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MINI-INVASIVE SURGICAL TECHNIQUES IN DOGS AND CATS

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ABSTRACT

Minimally invasive techniques are becoming increasingly popular in human medicine due to rapid patient recovery, minimal tissue damage, and a significant reduction in complications in the postoperative period. The development of this field in veterinary medicine is relatively slow due to some limiting factors such as specific equipment, higher cost of procedures, and lack of experience and training of specialists.

The purpose of this article is to show the areas of application of mini invasive surgical techniques in veterinary medicine as well as the advantages over the classical techniques.

Key words: mini-invasive surgical techniques, dog, cat.

Introduction

Minimally invasive techniques are becoming increasingly popular in human medicine. The boom of its development and its widespread use in various fields of human medicine is determined around the mid-1980s. The widespread use of these techniques is due to rapid patient recovery, minimal tissue damage, and a significant reduction in complications in the postoperative period.

There is evidence that the use of some minimally invasive techniques in veterinary patients such as laparoscopy reduces the severity and/or incidence of complications compared to open surgical techniques However, the use of these techniques is relatively limited and therefore randomized studies are needed to support or reject these assumptions (3, 4, 7, 9, 16, 20).

The most widely used minimally invasive techniques in veterinary medicine are *laparoscopy* (abdominal and pelvic surgery), *thoracoscopy* (pulmonary surgery) and *arthroscopy* (joint surgery).

I. LAPAROSCOPY

Laparoscopic abdominal surgery ranks first among minimally invasive surgical techniques used in veterinary medicine (Fig. 1, Fig. 2).

Figure 1: A laparoscope.

Figure 2: Laparoscopic forceps.

The most widespread application is in ovariohysterectomy, uroliths in the bladder, gastropexy in GDV-syndrome, biopsy when neoplasia is suspected etc. Although the operation is minimally invasive, it requires general anesthesia accompanied by routine preparation – a fasting diet up to 12 hours prior to manipulation, pre-morphological and biochemical blood examination for determining anesthesia risk, ultrasound and other imaging and functional studies, depending on the condition of the patient (14, 16, 20).

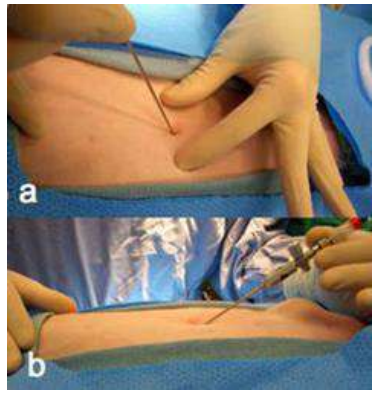

Figure 3: Inserting a Veress needle into the abdominal cavity and attaching the needle to the insufflation apparatus (source: Landsdowne et al., 2012).

Technique

A needle (Fig. 3) is inserted into the abdominal cavity at the level of the umbilical scar. After the insufflation in the abdominal cavity, the endoscope is inserted and the first cannula is placed. Often the endoscope is blurred at the initial entrance of the abdominal cavity, usually due to condensation of the lens at temperature change or contamination by blood or other fluid when passing through the cannula.

Upon insertion of the camera, the abdominal cavity is explored at 360° to identify possible contraindications for continued intervention (e.g. adhesions, large abdominal masses, bowel injury and/or other organs) (9).

Identifying the location of the portal tools is the next step. Once the pneumoperitoneum has been created, the tools can be safely introduced using a direct endoscope and camera visualization. The easiest way to determine the insertion site of the cannula is to press the potential area of the abdominal wall several times until the site becomes visible on the screen. The light source can be used to illuminate the wall from the inside to avoid large blood vessels (Fig. 4a). (9, 13, 16).

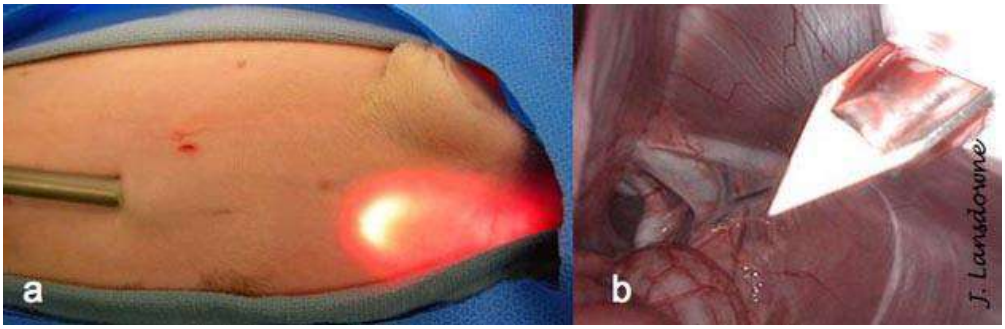

Figure 4: The Hesson technique- access to the thorax in a dog (source: Landsdowne et al., 2012).

