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## Review Article

### LAPAROSCOPY MINIMALLY INVASIVE SURGERY FOR PET ANIMALS

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#### ABSTRACT

Laparoscopy and minimally invasive surgery have become increasingly popular in veterinary medicine as they offer numerous benefits over traditional surgical techniques. This paper provides an overview of the basic principles of laparoscopy, the equipment and surgical instruments required, anesthesia and patient considerations, insufflation techniques, and specific laparoscopic procedures in veterinary medicine, such as biopsy, cystotomy, enterotomy, cryptorchidectomy, and gastropexy. **Methods:** Published peer-reviewed reports were used to write this short review paper. **Results:** The use of laparoscopy is enormously beneficial over open surgery. Published literature suggests using laparoscopy to reduce blood loss. Laparoscopy which is a minimally invasive surgery provide better visualization, less pain and scarring, faster recovery times, and fewer complications than traditional open surgery. **Conclusion:** The uses of laparoscopy in veterinary medicine are growing and continue to advance, offering new techniques and applications that will benefit both veterinarians and pet owners.


#### INTRODUCTION

Minimally invasive surgical techniques including laparoscopy are an area of veterinary medicine that has gained significant attention in recent years. Traditional surgery involves making large incisions, leading to extensive tissue damage, pain, and a prolonged recovery period for pets (Buishand et al., 2015). However, with laparoscopy, small incisions are made, and specialized instruments are used to perform surgical procedures. This minimally invasive technique offers numerous advantages over traditional surgery, including reduced pain, faster recovery times, and reduced risk of complications (Buote et al., 2022). As a result, laparoscopy and minimally invasive techniques are rapidly becoming the standard of care in small animal medicine, improving the quality of life for pets and providing pet owners with peace

of mind knowing their pets are receiving the best possible care. Here, we will discuss the benefits of advancing pet animal surgery with laparoscopy and minimally invasive techniques and how they are changing the landscape of veterinary medicine (Fransson, 2014).

#### Basic principle of laparoscopy

Laparoscopy is a minimally invasive surgical technique that uses small incisions and specialized instruments, including a camera, to access and view the abdominal or pelvic region of the body, resulting in less tissue damage, less pain, and a faster recovery time for patients (Fransson, 2014). The basic principle of laparoscopy is to perform surgical procedures in the abdominal or pelvic region of the body through small incisions in the skin, rather than making a large incision as in traditional surgery (Coleman et al., 2018). During a laparoscopic procedure, specialized instruments are inserted through small incisions, including a camera (called a laparoscope), which transmits images of the surgical site to a video monitor (Freeman, 2009). This allows the surgeon to view the inside of the body on the monitor while manipulating the instruments to perform the surgical procedure. The laparoscope is

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typically inserted through a small incision near the navel, and carbon dioxide gas is used to inflate the abdominal cavity, creating a space for the surgeon to work (Culp et al., 2009). This allows the surgeon to see the surgical site more clearly and manipulate the instruments more easily. Other specialized instruments are inserted through additional small incisions to perform the surgical procedure, such as grasping and cutting instruments or electrocautery instruments to control bleeding (Devitt et al., 2005). The surgeon can manipulate the instruments and view the entire procedure on the video monitor, which offers a high-resolution, magnified view of the surgical site. Laparoscopy can be used for a wide range of surgical procedures, including organ biopsy, tumor removal, spaying and neutering, and abdominal exploratory surgery (Ganjei, 2022). Compared to traditional surgery, laparoscopy results in less tissue damage, less pain, and a faster recovery time for patients (Daniel et al., 2019). Additionally, the smaller incisions reduce the risk of infection and other post-operative complications.

