POST-OPERATIVE MANAGEMENT OF THE CRITICAL ILL PATIENT

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Abstract: Post-operative care of the critically ill equine patient is one that involves a great deal of monitoring. When referring to adult patients, the most common patient in the ‘critically ill’ category is the post-operative colic patient, the topic of another paper. This presentation will discuss post-operative management of the critically ill foal. Common diseases resulting in surgery in the neonate include uroperitoneum (ruptured bladder or urachus), meconium impaction or intestinal accident and, increasingly, rib fracture repair surgery. Commonly employed post-operative patient management techniques include arterial blood gas measurement, indirect determination of systemic vascular pressures, intravenous fluid administration, antimicrobial treatment and nutritional management. Post-operative management of these cases plays a large role in allowing the best possible outcome for the patient.

Key words: intensive care, surgery, horse, foal, monitoring

Introduction:

Short- and long-term survival of critically ill animals requiring surgical intervention for treatment of their primary disease process requires not only adequate surgical treatment but appropriate post-
operative monitoring and management. Many of the causes of critical illness in horses requiring surgical treatment also can result in significant cardiovascular and respiratory compromise, so much effort is directed at these systems. The post-operative management of the adult colic patient will be discussed in detail in another session, and so will not be covered here. For this session we will concentrate on the post-operative management of critically ill foals. There are 3 large categories of surgical problems of foals associated with critical illness: Uroperitoneum, intestinal accidents/meconium impaction, and thoracic trauma.

**Uroperitoneum:**

Clinical signs associated with uroperitoneum in the neonatal foal typically include straining to urinate, dribbling urine, and a ‘stretched out’ stance. Weakness, tachycardia, tachypnea, and not sucking well are also commonly present. A distended abdomen may be observed and a fluid wave may be felt on ballottement of the abdomen. Urachal tears occurring near or outside the body wall may present with significant ventral abdominal ‘edema’, which is actually subcutaneous urine accumulation, with or without increased peritoneal fluid volume. Foals developing uroperitoneum while hospitalized for other problems are likely to have early signs of decreased urination frequency and urine volume and excessive weight gain. Foals may also show signs of sepsis, including fever, injected mucus membranes, diarrhea, and disease of other body systems.

Laboratory findings are variable, depending on the duration of the uroperitoneum as well as the presence and severity of sepsis and diet. Classic findings include hyperkalemia, hyponatremia, and hypochloremia arising from equilibration of urine electrolytes and water with blood across the peritoneal membrane. The usual foal diet of milk, which is high in potassium and free water, and low in sodium, promotes the electrolyte abnormalities. Foals that develop uroperitoneum while receiving sodium containing intravenous fluids, may not have electrolyte imbalances due to correction of electrolyte derangements, although hyperkalemia may be apparent if milk is provided.

Increased serum creatinine concentration is often present while blood urea nitrogen concentrations are occasionally, but not consistently, increased. Metabolic and/or lactic acidosis and hypoxemia may be present. Some patients also have serum hypo-osmolality. Foals should be tested for failure of passive transfer. One of the most sensitive laboratory tests for uroperitoneum is the peritoneal to serum creatinine ratio. A ratio greater than or equal to 2:1 is considered diagnostic of uroperitoneum. Cytologic evaluation of peritoneal fluid is necessary to identify concurrent peritonitis or other gastrointestinal compromise. An electrocardiogram may be performed on initial evaluation of a foal with suspected uroperitoneum as hyperkalemia can result in bradycardia, increased duration of the QRS complex, a shortened QT interval, increased P-wave duration, prolonged P-R interval, or AV conduction disturbances. Other possible cardiac sequelae to hyperkalemia include cardiac arrest, third degree A-V block, ventricular premature contractions, and ventricular fibrillation.
Ultrasonography has become the tool of choice in the diagnosis of uroperitoneum and is a useful tool available to the practitioner. Imaging of free peritoneal fluid can be readily accomplished and large tears within the bladder, and sometimes urachus, are readily seen. In a fluid-filled abdomen the empty bladder with a large defect will collapse on itself and often have a ‘U’-shape.