The trocar cannula is inserted with rotation movements, the camera follows and visualizes the path of its passage (Fig. 4b).

The most common complication in laparoscopy is injury or tearing of abdominal organs (intestine or spleen) during the insertion of the trocar. This is usually avoided by directly visualizing the trocar input point and, if necessary, changing the direction. Changing the position of the patient (lift or bend the head, slight lateral positioning, etc.) can lead to displacement of the organs, which facilitates the safe entry of the trocar. Once the endoscope is introduced, the instruments should not be removed or left in the abdominal cavity without direct visualization.

After completing the laparoscopic procedure, the endoscope and instruments are removed and the carbon dioxide from the abdominal cavity is eliminated through the openings. The cuts are then routinely sutured. Local canal infiltration with *bupivacaine* (1 mg/kg), with or without systemic analgesics (based on the patient's condition and the procedure being performed) is recommended (9, 13, 14).

Fields of application of laparoscopy

This method provides great opportunities for diagnostics and operations: diagnostic laparotomy and organ biopsy of the gastrointestinal tract, spleen, liver, pancreas, kidney, prostate, lymph nodes, abdominal masses in dogs and cats;

1. Laparoscopic ovariohysterectomy (Fig. 5) – castration is performed by two small openings up to 10 mm in diameter. The effect of surgery is the same regardless of the surgical technique, but the recovery period is 2 to 3 times shorter. The level of pain is significantly lower, allowing manipulation to be performed with more superficial plan of anesthesia. Laparoscopic techniques significantly reduce post-operative complications due to infections due to the lack of direct contact of the abdominal cavity with the environment. This technique is extremely suitable for sports animals, where striving is to minimize the postoperative recovery period (14, 16).

Figure 5: Laparoscopic ovariohysterectomy in a dog (source: https: //www.veterinarypracticenews.com).

2. Laparoscopic diagnostics and cryptorchidism operations –The size of the holes is up to 20 mm, depending on the weight of the patient. The endoscope is inserted cranially into the umbilical scar tissue, and the instruments – at the umbilical level. It is advisable to use capture bags in which the testicle falls before it is removed from the abdominal cavity and the presence of these auxiliaries is obligatory in the case of suspected neoplasia (10)

3. Laparoscopic cystotomy – the most common indication of cystotomy is the presence of uroliths in the bladder and proximal urethra, chronic cystitis not eligible for treatment and extraction of ulcerous zones. The endoscopic method significantly reduces the risk of peritonitis caused by urinary incontinence in the abdominal cavity and reduces bladder trauma, which in open surgical techniques is a major cause of post-operative complications. Laparoscopic cystotomy is contraindicated for suspected transitional cell carcinoma of the bladder due to the aggressive nature of the tumor and its tendency to give metastasis (9, 16).

This method can be used for another different surgical procedure such as gastropexia in dogs for GDV prevention – for large and giant breeds of dogs; colopexy and cystopexy in dogs – as partial operative therapy prior to surgical treatment of perineal hernia (9).

It is also used as a diagnostic procedure for performing a visual inspection of the abdominal cavity in case the final diagnosis cannot be performed with the imaging methods (16, 18).

II. THORACOSCOPY

Thoracoscopy (Fig. 6) is a minimally invasive method of direct thoracic cavity inspection. The advantages of this method to the open thoracotomy include good visualization – the image we observe is increased and well illuminated, helping to diagnose submacroscopic lesions; in deep-chested animals, the method allows interventions in difficult-to-reach areas due to the small diameter of the instruments; the recovery of the patient after thoracoscopy is rapid compared to open thoracotomy (especially in adult patients) (6, 8, 9).

Figure 6: Thoracoscopy (source: http: vsoak.com).

Technique

The patient is dorsal recumbent position, with a slight incline of the sternum aside from the surgeon or in the lateral lying position. Lateral intercostal or paraxyphoid approach is preferred.

Preoperatively routine examinations are performed to assess anesthesia risk. In the thoracoscopy, assisted pulmonary ventilation is mandatory, and the procedure can be performed by controlled pneumothorax or total atelectasis on the left or right lung (***one lung ventilation*** **– OLV**), resulting in shorter anesthesia time, improved visualization of the pulmonary hilus and reduces the risk of trauma to atelectatic lung areas. The main applications of thoracoscopy are: pericardectomy, partial or total lobectomy diaphragmatic hernia (9, 12, 16).