**Equipment for laparoscopy**

Laparoscopy requires specialized equipment and instruments that allow surgeons to perform minimally invasive procedures through small incisions (Ganjei, 2022). The basic equipment needed for laparoscopy includes (Fig. 1):

1. Laparoscope: A laparoscope is a thin, fiber-optic camera that is inserted through a small incision in the abdomen. The camera transmits images of the surgical site to a video monitor, allowing the surgeon to view the inside of the body

- (Dharmaceelan et al., 2000).
2. Insufflator: An insufflator is a machine that pumps carbon dioxide gas into the abdomen to inflate it, creating a working space for the surgeon. This allows the surgeon to see the surgical site more clearly and manipulate the instruments more easily (Fransson, 2014).
3. Trocars: Trocars are specialized instruments used to create small incisions in the abdomen through which the laparoscope and other instruments are inserted (Freeman, 2009).
4. Surgical instruments: Laparoscopic instruments are specialized tools that are inserted through the trocars to perform surgical procedures. These instruments include graspers, scissors, dissectors, and electrocautery instruments (Ganjei, 2022).
5. Light source: A light source provides illumination for the laparoscope, allowing the surgeon to see the surgical site more clearly (Dharmaceelan et al., 2000).
6. Video monitor: The video monitor displays images of the surgical site transmitted by the laparoscope (Freeman, 2009).

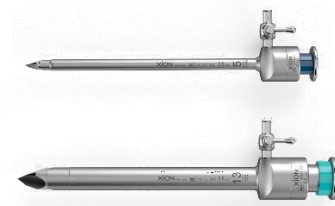
In addition to these basic pieces of equipment, laparoscopic procedures may also require additional specialized instruments and equipment, depending on the specific procedure being performed. Laparoscopy is a complex and highly specialized technique that requires extensive training and experience to perform safely and effectively (Goethem et al., 2009).



