. Sometimes in pediatric patients it can be very difficult to place a cephalic or saphenous catheter. However, a peripheral 22- or 25-gauge catheter can be placed in the jugular vein. You can also place an interosseous catheter if necessary. If neither of these catheter options is possible, you can place a nasogastric tube and put dextrose directly into the stomach. The dose of intravenous dextrose is 1 ml/lb of 25% dextrose. Fifty percent dextrose should not be given intravenously as it is too hyperosmolar and can cause phlebitis. A dextrose CRI will be needed after the initial dextrose, as the bolus will quickly be metabolized. Monitoring includes rechecking blood glucose every one to two hours until the glucose stabilizes and the puppy/kitten is eating well.

Diagnostics should be performed to find out the underlying cause for the hypoglycemia. This includes a fecal float and smear, as well as a parvo test in puppies. The possibility of a portosystemic shunt needs to be considered. It is also important to not forget that sepsis can cause hypoglycemia, so a search should be made for any other evidence of systemic infection, such as low white count, fever, etc.

For the most part, the prognosis for these puppies is excellent, provided it is an uncomplicated case. However, if there is an underlying disorder, such as a shunt or sepsis, the prognosis can worsen.

**Parvo**

Parvovirus replicates inside intestinal epithelial cells and causes destruction of the intestinal crypts. This causes intestinal lining sloughing, which results in the classic clinical signs of bloody diarrhea and vomiting. Other clinical signs include weakness or depression, marked dehydration, abdominal discomfort, and tachycardia due to hypovolemia.

The bloody diarrhea results in fluid loss as well as protein loss and sometimes a mild anemia. The vomiting further exacerbates the fluid loss and hypovolemia and can cause electrolyte abnormalities. Without the intestinal lining intact, these puppies are at risk for bacterial translocation and resulting sepsis. Furthermore, the virus is very good about killing off neutrophils, which is why these puppies can have an alarmingly low white blood cell counts. This also increases the risk of sepsis.

Diagnosis is usually done via an in-house parvo snap test; however, this test can be negative early on in the disease. Other diagnostics include a CBC, which often indicates a severe neutropenia. But this also may not be apparent early on. Minimal database also includes BUN, glucose, and electrolytes as well as a PCV and total protein. Ideally a full CBC and chemistry panel should be run. Often these puppies also have intestinal parasites; therefore a fecal should be submitted.

Parvo puppies die from hypovolemic shock, or sepsis from bacterial translocation. Consequently, the mainstay of therapy is aggressive fluid therapy and antibiotics.

These puppies may require high rates of fluid therapy due to the large volume of vomiting and diarrhea. Fluid therapy initially consists of crystalloids (Normosol R, LRS, etc). Initial boluses are often needed in the beginning to start to correct the hypovolemia. Severe hypovolemia, or signs of hypovolemic shock, warrant colloid therapy as well. After initiating fluid therapy the patient needs to be reassessed frequently, minimally at least every 4 to 6 hours, to make sure hydration is improving. Frequent body weights can help determine whether or not you are keeping up with losses. Pee pads can be weighed as well to estimate volume of losses.

Colloid use is often necessary in treating parvovirus. The most common colloid used in veterinary medicine is hetastarch. Other colloids that are available are Oxyglobin and plasma. Colloids have a number of properties that are helpful in the treatment of parvovirus. The first is to provide volume expansion. They help draw fluid from the interstitial space back into the vasculature. However, in the dehydrated patient there isn’t going to be much fluid in the interstitial space to draw upon. Therefore colloids often are not utilized until the interstitial space is somewhat replenished with crystalloid therapy, or at the very least given at the same time as crystalloids. Second, colloids help prevent peripheral edema secondary to hypoalbuminemia that often occurs with profuse diarrhea.