Initial treatment is aimed at stabilizing the patient and correcting any electrolyte and acid-base abnormalities and providing fluid volume replacement. 0.9% or 0.45% saline should be used until laboratory data are available. Potassium concentration >5.5 mEq/L can be life threatening. Hyperkalemia can be managed by peritoneal drainage to decrease whole body potassium stores. This can be performed with teat cannulas, foley catheters, large gauge (16g or 14g) intravenous catheters, or human peritoneal dialysis catheters. Fluid replacement should at least equal the amount of fluid removed from the abdomen to prevent acute hypotension due to expansion of previously collapsed capillary beds. Abdominal drainage will also help ventilation by decreasing pressure on the diaphragm.

Once the metabolic abnormalities have been addressed, surgical management can be considered. Preoperative medical stabilization reduces the anesthetic risk. Safer inhalant agents such as isoflurane, have also decreased risk. It is usual for the internal umbilical remnant to be removed at the time of surgery. Consideration should be given to culture of any removed umbilical remnant, and the peritoneal cavity, and the remnant should be submitted for histopathologic evaluation.

Many of these foals are persistently oxygen dependent for several days following surgical correction and serial arterial blood gas analyses should be performed before intranasal oxygen supplementation is discontinued. Thoracic radiographs may be indicated and may reveal diffuse, patchy interstitial and alveolar patterns. Sepsis, persistent hypoxemia, pneumonia, peritonitis, and acute respiratory distress syndrome all complicate the management of uroperitoneum. As result foals are frequently maintained on oxygen for at least 24 hours post-operatively at flow rates between 5-10 L.min. Arterial blood gas analysis should be performed at least daily for the first 24-48 hours to determine if respiratory management is effective or requires adjustment.

Surgical correction does not result in immediate correction of electrolyte abnormalities and it is not unusual for these cases to require some degree of intravenous fluid support for 24-48 hours post-operatively. Plasma/serum electrolyte and creatinine concentrations should be monitored daily until within normal limits. Antimicrobial therapy is generally continued for several day post-operatively, even longer if cultures are positive of if infection was the cause of uroperitoneum.

Recurrence of the urinary tract rupture can occur. This will be recognized as inappropriate weight gain, progressive abdominal enlargement, increased free peritoneal fluid apparent during abdominal ultrasonography and/or increasing potassium or creatinine concentrations. Many clinicians will leave the urinary catheter in place for several days following surgical correction to prevent pressure on the repair and hopefully circumvent this complication.
Prognosis is closely associated with concurrent illness, especially septicemia. Uncomplicated uroperitoneum from a defect in the bladder has a good prognosis. If the location of the lesion is other than the bladder, the prognosis is not as favorable. Foals with septicemia have a much poorer prognosis.

**Meconium Impaction or Intestinal Accident:**

Colic in the foal can be difficult to accurately diagnose as examination per rectum cannot be performed. However, many diagnostic aids, most importantly ultrasonography, are available to help differentiate medical from surgical causes of abdominal discomfort in the foal.

**Obstruction:**

Intestinal accidents of all types described in adult horses, perhaps short of enteroliths, occur in foals. Intussusception, volvulus, displacement, diaphragmatic hernia, and intra- and extraluminal obstruction have all been reported in foals. Diagnosis is greatly aided by abdominal ultrasonographic and radiographic evaluation. Treatment is primarily surgical. Foals with perinatal asphyxial syndrome (PAS) and intestinal dysmotility are at increased risk of intussusception and displacement and miniature breed foals appear to be at increased risk for fecalith and enterolith formation.

**Meconium Retention/Impaction:**

Meconium retention or impaction is a common cause of abdominal discomfort in the newborn foals. Most foals will defecate shortly after their first meal. It has become usual for most owners or veterinarians attending the birth of a foal to administer an enema to aid this process. In the past, phosphate based commercially available enemas were frequently used, but if used excessively these types of enemas can create problems of their own, including rectal irritation and hyperphosphatemia. It is best to use a warm soapy water enema that can be administered through soft rubber tubing using gravity flow. Foals with significant meconium retention will become colicky within the first few hours of life as gas accumulates within their bowel. Frequently the meconium can be palpated through the abdominal wall. Additional diagnostics can include abdominal ultrasonography and radiography, particularly if other, more serious, types of colic need to be ruled out. These foals will assume a classic stance with an arched back. This needs to be differentiated from the stance assumed by foals with uroperitoneum, which is more extended. Foals with meconium retention have presented with simultaneous ruptured bladder, however, so the clinician must ensure that the foal is fully evaluated for both problems. Foals that do not respond rapidly to enema administration will need additional treatment. This can include giving mineral oil (2-4 ounces) by nasogastric tube. Persistent meconium retention resulting in significant abdominal distention can be treated by muzzling the foal to prevent further milk intake and administering intravenous fluids at an appropriate maintenance rate. More
aggressive medical treatments include administration of retention enemas made using acetylcysteine, which serves as an irritant and increases secretion. Very extreme cases, those with respiratory compromise due to abdominal distention and development of abdominal hypertension or abdominal compartment syndrome, may require surgical intervention, but most will resolve with medical management alone within 12-24 hours. Some foals will require pain management. Nonsteroidal antiinflammatory drugs should be avoided in the neonate because of their effects on renal function and gastric mucosal blood flow. Many foals respond well to intramuscular torbugesic given at a dose of 3-5 mg to an average 50 kg foal. Intranasal oxygen insufflation is beneficial in foals with significant abdominal distention.