1. Laparoscope



2. Insufflator



3. Trocars



4. Surgical instruments



5. Light source



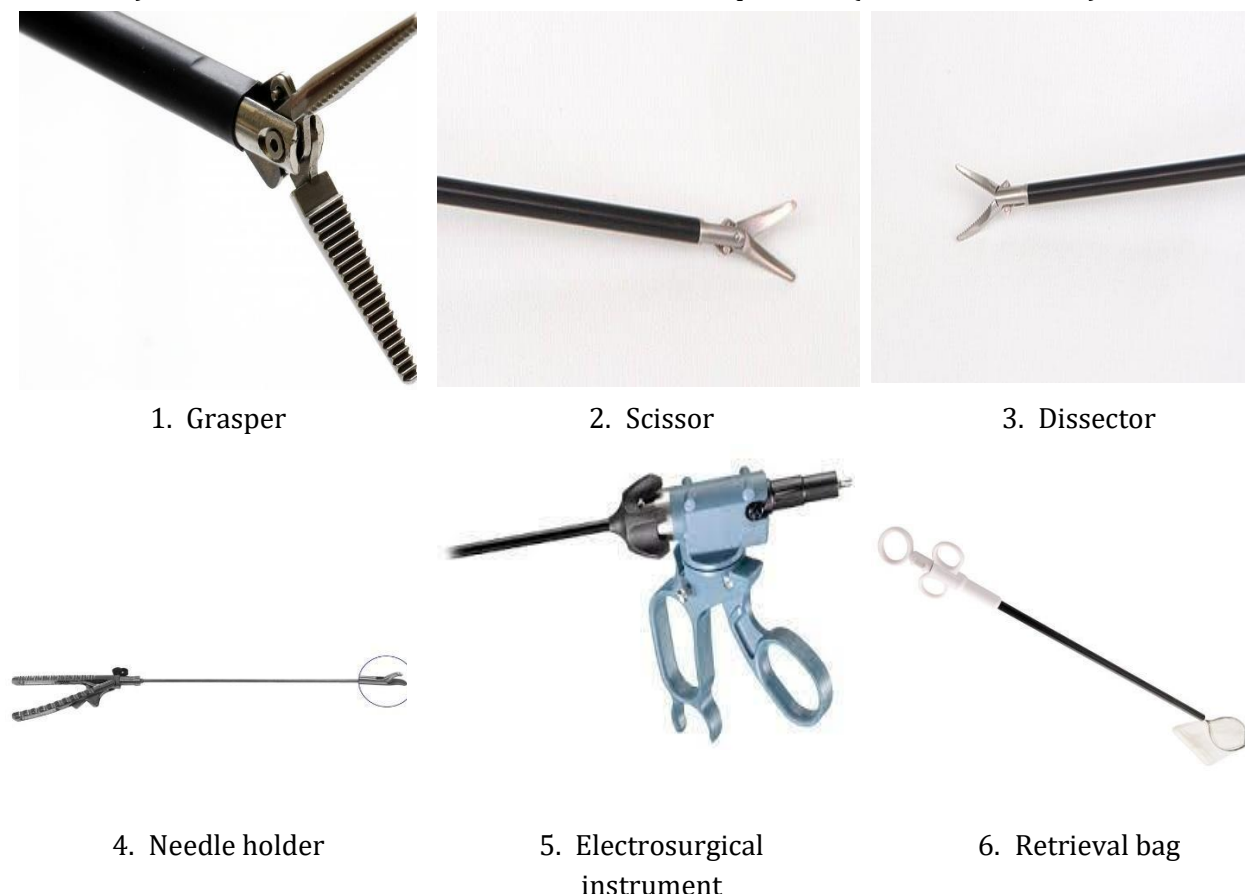
6. Video monitor

**Fig. 1 Equipment for laparoscopy**

### Surgical instruments for laparoscopy

Laparoscopy requires specialized surgical instruments that are designed to be used through small incisions in the abdomen. These instruments allow surgeons to perform minimally invasive procedures with greater precision and control (Gutt et al., 2002). Some of the commonly used surgical instruments for laparoscopy include (Fig.2):

1. Graspers: Graspers are used to hold and manipulate tissues or organs during laparoscopic procedures. They are available in different lengths and tips, including straight or curved, and may be blunt or have teeth for improved grip (Gutt et al., 1996).
2. Scissors: Laparoscopic scissors are used to cut or dissect tissue during surgical procedures. They are available in different blade shapes and lengths, including straight or curved blades (Koch et al., 2020).
3. Dissectors: Dissectors are used to create a plane of dissection and separate tissue layers during laparoscopic procedures. They are available in various shapes, including blunt or sharp-tipped.
4. Needle holders: Needle holders are used to grasp and manipulate needles during laparoscopic procedures, including suturing and knot-tying.
5. Electrosurgical instruments: Electrosurgical instruments are used to control bleeding during laparoscopic procedures. They use an electric current to cut or coagulate tissue and are available in different shapes and sizes (Ganjei, 2022).
6. Retrieval bags: Retrieval bags are used to remove large specimens or tissues from the abdominal cavity during laparoscopic procedures. They are designed to be inserted through small incisions and then expanded to contain the tissue or specimen (Kumar et al., 2007).



**Fig. 2 Surgical instruments required for laparoscopy**

These are just a few examples of the surgical instruments used in laparoscopy. There are many other specialized instruments and devices that may be used depending on the specific procedure being performed. It is important for surgeons to be trained in the proper use of these instruments to ensure safe and effective laparoscopic procedures (Lew et al., 2005).

### Anaesthesia for laparoscopy

Anaesthesia is a critical component of laparoscopic procedures, as it ensures the comfort and safety of the patient during surgery (Loy Son et al., 2016). There are several different types of anaesthesia that can be used for laparoscopy, depending on the specific procedure being performed and the patient's medical history. Some of the commonly used

anesthesia options for laparoscopy include:

1. **General anesthesia:** General anesthesia is the most commonly used type of anesthesia for laparoscopy. It involves the use of medications that induce a state of unconsciousness, which allows the patient to remain completely still and unaware during surgery (Goethem et al., 2009).
2. **Regional anesthesia:** Regional anesthesia involves the injection of a local anesthetic into a specific region of the body, such as the spinal cord or nerve roots. This type of anesthesia can be used in combination with sedation to provide a comfortable and pain-free surgical experience for the patient (McCarthy, 2019).