Fresh frozen plasma has many potential benefits in the treatment of parvovirus. It is a natural colloid that contains proteins including albumin. These puppies have severe inflammation, making them at risk for DIC, so the clotting
factors found in plasma may be beneficial. Finally, there is some debate over whether plasma contains antibodies against the virus since the donors have been vaccinated against parvo.

Puppies with parvovirus are incredibly nauseous, and the use of just one antiemetic is often not enough. Drug choices are listed in the table below.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Action</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metoclopramide</td>
<td>Increases esophageal clearance</td>
<td>Inexpensive</td>
<td>Often not enough</td>
<td>1–2 mg/kg/day CRI</td>
</tr>
<tr>
<td>(Reglan)</td>
<td>Accelerates gastric emptying</td>
<td>Can be used as a CRI</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Shortens bowel transit time</td>
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<td></td>
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<tr>
<td></td>
<td>Dopamine antagonist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorpromazine</td>
<td>Dopamine antagonist</td>
<td>Good antiemetics</td>
<td>Causes sedation, hypotension</td>
<td>0.5 mg/kg IV q 6-8</td>
</tr>
<tr>
<td></td>
<td>May decrease gastric acid formation</td>
<td>Inexpensive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ondansetron</td>
<td>Serotonin antagonist</td>
<td>Excellent antiemetics</td>
<td>Expensive, especially Zofran</td>
<td>Zofran: 0.11–0.17</td>
</tr>
<tr>
<td>(Zofran)</td>
<td></td>
<td>Anzemet once a day</td>
<td></td>
<td>IV q6–12h</td>
</tr>
<tr>
<td>Dolasetron</td>
<td></td>
<td>Minimal side effects</td>
<td></td>
<td>Anzemet: 0.6 mg/kg</td>
</tr>
<tr>
<td>(Anzemet)</td>
<td></td>
<td></td>
<td></td>
<td>IV q 24</td>
</tr>
<tr>
<td>Maropitant</td>
<td>Blocks substance P in CNS</td>
<td>Once a day dosing</td>
<td>Not labeled &lt;16 weeks old</td>
<td>1 mg/kg SC q 24 h</td>
</tr>
<tr>
<td>(Cerenia)</td>
<td></td>
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</tbody>
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Parvo puppies are prone to esophagitis from vomiting and regurgitation. Esophagitis can cause pain and contribute to anorexia and nausea. H2 blockers such as famotidine or ranitidine are recommended.

Antibiotics are critical to the treatment of parvovirus. The source of bacteria can be enteric bacteria such as Salmonella, clostridium, E. coli, etc. However, because these puppies have such low white blood cell counts, they are susceptible to bacteria from other sources. It can be very difficult to predict exactly which bacteria may be causing their infections.

Antibiotic therapy starts with a penicillin such as ampicillin or Unasyn IV. Some clinicians prefer to start with cefazolin or cefoxitin. If the puppy is severely neutropenic or there are signs of sepsis, then a broader spectrum is needed. If the puppy is well hydrated, consider adding a short course of Gentocin or amikacin. Another good way to expand the spectrum would be to add Baytril. While there is some concern about chondral defects in young puppies given Baytril, it is safe for short-term use at appropriate doses. You need to prioritize what is best for that puppy at that time. If he is dying of sepsis, that must take precedence over the remote possibility of a cartilage abnormality.

Finally, intravenous metronidazole can be used in combination with the other antibiotics.

Analgesia is often necessary for these puppies. The ileus causes abdominal discomfort, which can increase their depression and nausea. Esophagitis can also be quite painful. Fentanyl has less sedative effect than the other narcotics but must be given as a CRI. Buprenorphine is less likely to exacerbate the nausea as compared to morphine or hydromorphone. Butorphanol is too short acting so is not recommended.

These puppies should have daily PCV, total protein, glucose, electrolytes, and albumin run. A CBC should be performed on day one and then afterward depending on the individual case. There should be a minimum of twice-daily body weights and physical exams. Focus should be on checking the puppies’ hydration status and cardiovascular stability, as well as assessing for abdominal pain and adequate analgesia.

