Introduction
Operative laparoscopy in the horse has only recently extended beyond the bounds of procedures involving the genital systems. Laparoscopic abnormalities of the umbilicus were first observed during inguinal herniorrhaphy [1] and laparoscopic assisted umbilical resection has been described [2]. Laparoscopic cystotomy has been used for the removal of cystic calculi [3].

Laparoscopic Umbilical Resection
The foal is anesthetized and positioned in dorsal recumbency. The ventral abdomen is clipped and prepared for aseptic surgery. In male foals, the prepuce is sutured closed to reduce the likelihood of urine contamination during the procedure. A teat cannula is introduced into the abdomen 3 cm lateral to the midline, 10 to 15 cm cranial to the umbilicus. Intraperitoneal placement of the cannula is confirmed using a hanging drop technique. The abdomen is insufflated with CO₂ to a pressure not greater than 25 mm Hg. The teat cannula is removed and the laparoscope cannula with its sharp obturator is introduced through the same incision. The obturator is withdrawn and the laparoscope is placed into the abdomen. The umbilical structures are visually assessed. Elevation of the hindquarters into Trendelenburg’s position facilitates observation of the bladder and umbilical arteries. A 10 - 12 mm diameter instrument cannula is inserted on both sides of the abdomen 10 cm lateral to the midline and 5 cm cranial to the umbilicus. The ventral ligament of the bladder is divided with endolaparoscopic scissors. A grasping forceps is used to elevate one umbilical artery away from the bladder and the lateral ligament of the bladder is dissected to allow placement of two ligating clips. Alternatively, intracorporeal ligation can be performed with suture; however, that is technically more difficult. The umbilical artery is transected between the clips and the lateral ligament of the bladder is further divided to free the artery to the level of the urachus. The procedure is repeated for the contralateral umbilical artery. Transection of the arteries should always be performed proximal to any visible abnormality. The umbilical vein is separated from the falciform ligament, double ligated and divided. At this point, a fusiform incision is made around the umbilicus and the umbilical remnants and the apex of the bladder is exteriorized. Stay sutures are placed to stabilize the bladder during closure. The urachus and the tip of the bladder are amputated and the bladder is closed in 2 layers with a synthetic absorbable suture. With the aid of a laparoscopic suturing device (Endostitch, Auto Suture Company, Norwalk, CT), intracorporeal resection of the urachus and bladder tip should be possible; however, the advantage of that approach is not clear at this time. Closure of the umbilical incision and the laparoscopic portals is routine. Postoperatively, there is no exercise restriction. Postoperative antibiotics should not be required unless there was intraoperative Umbilical remnant infections involving the arteries and urachus can routinely be managed using this laparoscopic assisted procedure. Infections of the umbilical vein are less common, but may be considerably more challenging. In-line endoscopic stapling devices can be used to advantage in some foals with umbilical vein infections. In theory, an umbilical vein marsupialization procedure could be performed as a laparoscopic assisted procedure.

Laparoscopic Repair of Urinary Bladder Rupture
Rupture of the urinary bladder occurs most frequently as a parturition injury. Affected foals typically present at two to three days of age. Characteristic systemic biochemical abnormalities include: hyponatremia, hypochloremia and hyperkalemia. The risks of general anesthesia are greater in foals with elevated potassium concentrations and, for that reason, preoperative management should include measures to return the potassium level to the normal range. Repeated drainage of the urine from the abdomen while simultaneously diuresing the foal is generally sufficient to temporarily correct the abnormalities. Other adjunctive measures can include intravenous administration of glucose and insulin administration. When the serum potassium concentration has returned to the normal range, the foal is a candidate for surgical repair of the ruptured bladder. Traditionally, urinary bladder repair is performed as an open procedure. Umbilical remnant resection is often carried out concurrently. The open procedure is highly successful; however, there are instances where life-threatening incisional
complications develop. Laparoscopic repair of bladder ruptures is possible, providing the surgeon is adept at intracorporeal suturing.

