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Minimally Invasive Surgery for Advanced Practitioners Mini Series

Session Three: Minimally Invasive Surgery in the Abdominal Cavity

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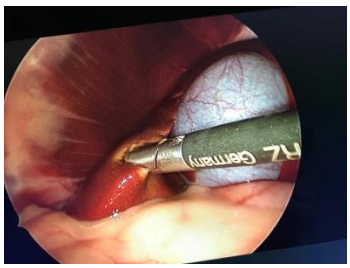

Video-assisted surgery: laparoscopic and laparoscopic-assisted procedures

Liver biopsy and cholecystocentesis

Liver biopsy is commonly performed in small animal practice as it can provide a definitive diagnosis for many diseases of the hepatobiliary system. This can guide additional diagnostic or therapeutic measures as well as can provide important prognostic information for the clinicians as well as the owners. Indications for biopsy are several and can include elevated liver enzymes, lesions identified during diagnostic investigations, abnormal liver size or staging for neoplastic disease. Many techniques have been described, such as percutaneous trucut needle biopsy with or without ultrasound guidance, laparoscopic liver biopsy or biopsy performed during exploratory laparotomy. The technique should be selected carefully taking into account the potential risks for the patient. It is important to remember that each technique for liver biopsy carries potential for complications and limitations, with bleeding as the most common complication described. Bleeding can be exacerbated in animals with hepatobiliary disease. Percutaneous trucut biopsy is a minimally invasive technique for biopsy as well as laparoscopic liver biopsy however this technique has been associated with reduced diagnostic efficacy compared to other techniques. The median surface area of the trucut biopsy commonly has a reduced number of portal triads and hepatic acini. In human the minimum number of portal triads required in a specimen to obtain an accurate morphologic diagnosis is about six to eight.
Laparoscopy provides several advantages also over the open technique including better visualization and detail of abdominal organs, reduced postoperative pain, better quality biopsy, and rapid return to function for patients. The biopsies are usually similar to those obtained by open technique and they can be obtain under direct visualization of each liver lobe and post biopsy haemorrhage can be directly monitored and addressed during the same procedure without need of conversion. The recommendation is to obtain multiple biopsy samples for histologic interpretation.
Cholecystocentesis is another procedure performed during investigation of hepatobiliary diseases of bacterial origin. Percutaneous ultrasound-guided cholecystocentesis is a safe, minimally invasive and effective procedure in dogs and cats. Laparoscopic cholecystocentesis is an additional minimally invasive technique that can be performed concurrently at the time of the laparoscopic liver biopsy. A clear advantage is the use of laparoscopic guidance for needle placement into the gall bladder and at the same time it is possible to monitor for bile leak into the peritoneal cavity.

Preoperative considerations
The liver is divided in 6 lobes: left lateral, left medial, quadrate, right medial, right lateral and caudate. The caudate lobe is the most caudal lobe and is further divided in the caudate process and the papillary process. The gall bladder is a structure present between the quadrate and the right medial lobe and has a cystic duct connected directly to the common bile duct. A variable number of hepatic duct also insert into the common bile duct. The common bile duct inserts into the major duodenal papilla in dogs and cats. The liver has an unique blood supply, provided by the portal vein (80%) and by the hepatic artery (20%). The cystic artery provides blood supply to the gall bladder. In patient undergoing liver biopsies a thorough diagnostic investigation has to be performed including complete blood count, serum biochemistry, urinanalysis and diagnostic imaging of the abdomen. Because of the potential for hemorrhages after liver biopsies all patients should have a coagulation profile (prothrombin time and partial thromboplastic time) performed. Patient selection is an important factor for the choice of the biopsy technique, laparoscopic biopsy represent the ideal technique in debilitated and metabolically compromised patients because it is a minimally invasive procedure, relatively quick, sampling is possible from all the lobes and the risk of hemorrhage is reduced compared to open technique. Possible contraindications are thrombocytopenia or marked prolongation of coagulation times however in most of the patients undergoing biopsies clinical bleeding is rarely seen. It has been also shown that hemorrhage from liver biopsy was not correlated with coagulation time. Ascites is not a contraindication but probably the preferable method for liver biopsy. Removal of ascetic fluid is usually not recommended or necessary.