Enterocytes regenerate by having directed glutamine contact, so nutritional support needs to be instituted as soon as possible. Increase the antiemetics to help control the nausea, so the puppies can start eating. Syringe feeding or coaxed hand feeding may decrease the nausea. After multiple days of total anorexia, there are a few options for nutritional support. One is to place a nasogastric tube and start trickle feeding. Often these animals can tolerate this better than bolus feedings. Consider parenteral nutrition such as PPN or TPN in puppies that cannot tolerate any enteral nutrition.
With aggressive, appropriate therapy more than 75% of these puppies survive. Death is usually due to one of four factors: 1) the patient develops sepsis, 2) inadequate fluid therapy, 3) development of intussusception, and 4) financial constraints.

Puppy Pneumonia
Many different etiologic agents can cause pneumonia in puppies. The most common are viral (distemper, canine influenza) and bacterial (E. coli, Bordetella bronchiseptica, Mycoplasma, etc.). However, fungal infections, foreign bodies, aspiration pneumonitis, ciliary dyskinesis, and parasitic infections cannot be forgotten.

Obtain a minimum database such as CBC, chemistry panel, urinalysis, and fecal. A Baermann float may be necessary to rule out parasitic lung infections. Consider distemper titers as well as conjunctival scrapes. Blood pressure should be done to check for hypotension. Ideally arterial blood gases should be obtained if possible; however, in most cases pulse oximetry may substitute. Thoracic radiographs are critical for the diagnosis of pneumonia, but these need to be delayed until the puppies have been stabilized and are not overtly dyspneic.

Ideally a transtracheal or endotracheal wash should be performed before initiating antimicrobial therapy. Antibiotic selection should be based on culture and sensitivity. In most puppies the simplest method to obtain a sample for culture is an endotracheal wash. Brief anesthesia is induced with propofol, and a sterile endotracheal tube is passed through the laryngeal folds into the trachea. A sterile red rubber catheter is passed down the endotracheal tube and a wash performed using sterile saline. Samples can then be submitted for culture and cytology.

Oxygen therapy is needed until the pulse ox is consistently over 96% and the puppy has a normal respiratory rate and effort. It is very important to not use just one monitoring value, e.g., the pulse ox, in deciding to give oxygen. Respiratory rate and effort as well as attitude are just as important as a pulse ox or blood gas reading.

Empirical antibiotic selection is needed until the results of culture and sensitivity are back. There are many different published recommendations for antibiotic therapy in puppies with pneumonia. Most include a combination of penicillin combined with metronidazole, clindamycin, or Baytril. There is some question about the efficacy of penicillins, because many puppies that present with pneumonia have been placed on Clavamox for possible Bordetella but still developed pneumonia. Baytril is an excellent antibiotic for most puppies with pneumonia, and short-term, appropriate dose use of Baytril is not contraindicated.

Nebulization and coupage should be instituted to help break up the secretions. Nebulize with saline 3 to 4 times a day followed by 10 minutes of coupage. In severe cases of pneumonia that are not responding to other therapies, amikacin or Gentocin can be nebulized as well. It is also important to keep these puppies up and moving to help them fully expand their lungs, break up secretions, and encourage coughing.

Monitor respiratory rate and effort as well as serial pulse ox and possible arterial blood gas measurements. Because these puppies are often not eating, the glucose should be checked on a regular basis. A CBC should be run every 24 to 48 hours as well as thoracic radiographs every two to three days. Remember that the thoracic radiographs often lag behind clinical improvement or worsening.

If the pneumonia persists despite appropriate antibiotic therapy, an endotracheal wash or BAL must be performed, if it has not already been done, to obtain samples for culture. A persistent lung lobe consolidation could also be aspirated to obtain samples for cytology and culture. Underlying conditions such as ciliary dyskinesis, foreign bodies, coccidiomycosis, or recurrent aspiration must be considered for persistent pneumonia.