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Combined hepatic and splenic biopsies in a dog via gasless using a multidirectional traction platform: case report

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Case Report

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Abstract

Videolaparoscopic collection of samples for hepatic and splenic biopsy is an important diagnostic tool in veterinary medicine. The capnoperitoneum used in conventional laparoscopy can cause relevant physiological changes depending on the pressure used and the patient's condition. This study reports using a multidirectional traction platform for gasless videolaparoscopy to perform hepatic and splenic biopsies in a six-year-old female Siberian Husky with hepatic and splenic ultrasonographic changes. The procedure was performed by videolaparoscopy without CO2 insufflation, using mechanical elevation of the abdominal wall to obtain the working space. Laparoscopic exploration allowed adequate visualization of the organs and collection of representative samples for histopathological evaluation. The procedure occurred without intraoperative or postoperative complications, and the patient was discharged from the hospital on the same day. Histopathological examination revealed chronic degenerative hepatopathy characterized by hepatocellular vacuolar degeneration, periportal fibrosis, and hepatic regeneration nodules, while the spleen showed no relevant changes. The gasless technique proved to be feasible and safe, providing adequate surgical exposure without the need for pneumoperitoneum. Gasless laparoscopy represents a promising alternative for combined diagnostic procedures.

1. INTRODUCTION

The collection of tissue samples for histopathological evaluation plays an essential role in the diagnosis of hepatic and splenic diseases, aiding in the choice of treatment and in the estimation of prognosis (Rothuizen and Twedt, 2009). Although minimally invasive methods, such as fine-needle aspiration (FNA), are widely used, their diagnostic capacity may be limited. Ballegeer et al. (2007) demonstrated that cytology of splenic lesions does not always show agreement with histopathological findings, especially in cases in which evaluation of tissue architecture is necessary. Similarly, Cole et al. (2002) found that hepatic samples obtained by wedge biopsy present greater diagnostic representativeness when compared with those obtained by needle.

As a result, minimally invasive surgery has been widely employed in veterinary medicine due to its various advantages, such as less surgical trauma, reduced postoperative pain, better visualization of anatomical structures, faster patient recovery, and shorter hospitalization time (Culp et al. 2009).

To perform traditional laparoscopy, the creation of pneumoperitoneum is necessary, obtained by insufflating the abdominal cavity with gas, in order to provide adequate working space for the introduction of instruments and execution of the surgical procedure. Carbon dioxide (CO2) is the most commonly used gas for this purpose due to its low cost, wide availability, non-flammability, and high blood solubility, which favors its elimination by the lungs and reduces the risk of complications arising from gas embolism (Duque and Moreno 2015; Mayhew 2018; Neuhaus et al. 2001).

With the aim of minimizing the physiological effects associated with pneumoperitoneum, laparoscopic techniques without gas insufflation, called gasless, were developed. This approach is generally based on

mechanical elevation of the abdominal wall to create the surgical working space, dispensing with the use of carbon dioxide (CO2). Gasless laparoscopy was developed as an alternative to pneumoperitoneum, aiming to reduce cardiorespiratory and hemodynamic changes associated with abdominal insufflation, in addition to minimizing perioperative hypothermia and other complications related to the use of CO2 (Fransson and Ragle 2011).

The application of gasless laparoscopy in veterinary medicine is still limited, with a scarcity of studies evaluating its feasibility and applicability in diagnostic procedures, such as hepatic and splenic biopsy. Thus, it becomes relevant to investigate alternatives that allow obtaining quality hepatic samples associated with less physiological impact for patients. In this context, the present study aims to report a case in which the gasless multidirectional traction platform was successfully employed in combined hepatic and splenic biopsies, highlighting the benefits associated with its use and its potential as an alternative in minimally invasive surgical procedures.

2. CASE REPORT

A six-year-old, 23 kg, spayed female Siberian Husky dog was attended at the University Veterinary Hospital of the Federal University of Santa Maria, referred for hepatic and splenic biopsies by videolaparoscopy. According to the owners, the patient had been under their care since she was a puppy and had a history of seizure episodes since she was two years old, being followed by a specialized neurology service since then. At the time of attendance, the seizure episodes occurred at an approximate frequency of once a month. The patient presented no clinical signs at the time of consultation.