Patient preparation
The patient should have a wide clip approximately 5cm cranial to the xiphoid process and extended beyond the pelvic brim. The area is then prepared using standard aseptic technique. The patient is positioned in dorsal recumbency or in a reversed Trendelenburg (head elevated 15-30°), this would allow the abdominal organs to move caudally and away from the liver. The anaesthetic machine and the endoscopic tower should be positioned toward the head of the patient. Surgeon and assistant should stand lateral to behind the patient.
A two-port technique is the most commonly used for laparoscopic liver biopsy; a single-port technique can also be used. A modified Hasson technique or Veress needle is used to place a 6-mm subumbilical camera port using a smooth or threaded cannula.

Pneumoperitoneum is created using CO2 from a mechanical insufflator to an intraabdominal pressure of 8-12mmHg in dogs (8mmHg in cats). A 5mm 30cm 0° laparoscope is inserted and an initial general evaluation of the abdominal structure is performed. A second 6mm instrument port is placed under direct visualization midway between the camera port and the xyphoid process. This port can be potentially place in different locations based on surgeon preference.

Surgical technique

Based on surgeon preference and type and location of the lesion, different methods can be used. Using a 5mm blunt probe under laparoscopic guidance an exploration of the abdominal structures is performed. The hepatobiliary system should be evaluated and all the lobes (diaphragmatic and visceral surfaces), gall bladder and common bile duct should be inspected. The blunt probe can be used to elevate and to manipulate each lobe. The gall bladder is elevated to visualize the common bile duct. If liver lobes cannot be adequately visualized the patient can be tilted in either left and right lateral recumbency. When a diffuse hepatopathy is present sampling of the distal edges of the liver lobes is recommended. Cup or punch biopsy forceps are passed into the instrument port and inserted under the liver lobe to be biopsied in a close configuration. The forceps are then open and gently withdrawn allowing the edge of the lobe to fall into the jaws of the forceps. The forceps are then closed for about 30 seconds to promote hemostasis and the pulled and twisted till the biopsy is retrieved. Multiple biopsies are normally taken and submitted for histopathology and/or bacteriology. For hepatic lesions or masses not located at the periphery of the lobes, the forceps are opened and pressed on the desired area, then closed for 30 seconds. Pieces of haemostatic gelatin can be precut and placed at the biopsy site using the forceps to promote hemostasis. Sealing device or a pre-tied/extracorporeal loop ligature can be used. In the latter case an additional instrument port is used. The loop is pass around a pair of forceps, the forceps are used to grasp the liver lobe and the loop is advanced and secure proximal to the forceps at the level of the bleeding.

Usually the bleeding is minor and self-limiting, but in case of hemorrhage the surgeon should be ready to covert to open surgery. At the end of the procedure all the biopsy sited are evaluated for bleeding before instrument withdrawal.

Laparoscopic cholecystocentesis can be done at the same time using a two-port technique. A spinal needle (22G) can be inserted caudal to the diaphragm and advanced at such an angle to enter the gall bladder or first enter the quadrate lobe and then the gall bladder. The blunt probe is used to provide counter pressure on the gall bladder during needle insertion. Puncture of the quadrate lobe is advocated by some surgeons to avoid bile leakage. The gall bladder should be drained as much as possible. The intracorporeal CO2 should be removed as much as possible and the port sites closed routinely.

Complications and postoperative care

Normal average hospitalization time is 24 hours. Laparoscopic liver biopsy is considered a safe procedure with an extremely low complication rate. Complications associated to laparoscopy cholecystocentesis have not been evaluated in small animals. Patients return to preoperative status quite quickly because of the short anaesthetic time. Local block and analgesia are commonly administered in these patients. Non-steroidal anti-inflammatory are usually avoided because of the hepatic dysfunction and possible altered drug metabolism. Patients are commonly discharge on the following day.

Laparoscopic ovariectomy

This is probably one of the most commonly performed laparoscopic procedures and it can be performed in cats and any size of dog. Laparoscopy ovariectomy has clear biochemical and pain score advantages over open ovariectomy with no notable surgical complications as well as an increase in postoperative activity levels.