1. Thoracoscopyc pericardectomy (subtotal or partial) (Fig. 7) – In pericardial effusion that doesn't improve by drugs, surgical drainage of the fluid through thoracoscopy is excellently tolerated by patients. The procedure significantly reduces surgical trauma and tissue damage caused by thoracotomy. This is a minimally invasive method th at uses 2-3 small portals (5 mm) through which the endoscope and tools are introduced (1).

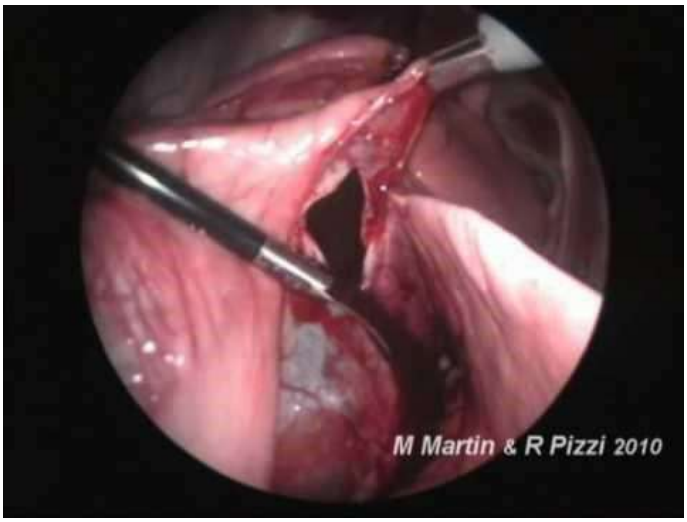

Figure 7: Pericardectomy in a dog (source: www.vetlapsurg.com).

The partial pericardectomy may be performed in a lateral or dorsal recumbency, while the subtotal is made only in dorsal – the advantage of this positioning is that it does not require the use of **one-lung ventilation** and allows a full visualization of the thorax (Fig. 8). The removed portion of the pericardium should always be examined histopathologically and microbiologically (9, 11).

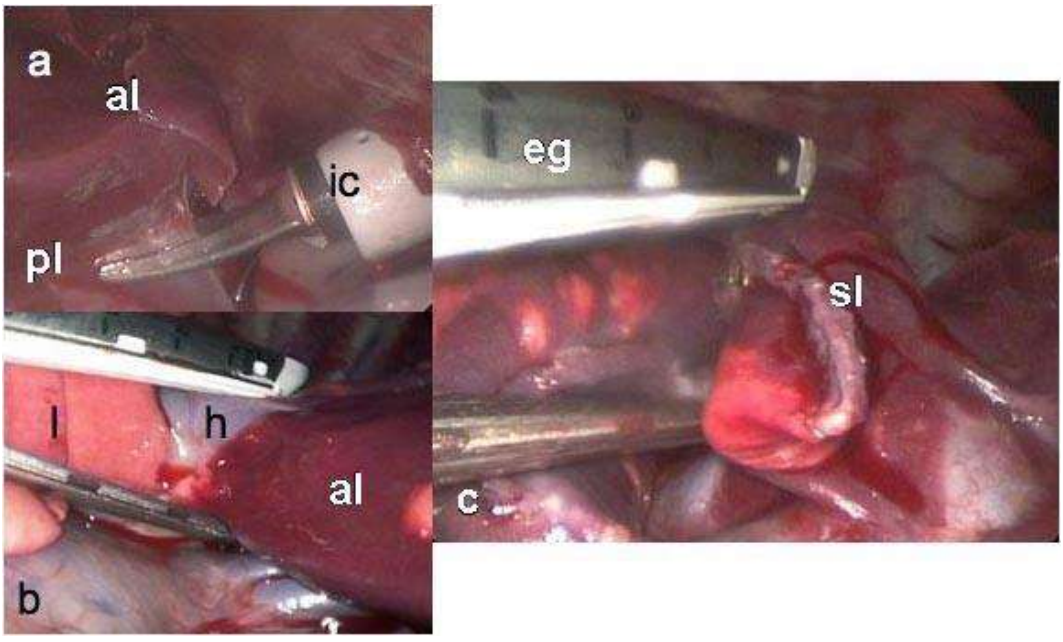

Figure 8: a) Transection of the pulmonary ligament of the left caudal lobe; b) Inserting the stapler through the hilus of the left caudal lobe; c) the final look of the stepping line before removing the pulmonary lobe (source: Landsdowne et al., 2012).

2. Diaphragmatic hernia – a dorsal recumbency is recommended by introducing a trocar into the abdominal cavity midway between the umbilicus and the pelvis. After the cavity is filled with CO_2 (12 mmHg), two more instruments are introduced, following the triangular principle. After suturing the hernia, endoscopic instruments are removed, with residual pneumothorax drained by thoracentesis. Laparoscopic approach allows simultaneous examination of the abdomen and chest cavity, which is an important advantage over the open surgical technique (2). The minimal invasiveness of the method allows rapid recovery of the patient. Laparoscopy in diaphragmatic hernia is both a diagnostic and therapeutic approach (5, 19).