Post-operatively, many of these foals will have similar respiratory problems as foals with uroperitoneum and may require respiratory management, intranasal oxygen insufflation and frequent arterial blood gas monitoring for several days. Frequently, a period of gastrointestinal rest is desirable and nutritional management by the intravenous route will need to be considered. Some foals will go back to nursing immediately. Post-operative antimicrobials are frequently administered to these cases for several days, particularly if an enterotomy was performed. Failure of passive transfer is common in newborn foals with gastrointestinal problems, so this should be tested for and treated if needed.

Foals presenting with meconium impaction/retention should be fully evaluated for evidence of PAS, as intestinal dysmotility is common in PAS. Also, colostrum is a laxative and these foals may also suffer from failure of passive transfer, with the meconium retention being secondary to the lack of adequate colostrum. These foals are also at risk of sepsis, as the mucosal intestinal barrier has probably been disrupted and translocation of bacteria can occur. Blood cultures should be obtained on these foals and they should be monitored closely for signs of sepsis.

**Thoracic Trauma**

Rib fractures in foals admitted to NICU have been known to account for both morbidity as well as mortality. Ribs 3-8 account for the majority of injuries. Clinically important consequences of rib fractures include hemothorax, pneumothorax, pulmonary contusion, pulmonary laceration, diaphragmatic hernia secondary to diaphragmatic laceration, pericardial laceration, hemopericardium, myocardial laceration, and laceration of the coronary arteries or great vessels. Foals treated with conservative therapy are encouraged to remain in lateral recumbency with the affected side down to maximize ventilation by the unaffected lung. Foals with less severe (i.e. non-displaced) fractures are encouraged to limit their activity and, if necessary, are mildly sedated. Fractures may be present at presentation but, until such time as they become displaced, may not be clinically apparent excepting mild signs.
Guidelines have not been well-established as to when to recommend surgical intervention in foals with rib-fractures. Life-threatening complications are more prevalent with an increase in the number of affected ribs. Fracture displacement may influence clinical severity.

Thoracic trauma has been associated with primiparous mares and dystocia in foals. Careful attention during physical examination can detect many fractured ribs with extra awareness in examining the thoracic area in foals from primiparous mares or difficult parturitions. Clinical signs that may indicate rib fracture include groaning or grunting by the foal, plaques of subcutaneous edema overlying the ribs or along the ventral aspect of the thorax, pain upon palpation of the ribs, audible or palpable crepitation, or subcutaneous emphysema. Ultrasonographic examination is most useful for precisely diagnosing fractured ribs as well as the determining degree of displacement. It is also useful in evaluating damage to adjacent structures such as the lung parenchyma, myocardium, pleural cavity, peritoneal cavity, and diaphragm.

Pneumothorax during surgery may have been an iatrogenic consequence of surgical manipulation of fractured rib fragments or a sequel to positive pressure ventilation. Clinical signs of pneumothorax include respiratory distress, shift of cardiac point of maximum impulse, cyanosis, hypotension, decreased PaO₂, and/or increased peak inspiratory airway pressure. Auscultation may reveal decreased breath sounds but radiographs will confirm the diagnosis. Pneumothorax, if recognized early, may be easily managed and resolve completely within 12 hours without further complication. Management includes limiting movement and placement of indwelling pleural drains attached to suction. Intranasal oxygen insufflation and repeated arterial blood gas analysis assists in management. Drains may be removed once air accumulation ceases.

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