The combination of decreased cardiac output under general anesthesia and the sudden increase in central venous pooling associated with drainage of the abdomen can lead to cardiovascular collapse. To avoid this complication, the abdomen should be drained before the foal is anesthetized. When the peritoneal cavity is essentially free of urine, general anesthesia is induced and the foal is positioned in dorsal recumbency. The ventral abdomen from the pubis to the xiphoid is clipped and prepared for aseptic surgery. In male foals, the prepuce is sutured closed to reduce the likelihood of urine contamination during the procedure. A teat cannula is introduced into the abdomen 3 cm lateral to the midline, 10 to 15 cm cranial to the umbilicus. Free flow of fluid from the cannula confirms intraabdominal positioning. The abdomen is insufflated with CO₂ to a pressure not greater than 25 mm Hg. The teat cannula is removed and the laparoscope cannula with its’ sharp obturator is introduced through the same incision. The obturator is withdrawn and the laparoscope is placed into the abdomen. Intraperitoneal positioning of the laparoscope is visually confirmed and the hindquarters are elevated to allow the viscera to displace cranially. A 10 - 12 mm diameter instrument cannula is inserted on both sides of the abdomen 10 cm lateral to the midline and 5 cm cranial to the umbilicus. Residual urine can be removed using a suction device inserted through one instrument cannula. A pair ofatraumatic grasping forceps are used to manipulate the bladder and umbilical structures to bring the area of rupture into view. The dorsal aspect of the bladder is reported to be the most common site of rupture; however, many tears occur near the junction of the urachus and the apex of the bladder. When the defect has been located, the edges should be debrided using endolaparoscopic scissors. Two additional instrument cannulas may need to be placed to allow manipulation of the bladder to gain optimal visual and manipulative access. Beginning at the caudal extent of the tear, a simple continuous absorbable suture is placed to appose the edges of the defect. Intracorporeal suturing is greatly facilitated by the endolaparoscopic suturing device (Endostitch); however, suturing is possible using standard materials with swaged on needles. Tying knots within the abdomen is challenging and that step can be avoided by using suture clips. A continuous Lembert suture is placed over the first layer of closure. The abdomen is decompressed and the foal is returned to a horizontal position. Monofilament absorbable suture is used to close the external abdominal fascia and subcuticular sutures are used to appose the skin.

Umbilical resection need not be performed unless there are visible abnormalities of the umbilical remnants. Foals with rupture of the urachus should be managed by performing an umbilical resection. The use of endolaparoscopic staples to close the bladder defect may be associated with the formation of cystic calculi [4].

**Laparoscopic Removal of Cystic Calculi**

Cystic calculi in mares can usually be removed through the urethra. Removal of cystic calculi in the male requires a ventral celiotomy and can be difficult owing to the limited exposure to the bladder that the approach affords. Laparoscopic cystotomy allows excellent exposure to the ventral surface of the bladder (Fig. 1) [2].

![Figure 1. Caudal view in dorsal recumbency. B: urinary bladder.](image_url)

Horses should be fasted for 48 hours before surgery to reduce the volume of intestinal fill. Broad spectrum antibiotics are given before surgery. Under general anesthesia, the horse is positioned in dorsal recumbency and the ventral abdomen is clipped and prepared for aseptic surgery. The penis is extended and reflected caudally after a urinary catheter is placed. The bladder is lavaged with two liters of normal saline and drained. The lavage procedure is repeated until the effluent is clear. The bladder is distended with two liters of saline and the catheter is clamped. The incision into the bladder is easier with the bladder distended.

A 1 cm stab incision is made at the umbilicus and a teat cannula is introduced into the abdomen. Intraabdominal positioning is confirmed using a hanging drop technique. The abdomen is insufflated with CO₂ to a pressure not exceeding 25 mm Hg. The teat cannula is removed and the laparoscopic cannula with a sharp obturator is inserted. The obturator is removed and replaced with the laparoscope. When intraabdominal placement has been visually confirmed, the hindquarters are elevated to allow the viscera to displace cranially facilitating viewing of the bladder. A total of five instrument cannulas are placed, 3 on the right and 2 on the left. A laparoscopic specimen retrieval bag is introduced into the abdomen, positioned under the bladder and opened. A ventral longitudinal incision through the bladder wall is made using electrosurgery. A retractable metal loop forceps is used to manipulate the calculus from the bladder into the specimen bag. The bag is closed and set aside for later removal. A suction lavage system is used to lavage the bladder and remove debris. An automated suture device (Endostitch) is used to place a simple continuous suture followed by continuous Lembert suture using 2-00 polysorb. The
bladder is distended with saline to check for leaks in the incision line and decompressed. The laparoscope is transferred to
one of the cranial instrument ports and a gasping forceps is introduced at the umbilicus to facilitate removal of the specimen
bag with the contained calculus. The umbilical incision is enlarged to allow removal of the bag and calculus. Closure of the
incisions is routine.
Postoperatively, horses are maintained on antibiotics for at least 24 hours. Antibiotics may be continued for longer if needed.
Exercise restriction is recommended for 30 days. The importance of anesthetic management and economic use of time during
the surgical procedure cannot be underestimated. Extensive experience with laparoscopic operative techniques, specifically,
intracorporeal suturing techniques are a prerequisites for successfully performing this procedure.

References


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