Preoperative considerations

The anatomy is usually very familiar to most veterinarians. The ovary is attached to the dorsolateral abdominal wall by the mesovarium which contains the ovarian blood vessels. The mesovarium is continuous with the suspensory ligament and caudally with the mesometrium. Dogs and cats of all ages, sizes, and breeds can be good candidates for laparoscopic ovariectomy techniques. The size of the patient is not a contraindication however the surgeon should be aware of the difficulty in performing intraabdominal laparoscopic procedures with a small working space. This could lead into longer anaesthetic and operative time and consequent hypothermia. If the procedure does not proceed smoothly the surgeon should be ready to convert to an open surgery. In older or obese dogs this procedure can be beneficial because the magnification allows for better confidence during pedicle ligation and less bleeding from the mesometrial tissue. Also, multiparous or older dogs and cats with a greater blood supply to the ovaries and uterus and increased tissue friability benefit from a laparoscopic procedure. There are only few contraindications such as cardiopulmonary compromise or a diaphragmatic hernia.

Other relative contraindications are an active heat cycle, early pregnancy and pyometra with moderate to large uterine distension. Pyometra or pregnancy are not contraindications for laparoscopy ovariohysterectomy.
The majority of the patients are young and healthy animal however a special attention should be paid to any visible congenital defect such as umbilical hernias because they could be an indication of other congenital defects (diaphragmatic hernia, peritoneopericardial hernia). The respiratory system should be carefully evaluated because of the insufflation used during this procedure as well as any predisposition to bleeding.

Patient preparation
The patient should be clipped as for a normal open ovariohysterectomy, extending to just lateral to the nipple line on each side, cranial to the pubis and caudal to the rib cage in case of conversion. If transabdominal suspension of the ovary is going to be performed using a hook or needle a wider clip needs to be prepared. Aseptic preparation is needed before draping. The patient is positioned in dorsal recumbency and if a tilt table is available this would greatly facilitate the procedure. An angle of 15-30° (or near to lateral positioning) should be adequate to move intraabdominal organs off of the underlying ovary. This is particularly important on the left side where the spleen has the tendency to cover the left kidney and ovary. If a tilt table is used the patient has to be securely attached to the table to prevent any movement during the procedure. The positioning of the surgeon changes depending on the side of the ovary being removed. The endoscopic tower and the anaesthetic machine should be positioned at the head or back of the table. The monitor should be positioned at the end of the table as the dissection is normally performed in a cranial to caudal direction.
There is a variety of different configurations for portal placement including a three-, two- and one-port technique. No difference in postoperative pain was reported but longer surgical time was noted with a one-port technique. With the three-port technique all the ports are inserted along the ventral midline, the camera port is place in a subumbilical position and the two instrument ports are place 2-3cm cranial to the umbilicus and 3-5cm cranial to the pubis respectively. With a two-port technique the camera port is placed 1 cm caudal to the umbilicus and the instrument port is place 3-5cm cranial to the pubis (this technique uses the needle suspension method). The one-port technique used a single port placed 1-2cm caudal to the umbilicus and uses a telescope with an operating channel. Otherwise placement of a multiport device has been described (usually cranial to the umbilicus).