**Local anesthesia:** Local anesthesia involves the injection of a numbing medication into the surgical site to block pain signals. This type of anesthesia is typically used for minor laparoscopic procedures or for diagnostic procedures that do not require a deep level of sedation (McCready et al., 2020). The choice of anesthesia for laparoscopy depends on several factors, including the patient's medical history, the type and duration of the procedure, and the surgeon's preference. It is important for patients to discuss their options for anesthesia with their surgeon and anesthesiologist prior to surgery, in order to ensure that they receive the most appropriate and safe anesthesia for their individual needs (Robertson et al., 2014).

### **Patient and Surgical Consideration for Laparoscopy**

Laparoscopy is a minimally invasive surgical technique that offers many advantages over traditional open surgery, including reduced pain, shorter recovery times, and smaller incisions. However, there are several important patient and surgical considerations that must be taken into account when performing laparoscopic procedures (Lew et al., 2005). Some of these considerations include:

#### **Patient Considerations**

- **General health:** Laparoscopy is generally considered safe for most patients, but certain health conditions, such as heart or lung disease, may increase the risks associated with anesthesia and surgery (McCready et al., 2020).
- **Obesity:** Patients who are overweight or obese may be at increased risk of complications during laparoscopy, as the procedure may be more technically challenging and require more time (Monnet et al., 2008).
- **Previous abdominal surgery:** Patients who have undergone previous abdominal surgery may

have adhesions or scar tissue that can make laparoscopy more difficult and increase the risk of complications.

- **Pregnancy:** Laparoscopy can be performed safely during pregnancy, but it is generally avoided during the first trimester due to the risk of fetal harm (Ganjei, 2022).

#### **Surgical considerations**

- **Equipment and instrument selection:** Proper selection and use of specialized laparoscopic instruments is essential for safe and effective laparoscopy.
- **Port placement:** Careful placement of the laparoscopic ports is important to ensure adequate access to the surgical site and minimize the risk of injury to surrounding structures (Koch et al., 2020).
- **Visualization:** Adequate visualization of the surgical site is essential for safe laparoscopy. The use of high-quality cameras and monitors is essential to ensure that the surgeon has a clear view of the surgical field (Sladakovic & Divers, 2016).
- **Surgeon training and experience:** Laparoscopy is a technically demanding procedure that requires specialized training and experience. It is important for surgeons to be properly trained and experienced in laparoscopic techniques to ensure safe and effective procedures (Monnet et al., 2008). In summary, laparoscopy offers many advantages over traditional open surgery, but it is important to carefully consider patient and surgical factors to ensure safe and effective procedures (Ganjei, 2022). Close collaboration between the surgeon, anesthesiologist, and patient is key to ensuring the best possible outcome for laparoscopic procedures.

#### **Insufflation for Laparoscopy**

Insufflation is a critical component of laparoscopy, as it creates a working space inside the abdomen and allows the surgeon to visualize and access the surgical site (Freeman, 2009). During insufflation, carbon dioxide gas is introduced into the abdominal cavity through a needle or specialized trocar, which is inserted through a small incision in the abdominal wall. The pressure and volume of the gas used for insufflation are carefully controlled to minimize the risk of complications, such as excessive gas absorption or cardiovascular changes (Gutt et al., 1996; Moore & Bennett, 1995). The most commonly used gas for insufflation is carbon dioxide, which is rapidly absorbed by the body and does not support combustion. Once the abdominal cavity is inflated,