The hepatic and splenic changes observed by ultrasonography that motivated the performance of biopsies were incidentally identified during the diagnostic investigation of an episode of hematuria associated with cystitis. On abdominal ultrasonographic examination, the liver was observed with multiple homogeneous hyperechoic structures distributed throughout the parenchyma, associated with heterogeneous and coarse echotexture. In the spleen, at least two homogeneous intraparenchymal structures were identified, measuring approximately 0.83 × 0.57 cm and 0.60 × 0.30 cm.

The complementary laboratory tests included a complete blood count and serum biochemical profile. In the complete blood count, the observed values were: red blood cells of 5.55 × 10^6/mm^3, hemoglobin of 14.6 g/dL, hematocrit of 43%, mean corpuscular volume (MCV) of 77.0 fL, mean corpuscular hemoglobin concentration (MCHC) of 33.9 g/dL, total leukocytes of 12,700/mm^3, and platelets of 314,000/mm^3, with the presence of platelet aggregates observed. In the serum biochemical evaluation, albumin concentrations of 3.3 g/dL (2.6–3.3 g/dL), total proteins of 7.0 g/dL (5.4–7.1 g/dL), urea of 37.2 mg/dL (21.4–59.92 mg/dL), and creatinine of 1.04 mg/dL (0.5–1.5 mg/dL) were verified. The serum activities of hepatic enzymes were increased, with alanine aminotransferase (ALT) of 200.5 U/L (10–88 U/L) and alkaline phosphatase (ALP) of 614 U/L (20–156 U/L). In the hemostatic evaluation of blood coagulation

time, a prothrombin time (PT) of 9.90 seconds and an activated partial thromboplastin time (aPTT) greater than 60 seconds were observed, evidencing altered blood coagulation.

After anesthetic induction, the patient was positioned in dorsal recumbency. Access to the abdominal cavity began with the introduction of a 10 mm portal inserted approximately 10 cm caudally to the umbilical scar, through which a 5 mm optics with a 30° angle was introduced for inspection of the abdominal cavity. A second 3 mm portal was inserted in the region of the umbilical scar and was subsequently replaced by a 10 mm portal. To obtain the working space, the multidirectional traction platform for gasless videosurgery (Bhio Supply Vet 90000®) was used to traction a 2 – 0 mononylon thread inserted cranially to the second portal and fixed in a hemostatic forceps coupled to the platform, thus suspending the abdominal wall (Figs. 1 and 2).

Source: personal archive

Source: image generated by artificial intelligence

The technique employed provided an adequate working space, allowing good visualization of the abdominal structures and efficient manipulation of the instruments for performing both biopsies. The right and left hepatic lobes were decreased in size, with a cirrhotic, multilobulated appearance and containing multiple whitish areas distributed throughout the parenchyma. Samples were collected from these lobes using a 5 mm laparoscopic pancreatic biopsy forceps (punch-type). During collection, regions of the liver with friable consistency and moderate bleeding were observed, while other regions appeared firmer and with minimal hemorrhage after biopsy (Fig. 3).

Source: personal archive

The spleen presented a coarse and irregular appearance upon laparoscopic inspection. Two splenic samples were collected using a 3 mm biopsy forceps (cup-type). After collection, local bleeding was observed, which was controlled by direct compression with a gauze swab and application of an absorbable collagen hemostatic sponge (hemospon®).

At the end of the procedure, synthesis of the abdominal wall was performed with polydioxanone 2 – 0 in a cruciate mattress pattern. The subcutaneous tissue was approximated with the same thread in a zigzag pattern, followed by dermorrhaphy with mononylon 4 – 0 in a cruciate mattress pattern. No trans- or postoperative complications associated with the procedure occurred, and the patient was discharged from the hospital on the same day. Postoperative medications included tramadol hydrochloride (4 mg/kg, PO, TID, for three days) and dipyrone (25 mg/kg, PO, TID, for four days).

The histopathological examination of the hepatic samples revealed moderate multifocal lipid and glycogen vacuolar degeneration of hepatocytes in all evaluated fragments. In some samples, mild periportal fibrosis was observed, while in one of the fragments, hepatic regeneration nodules associated with marked periportal fibrosis and moderate hyperplasia of bile ducts were identified. The spleen showed no relevant histopathological changes. The findings were compatible with chronic degenerative

hepatopathy, characterized by hepatocellular vacuolar degeneration associated with fibrotic and regenerative changes of the hepatic parenchyma. These lesions are considered to be irreversible and may progress to chronic hepatic failure.