Surgical technique
After portal placement and pneumoperitoneum established the patient can be tilted toward the side of the surgeon 15-30°. For the left ovary the spleen is commonly encountered for the right ovary the duodenum and other intestine often overlying the ovary. A blunt probe can be used to move these organs away from the ovary. The ovaries are located just caudal to the kidneys. When the uterine horn is found, the proper ligament is grasped with forceps and held up to the body wall. If a three-port technique is used a sealing device is introduced in the third port, if the two-port technique is used a hook or needle can be used to suspend the ovary. The camera light can be used to illuminate the body wall to identify the best position to anchor the ovary. A half-circle needle is placed percutaneously through the body wall under visualization through the proper ligament or cranial to the uterine horn then out the body wall again. The suture is then pulled and clamped with a mosquito hemostats. Care should be taken not to puncture the ovary or to lacerate the pedicle.
The forceps are exchanged with a vessel sealing device. This instrument should be used in a line from the suspensory ligament to the proximal uterine horn staying as close as possible to the uterine body and ovary avoiding ureters and large mesometrial vessels. Most times part of the uterine horn is removed with the ovary, this does not appear to cause a clinical problem. When the ovariectomy is completed the ovary can be removed from the port or left attached to the body wall and the patient repositioned for the removal of the contralateral ovary. After the procedure has been completed both the ovaries are removed through the port or enlarging the port incision if necessary. Exploration is advised in case of bleeding of the pedicles. The cannulae are removed and the port sites closed routinely.
For ovariohysterectomy a three-port technique is commonly use. The procedure is exactly as for ovariectomy but dissection of the mesometrium in each side is continued caudally till the uterine body is visible. Maintaining the forceps to one of the ovaries the caudal cannula is removed as well as the forceps, the incision enlarged, and the uterus exteriorized. The uterine body is double ligated or sealed. The uterine stump is replaced into the abdomen and the body wall closed routinely to allow reinsufflation. A brief exploration is performed to ensure no bleeding is present. The cannulae are removed and the port sites closed routinely.

Complications and postoperative care
Complication rate is usually low. One of the most common intraoperative complication is trauma to intraabdominal organs, most commonly the spleen. The magnification of the camera can create the impression of significant haemorrhage. Other complications include puncture of the urinary bladder, bleeding from the pedicle and dropping of the ovary. Conversion to open surgery is usually needed for uncontrolled haemorrhage from the pedicle of spleen or the inability to find a dropped ovary. The discovery of a diaphragmatic hernia would be a reason for immediate conversion. Postoperative complications include seroma, haematoma, surgical site infection, retained ovarian tissue, herniation, ongoing bleeding. Most of the complications are self-limiting.
Postoperative care includes analgesia, incision care and exercise restriction. The patient is normally discharge on the same day with 2 to 3 days of analgesia.

Laparoscopic cryptorchidectomy

Intraabdominal testicles can be found anywhere between the kidneys and scrotum. Diagnostic ultrasonography is generally highly effective at localizing retained testicles in both inguinal and abdominal region. Testicles generally maintain their normal ultrasonography appearance.

Patient preparation
One-, two- or three-port technique can be used in dogs and cats. The patient is placed in dorsal recumbency. A 15° Trendelenburg position can be used to increase the visualization of the caudal abdomen. The abdomen is aseptically prepared as for a normal coeliotomy procedure. A 0° rigid laparoscope is usually sufficient however a 30° rigid laparoscope can be used to increase visualization. If the testicle is suspected to the neoplastic a retrieval bag should be available to avoid seeding. A camera cannula is placed on the midline 1-2cm caudal to the umbilicus and a second cannula cranial to the prepuce or midway between the umbilicus and the pelvic brim. A caudolateral position can also be used being sure to avoid the caudal superficial epigastric artery. If a three-port technique is used, caudolateral ports (right and left) can be placed.

Surgical technique
To locate the testicle the testicular artery and vein can be followed from the origin near the kidney or the ductus deferens can be followed from its insertion into the prostatic urethra. If the testicular artery and vein and the duct deferens are visualized disappearing within the inguinal canal, then the testicle has entered the inguinal canal. In this case the ductus deferens can be grasped and gently retracted into the abdominal cavity. The testicle can be brought toward the instrument cannula, the port enlarged, and the testicle extruded for ligation (laparoscopic-assisted cryptorchidectomy). For a laparoscopic cryptorchidectomy the vascular structure and the duct deferens are ligated or sealed and the testicle removed from the abdomen enlarging the instrument port. Regardless of the technique of port sizes, the external rectal sheath should be sutured into apposition to prevent herniation.

Complications and postoperative care
Surgical complications include infection, haemorrhage, ecchymosis on the incision sites and swelling. These are usually minor and self-limiting. Surgery can be performed on an outpatient basis. Postoperative recovery is similar to that of other abdominal surgeries. Exercise restriction and analgesia are recommended.