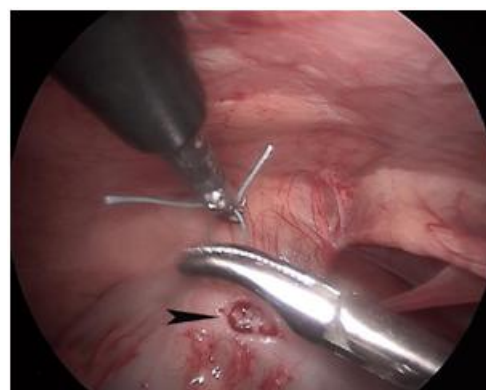
the surgeon can visualize the surgical site using a laparoscope, which is a specialized camera that is inserted through a separate port. The laparoscope transmits high-quality images of the surgical field to a high-definition monitor, allowing the surgeon to perform the procedure with precision and accuracy (Robertson et al., 2014). After the procedure is complete, the gas used for insufflation is removed from the abdominal cavity and the incisions are closed with sutures or surgical glue. Because insufflation is a critical component of laparoscopy, it is important for surgeons to carefully monitor gas pressure, volume, and absorption throughout the procedure to minimize the risk of complications and ensure the best possible outcome for the patient (McCready et al., 2020).

### Laparoscopy and other minimal techniques in different surgical procedures

#### Biopsy

Laparoscopy is a minimally invasive surgical technique that can be used to perform a biopsy of abdominal organs such as the liver, pancreas, or kidneys (Monnet et al., 2008). The procedure involves making small incisions in the abdomen and inserting a laparoscope, a thin tube with a camera and light, to visualize the surgical site (Robertson et al., 2014).

To perform a biopsy, specialized laparoscopic instruments are inserted through additional small incisions in the abdomen. These instruments are used to obtain a tissue sample from the organ of interest. The tissue sample is then sent to a laboratory for analysis, which can help diagnose various medical conditions such as cancer (O'Malley & Cunningham, 2001). Before the procedure, the patient will undergo a thorough medical evaluation, including blood tests and imaging studies, to ensure that they are a suitable candidate for laparoscopic biopsy. The procedure is typically performed under general anesthesia, and patients are closely monitored throughout the procedure and during the recovery period. After the procedure, patients may experience some discomfort at the site of the incisions (Freeman, 2009), but this can be managed with pain medications. Patients are usually able to return to normal activities within a few days to a week, depending on the extent of the procedure and their overall health (Rawlings et al., 2003).



**Fig. 3 Laparoscopic extramucosal biopsy Cystotomy**

Laparoscopy is a minimally invasive surgical technique that has gained popularity in veterinary medicine for the management of various medical conditions (Rutherford & Finding, 2009). One such condition is bladder stones, or urolithiasis, which can cause urinary tract obstruction and can be life-threatening if left untreated. In cases where medical management of bladder stones has failed, or the stones are too large to pass on their own, surgical removal of the stones may be necessary (Robertson et al., 2014). Traditionally, open surgery, or cystotomy, has been the preferred method of surgical intervention for bladder stone removal in pets. However, laparoscopic-assisted cystotomy is becoming an increasingly popular alternative.

During the procedure, a small incision is made in the abdomen to insert the laparoscope (Rutherford & Finding, 2009), and additional small incisions are made for specialized instruments to remove the bladder stones. The laparoscope provides high-definition images of the bladder and surrounding tissues, allowing for precise removal of the stones and minimal disruption of healthy tissues. Laparoscopic-assisted cystotomy has several advantages over traditional open surgery. It results in less postoperative pain, a shorter hospital stay, and faster return to normal activities. The small incisions also reduce the risk of infection and other complications (Fransson, 2014).

However, there are some limitations to laparoscopic-assisted cystotomy. It requires specialized equipment and training, which may not be available in all veterinary hospitals. Additionally, the technique may not be suitable for all patients, depending on the size and location of the bladder stones and other medical factors (Koch et al., 2020).