3. Examination of the hilar lymph nodes – when the hilar lymph nodes are enlarged, they can be visualized. In case of partial collapse of the lung, the lymph vessels are well visible, and in addition to a comprehensive view, a biopsy material can also be obtained. Samples can be obtained (with attention to the aorta nearby) using biopsy forceps (Fig. 9) with a double spoon or removed with a combination of acute and rounded dissection (9).

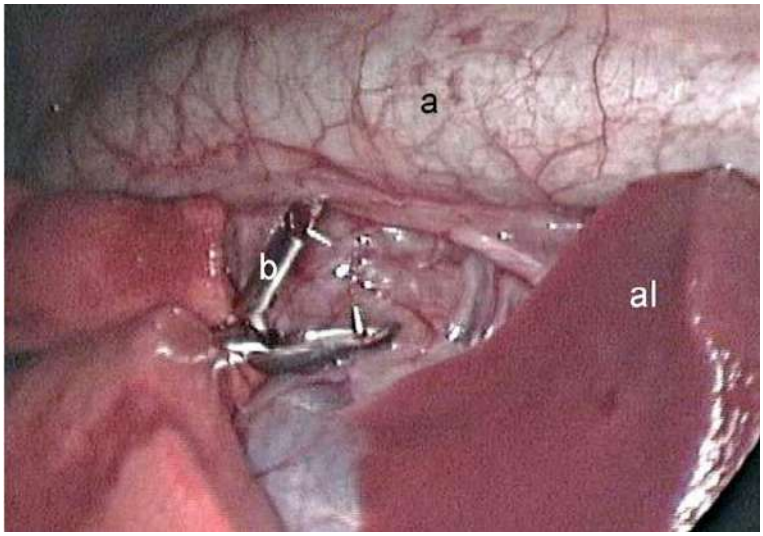

Figure 9: Biopsy of the hilar lymph nodes (source: Monnet et al., 2003), a – aorta, al – atelectasis of the lung; b – biopsy forceps.

III. ARTHROSCOPY

Arthroscopic surgery has had the most significant advancements in orthopedics in small animals, especially in the last 15 years. Open surgical methods are associated with a great traumatism, a long recovery period and a significant risk of complications (infections, contractures, etc.). Due to the low postoperative pain in arthroscopy, the rehabilitation period is shortened repeatedly.

Theoretically, arthroscopy can be performed on each joint, but is most commonly applied to the elbow joint in the diagnosis of elbow dysplasia (fragmented proc. coronoideus), a shoulder joint for conditions such as Osteochondritis Dissecans (OCD), suspicion of having a tendon rupture of m. biceps femoris and rupture of ligaments (17).

Preoperatively the anesthetic risk should be assesed, X-ray, CT or MRI imaging of the relevant joint structures is performed to assess whether the intervention can be performed by this method.

The patient is subjected to general anesthesia, making 2 to 3 small holes (up to 3 mm) in the joint, then direct visualization is possible (Fig. 10, Fig. 11).

Figure 10: Ruptured cranial cruciate ligament (source: www.skylossportsmedicine.com).

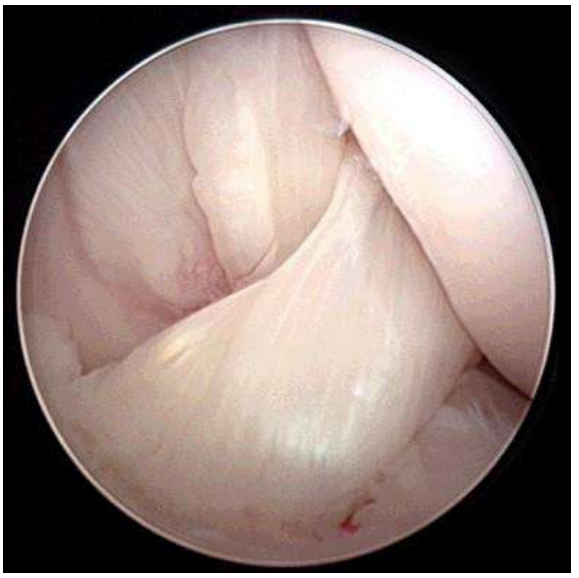

Figure 11: Healthy cranial cruciate ligament (source: www.skylossportsmedicine.com).

Conclusion

Mini-invasive techniques have a variety of applications and can be introduced as routine surgical methods. They are minimally invasive in terms of tissue trauma, short anesthesia time, and shortened recovery period.

Many of the techniques were initially experimentally applied to animals, demonstrating their suitability in veterinary surgical practice.

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