Laparoscopic-assisted gastrointestinal procedures

Patient selection
Selection criteria for laparoscopic procedures of the gastrointestinal tract have not been determined for small animals, however it appears that patients with low total proteins, presence of a solitary liver tumour and diagnosis of neoplasia were associated with an increased risk of conversion to open coeliotomy. Contraindications for laparoscopy of the gastrointestinal tract have not been defined specifically in small animals however linear foreign bodies, septic peritonitis, history of peritonitis, intestinal adhesions and large-diameter lesions represent some examples of possible contraindication to a laparoscopic approach. The diameter of the lesion can be a limiting factor as large lesions would require a significant enlargement of the port incision. Therefore, current guidelines suggest a maximum diameter of approximately 5cm as upper limit for lesion to be approached laparoscopically. The length of the lesion is not an important factor as much as the diameter and lesion up to 9cm in length has been reported to be amenable to a laparoscopic approach. Also, the location of the lesion appeared to be an important factor with lesion affecting stomach, proximal duodenum or colon may be not amenable for laparoscopic treatment. Adhesions represent another contraindication as they result in the inability to safely exteriorized bowel from the peritoneal cavity without lengthening the port incision.

Linear foreign bodies, gastrointestinal perforations and septic peritonitis or lesions associated to structures such as common bile duct, pancreas or major vessels are recognized contraindications. Also surgeon experience is a limiting factor and the surgeon should always elect for the most safe and rapid approach especially if the patient stability is an issue.
Gastrointestinal biopsy is actually a good indication for laparoscopic-assisted procedures such as in case of inflammatory bowel disease or alimentary lymphoma.

Patient preparation and position
Dogs and cats are prepared similarly to dogs undergoing traditional exploratory surgery because conversion to laparotomy is occasionally necessary. As for any classic abdominal surgery there is also a risk of reflux and aspiration of gastric content. Therefore, before induction, an effort should be made to reduce gastric volume and content. Proton pump inhibitors and prokinetics may reduce the risk of gastric reflux, oesophageal ulcerations and gastric emptying time. In case of obstructive lesion, the prokinetics should be given once the obstruction has been relieved.
The endotracheal tube cuff should adequately seal the airways and the urinary bladder should be fully voided, especially in case the lesion is located in the caudal abdomen. The patient is clipped widely, as previously described and the preparation should be adequate in case of conversion. Perioperative antibiotics for procedures of the gastrointestinal tract are usually indicated as the surgery is likely to last for longer than 90 minutes. However, continuation of antibiotics in the postoperative period is rarely indicated.
Patients are normally positioned in dorsal recumbency however alteration of the patient's position is often necessary. An operating table with the option to change the patient position is normally recommended. Surgeon and assistant should stand lateral to the patient with the monitor in a comfortable position for a surgeon. The anaesthetic tower should be toward the head of the patient and the instrument table should be position at the end of the table giving enough space for surgeon and assistant to move freely around the patient.
Port location and type is based on the procedure to be performed and on the location of the lesion. A multiport technique is usually performed with the camera port in an umbilical or subumbulical location followed by other instrument ports either midway between the umbilicus and the xyphoid or between the umbilicus and the pubis. Threaded cannulas are usually recommended to avoid slippage of the cannula from the peritoneal cavity.
Pneumoperitoneum is established at 8-10mmHg using CO2. A 5mm 30cm 0-30° rigid endoscope is usually recommended. Blunt probes and forceps are helpful for the examination of the organ surfaces in combination with different patient positioning.

Laparoscopic-assisted gastrointestinal exploration
Laparoscopic exploration of the gastrointestinal tract can be challenging due to the location, length and variation in size within the peritoneal cavity. The technique of choice should ensure that all the regions are adequately examined. The approach has to be systematical and in the same manner among the patients. A cranial-to-caudal and side-to-side approach is more preferable. The stomach is evaluated first, intracorporeally:

- The parietal surface is evaluated using a blunt probe.
- The antrum and the cardia are evaluated retracting ventrally the liver lobes.
- The cranial part of the stomach is evaluated with a caudal retraction of the gastric body using laparoscopic forceps.
- The gastric fundus is evaluated in right lateral recumbency and reverse Trendelenburg recumbency with caudal retraction of the gastrosplenic region. At the same time, in this position also the colon should be evaluated.
- The visceral surface is evaluated by displacing the greater omentum and gastric body medially from the same recumbency.
- Pylorus and descending duodenum are evaluated in left lateral recumbency. In particular the descending duodenum can be explored only to the level of the caudal duodenal flexure.
- In the same position, right limb of the pancreas, vena cava, right kidney and right adrenal gland cab ne visualized.