Fig. 4

#### Laparoscopic-assisted cystotomy

##### Urethrocystoscopy

Urethrocystoscopy is a minimally invasive diagnostic and therapeutic technique used in veterinary medicine to visualize and treat the lower urinary tract, specifically the urethra and bladder. It involves the use of a small, flexible tube equipped with a camera and light source (Rutherford & Finding, 2009), known as an endoscope, to visualize the inside of the urinary tract.

During a urethrocystoscopy procedure, the endoscope is inserted through the urethra and advanced into the bladder. The camera and light source provide high-quality images of the bladder and urethra, allowing for visualization of any abnormalities, such as bladder stones, tumors, or infections (Sladakovic & Divers, 2016). Urethrocystoscopy can also be used for therapeutic purposes, such as removal of bladder stones or biopsies of suspicious lesions. This minimally invasive technique reduces the risk of complications and allows for a faster recovery time than traditional open surgery. Urethrocystoscopy is typically performed under general anesthesia to ensure the patient's comfort and safety (Freeman, 2009). It is a safe and effective diagnostic and therapeutic tool that can provide valuable information for the management of various urinary tract conditions in pets.

##### Enterotomy

Enterotomy is a surgical procedure that involves making an incision into the small intestine to remove foreign bodies or tumors, repair damaged tissue, or relieve an obstruction. In traditional open surgery, a large incision is made into the abdominal cavity to access the small intestine (Freeman, 2009; Robertson et al., 2014). However, with the advent of laparoscopy, enterotomy can now be performed using minimally invasive techniques.

Laparoscopic enterotomy is performed under general anesthesia, and requires specialized equipment and training. Small incisions are made in the abdomen, and a laparoscope is inserted to visualize the small intestine (Kumar et al., 2007). Additional incisions are made as needed to introduce

specialized surgical instruments, such as graspers, scissors, and staplers, to perform the enterotomy. The laparoscope provides a magnified, high-definition view of the small intestine, allowing the surgeon to precisely locate the site of the enterotomy and perform the procedure with greater accuracy (Buote et al., 2022). Laparoscopic enterotomy is associated with several benefits, including reduced postoperative pain, shorter hospitalization time, and a faster recovery compared to traditional open surgery

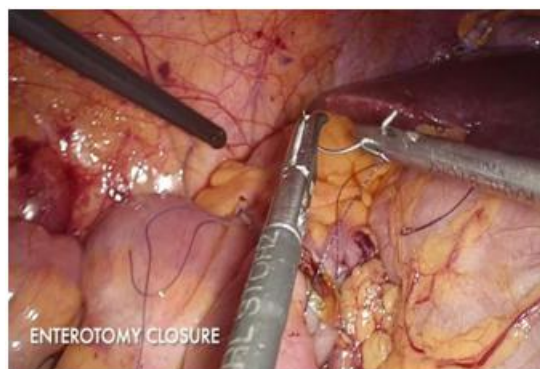


Fig. 5 Laparoscopic ileocecal resection

##### Cryptorchidectomy

Cryptorchidism is a condition in which one or both testicles fail to descend into the scrotum, resulting in retained testicles in the abdominal cavity or inguinal canal (Coleman et al., 2018). Cryptorchidism is common in dogs and can lead to serious health issues such as testicular torsion, testicular cancer, and infertility (Buishand et al., 2015; Lew et al., 2005). Cryptorchidectomy is the surgical removal of retained testicles and is typically performed by traditional open surgery. However, with the advent of laparoscopy, cryptorchidectomy can now be performed using minimally invasive techniques.