The patient is then position in dorsal recumbency and a loop of jejunum is grasped with forceps and brought ventrally to the port. The abdomen is evacuated of CO2 and the instrument port is removed while maintaining a grasp of the jejunum. Otherwise after port removal a finger can be inserted, and the intestine gently grasped. The margins of the coeliotomy are retracted using baby Gelpis or wound retractors. The exteriorized jejunum is evaluated using an extracorporeal hand-assisted technique. The bowel is examined in an oral direction (till the duodenal flexure) and then aborally till the ileocecocolic junction. Exteriorisation of excessive bowel can create vascular occlusion and ischemia if the incision is not large enough.

Extracorporeal evaluation of the colon is difficult due to its short mesenteric attachment therefore the colon is evaluated in an intracorporeal fashion.
Extraction incision length of 4-5cm in large breed dogs, 3cm in small breed dogs and cats adequate for an unrestricted exteriorization of the small intestine.

Complications
Complications are normally limited to inability to evaluate specific region of the intestinal needed a conversion. Viscera perforation, haemorrhage and infection are possible complications.

Laparoscopic-assisted gastrotomy
Flexible endoscopy is successful for the removal of gastric foreign bodies in 90% of cases and it remains the ideal method for removal. For laparoscopic-assisted gastrotomy two- or single- port technique is used. With a single- multi- port method, the port is placed on the midline midway between the umbilicus and the xyphoid. The abdomen is explored, and the parietal body of the stomach is grasped with forceps and elevated ventrally toward the port. The port is then removed, and the stomach exteriorized. Two stay sutures are placed into the stomach and baby Gelpis or wound retractors are placed on the abdominal wall. The stomach is packed with laparotomy swabs and a gastrotomy is performed in a standard manner. Endoscopic forceps can be used to retrieve the gastric foreign body. At this point the endoscope can be inserted into the stomach to confirm the complete foreign body removal (it should not be used again for laparoscopy because of the gastric contamination). A single or double layer single continuous closure should be performed, and the abdominal wound should be closed routinely.

Laparoscopic-assisted enterotomy and intestinal biopsy
Two- and single-port techniques have been described. As for the gastrotomy, after evaluation of the abdomen a loop of intestine is grasped and exteriorized after the port removal. The small intestine is evaluated by visualization and palpation till the area of interest is found. Baby Gelpis or wound retractors are placed on the abdominal wall and the intestinal loop is isolated with laparotomy swabs. An antimesenteric incision or an elliptical incision in case of biopsy is performed. The enterotomy site is closed in a transverse of longitudinal orientation using a single-layer appositional pattern to minimize tissue eversion and mucosal necrosis. It is important to minimally enlarge the abdominal incision to facilitated exteriorization of the intestine and to prevent strangulation of the mesenteric vasculature.

Laparoscopic-assisted enterectomy and anastomosis
Resection and anastomosis is performed extracorporeally using standard techniques after the affected intestinal segment has been exteriorized vie the extraction incision. This approach minimizes tissue trauma, visceral manipulation and peritoneal contamination. Anastomosis can be performed either with an interrupted or continuous appositional pattern or a staple side-to-side functional end-to-end anastomosis.

With all these procedure omentalisation can also be performed simply exteriorizing part of the greater omentum with the enterotomy or anastomosis site. Omentalisation can be also performed in an intracorporeal manner simply wrapping the omentus around the enterotomy or anastomosis site.

Postoperative care
Pain control: usually with a combination of local incisional analgesics and injectable opioids till the patient is eating and drinking. Most dogs and cats do not require oral analgesics within 3 days of surgery.
Gastrointestinal protectant and antiemetics: can be used based on the underlying condition and may be indicated to palliate clinical signs until definitive treatment is instituted.
Postoperative ileus: can be treated using metoclopramide as first line medication as a constant rate infusion.
Maropitant: can be effective in reducing nausea associated with opioids.
Enteral feeding is normally suggested as soon as the patient is fully recovered.
Hospitalisation time for most of patients appeared to be relatively short. Reduced hospitalization time is usually attributed to less postoperative pain, improved bowel recovery and fewer complications associated with these techniques.