Laparoscopic cryptorchidectomy is performed under general anesthesia and requires specialized equipment and training (Culp et al., 2009). Small incisions are made in the abdomen, and a laparoscope is inserted to visualize the abdominal cavity and locate the retained testicle. Additional incisions are made as needed to introduce specialized surgical instruments, such as grasping forceps and scissors, to remove the retained testicle (Daniel et al., 2019). The laparoscope provides a magnified, high-definition view of the abdominal cavity, allowing the surgeon to precisely locate the retained testicle and perform the cryptorchidectomy with greater accuracy (Ganji, 2022). Laparoscopic cryptorchidectomy is associated with several benefits, including reduced Post operative pain, shorter hospitalization time, and a faster recovery compared to traditional open surgery. However, not all cases of cryptorchidism are suitable for

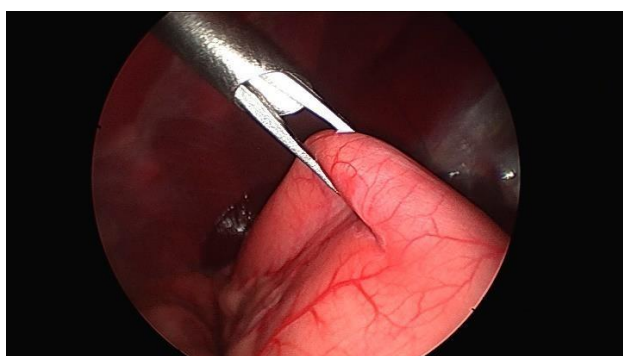
laparoscopic surgery (Devitt et al., 2005). Factors such as the location and size of the retained testicle, the presence of adhesions or other abdominal abnormalities, and the patient's overall health and condition must be carefully evaluated by the veterinarian to determine if laparoscopic cryptorchidectomy is the most appropriate approach for the individual patient (Dharmaceelan et al., 2000).



**Fig 6. Laparoscopic cryptorchidectomy**

### Gastropexy

Gastropexy is a surgical procedure that involves attaching the stomach to the abdominal wall to prevent it from twisting or rotating, a condition known as gastric dilatation-volvulus (GDV) or bloat (Freeman, 2009). GDV is a serious and potentially life-threatening condition that commonly affects large and deep-chested dogs (Rutherford & Finding, 2009). While gastropexy can be performed via traditional open surgery, laparoscopic gastropexy offers a minimally invasive approach that can provide several benefits. Laparoscopic gastropexy involves making small incisions in the abdomen and inserting a laparoscope, which is a small camera that allows the veterinarian to visualize the abdominal cavity (Sladakovic & Divers, 2016). The laparoscope also enables the veterinarian to introduce specialized instruments to perform the gastropexy. The stomach is sutured to the abdominal wall using a laparoscopic stapler or suturing device, which is guided by the laparoscope (Goethem et al., 2009).



**Fig. 7 Laparoscopic gastropexy**

Laparoscopic gastropexy offers several advantages over traditional open surgery. First, the smaller incisions used in laparoscopy result in less pain,

reduced bleeding, and a shorter recovery time (Loy Son et al., 2016). Laparoscopy also provides better visualization of the abdominal cavity, allowing for more precise placement of the gastropexy sutures. The laparoscopic approach is less invasive, resulting in less trauma to the tissues and organs of the abdomen (Ganjei, 2022). Finally, laparoscopic gastropexy can be performed as a standalone procedure or as part of other laparoscopic surgeries, such as spay or cryptorchidectomy.

### CONCLUSION

In conclusion, laparoscopy and minimally invasive techniques have revolutionized pet animal surgery by providing safer and more effective treatment options. With the use of specialized equipment and instruments, veterinary surgeons can now perform a wide range of procedures using minimally invasive techniques, resulting in reduced pain, faster recovery times, and improved outcomes. From routine procedures like spay and neuter to more complex surgeries like gastropexy, laparoscopy has become an increasingly popular approach for many veterinarians. However, not all cases are suitable for laparoscopy, and careful patient selection and surgical planning are essential for achieving the best possible outcomes. As the field of veterinary medicine continues to advance, the use of laparoscopy and minimally invasive techniques is likely to play an increasingly important role in improving the health and well-being of pets.

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