Laparoscopic-assisted gastropexy
The patient is placed in dorsal recumbency. The abdomen is clipped and aseptically prepared as for a normal midline coeliotomy from the xyphoid process to the pubis. The camera port is place in a subumbilical position and transillumination of the body wall is used to identify a safe region for insertion of the instrument port. The instrument port is placed adjacent to the lateral margin of the rectus abdominis on the patient right side 3-5cm caudal to the last rib (based on patient's size). Grasping forceps are passed through the second port and used to manipulate the stomach under direct visualization. If visualization is suboptimal the patient can be tilted in reverse Trendelenburg positing to shift all the organs caudally.

The antrum of the stomach is grasped midway between the greater and lesser curvature of the stomach 5-7 cm oral to the pylorus. This site represents the location for the incisional gastropexy. The forceps and the antrum are exteriorized with the cannula and the port incision enlarged to 4-5cm in an orientation parallel to the last rib. The dissection of the body wall is accomplished through the external and internal abdominal oblique; the transversus abdominis is the final layer before exteriorization of the stomach.
Care should be taken to avoid twisting the stomach. Two stay sutures should be placed in the antrum about 4-5cm from each other and these define the length of the gastropexy. An incision in the seromuscular layer of the antrum is made and two simple continuous lines are placed to appose both margins of the seromuscular layer in the antrum to the trasversus abdominis muscle. The rest of the muscles are reapposed and the remainder of the incision is closed in routine fashion. Pneumoperitoneum is reestablished and the gastropexy is visualized to ensure optimal location and orientation. The subumbilical port is removed and the port site incision is close routinely.

Laparoscopic splenectomy

The spleen is located on the left side of the abdomen. The head of the spleen rests between he fundus of the stomach and the left kidney, this is the least freely moveable portion of the spleen. The tail of the spleen has less restrictive omental attachments and is variable in position. Relative contraindications to laparoscopic splenectomy is massive splenomegaly, splenic masses larger than 6cm and hemoperitoneum.

Patient preparation and position

The abdomen is clipped and aseptically prepared as for a normal midline coeliotomy. The patient is placed in dorsal recumbency with the possibility to position the patient in an oblique right lateral position during surgery. Surgeon and assistant should stand on the patient's right side with the endoscopic tower and monitor in front of them (patient's left side). Multiple-port procedure is the most commonly described surgical technique. The location of the ports varies among surgeons and no definitive location has been identifies as superior. The camera port is placed in a subumbilical location, and instrument ports are located cranial and caudal to that on a ventral midline. A laparoscopic-assisted procedure with the use of a wound retractor has also been described. The retractor is placed on the umbilicus and allows the spleen to be exteriorized.

Surgical technique
After the ports are placed and the pneumoperitoneum established, the spleen can be manipulated using a blunt probe till the hilus is exposed. Care should be taken to avoid puncturing the splenic capsule. Transection of the vessels can start from the tail toward the head of the spleen. The use of a sealing device is strongly recommended. Rotation of the patient to an oblique or right lateral position may be necessary to expose the gastrosplenic ligament and the short gastric vessels. A specimen retrieval bag is introduced through a large cannula and the spleen manipulated till into the bag. The umbilical incision is enlarged, and the bag retrieved. After retrieval the abdomen is evaluated for any evidence of hemorrhage before removal of the ports and routine closure.
For laparoscopic-assisted splenectomy, an initial laparoscopic exploration is performed followed by a placement of a wound retractor. The spleen is then manually elevated out of the incision and the hilar vasculature is sealed.
Complications and postoperative care
Haemorrhage is the major intraoperative complication during laparoscopic splenectomy; this could occur during cannula placement, inadequate sealing of vessels, tear to the splenic capsule or disruption of small omental vessels. This is usually not significant or severe enough to warrant conversion. Interestingly infection and inflammation of the surgical wound was lower compared to surgical incision from open splenectomy.
Recovery is generally rapid, and patient can be monitored with analgesia for the next 24 hours and discharged to their owner's care.