3. DISCUSSION

Although pneumoperitoneum with CO2 is considered safe in most patients, its use may be associated with relevant physiological changes (depending on the patient's clinical condition, volume, and pressure used). It is described that pneumoperitoneum can cause respiratory acidosis, hypercapnia, reduced cardiac output, hypothermia, and increased postoperative pain (Neuhaus et al. 2001; Scott et al. 2020). Furthermore, it is considered one of the main sources of surgical stress during laparoscopy and may represent a relative contraindication in geriatric patients or those with cardiorespiratory diseases, due to lower tolerance to increased intra-abdominal pressure (Marcovich et al. 2001). Regarding cardiovascular changes, the elevation of intra-abdominal pressure caused by pneumoperitoneum reduces venous return and end-diastolic volume, as a result of compression of the vena cava. This results in decreased stroke volume and may lead to a drop in cardiac output if there is no adequate compensation through increased heart rate (Brainard and Hofmeister 2018).

In some cases, the use of pneumoperitoneum can also promote hemodynamic changes that influence the perfusion of abdominal organs. In an experimental study in pigs, Hoekstra et al. (2013) demonstrated that pneumoperitoneum with CO2, maintained at a pressure of 14 mmHg for six hours, can reduce hepatic microvascular perfusion, evidencing the effects of increased intra-abdominal pressure on the blood circulation of the liver. The authors also evaluated a pressure of 25 mmHg, at which the reduction in perfusion was more pronounced. Although the authors did not observe significant functional impairment in healthy animals, such changes may present greater clinical importance in patients with pre-existing hepatic disease, where the preservation of hepatic perfusion during the intraoperative period is essential.

In the present report, the patient presented elevated hepatic enzymes and prolonged coagulation times. Patients with hepatopathies frequently present systemic changes, including coagulation disorders, hypoalbuminemia, metabolic alterations, and reduced capacity for drug biotransformation, factors that can increase anesthetic and surgical risk (Garcia-Pereira 2015). Thus, minimally invasive approaches associated with the absence of pneumoperitoneum may represent an interesting alternative for hepatopathic patients, as they combine the benefits of videosurgery with the reduction of physiological impacts related to increased intra-abdominal pressure.

Furthermore, the use of pneumoperitoneum may be associated with tumor dissemination, which in cases of suspected neoplasms, as in the case reported here, represents a factor of clinical concern, motivating the adoption of intraoperative strategies that minimize this risk, such as the use of the gasless technique. Shen et al. (2008) conducted a study in a murine experimental model, where they observed that pneumoperitoneum favored the growth and intraperitoneal dissemination of tumor cells.

These results support the hypothesis that pneumoperitoneum may influence the implantation of free neoplastic cells in the abdominal cavity. Scott et al. (2020) highlight that injury to the peritoneal mesothelium induced by CO2 may contribute to the implantation of neoplastic cells.

In this context, the gasless technique emerged as an alternative capable of preserving the benefits of minimally invasive surgery without exposing the patient to these physiological changes. The gasless multidirectional traction platform used in this case is composed of an articulated structure and suspension points for the abdominal wall, allowing the creation of working space without pneumoperitoneum. In an experimental study with canine cadavers, the device enabled the correction of diaphragmatic hernias by laparoscopy in all 10 cases, making the technique viable and providing good exposure of the diaphragm (Brun et al. 2022), demonstrating potential use for surgeries in the cranial abdomen.

In a comparative study, Frasson et al. (2014) observed that this gasless technique resulted in a lower occurrence of hypercapnia and a lower need for anesthetics during the intraoperative period when compared to conventional laparoscopy, with no significant differences regarding surgical time and postoperative pain. Furthermore, Fransson and Ragle (2011) reported the successful application of the technique in different laparoscopic procedures performed in dogs and cats, with the need for conversion to laparotomy in two of the 12 cases evaluated.

In a study conducted by Watkins et al. (2013), volume variations between the thoracic and abdominal cavities were compared during CO2 insufflation and abdominal wall elevation using the same device described by Fransson and Ragle (2011). The application of pneumoperitoneum resulted in a significant reduction of thoracic volume, while this change was not observed with the use of the gasless technique. This demonstrates that the volumetric modification suggests changes in pressure transmission through the diaphragm, which may impact the thoracic cavity and compromise pulmonary compliance.

Although gasless laparoscopy is often associated with a smaller working space when compared to pneumoperitoneum, the platform used provided adequate visualization of the liver and spleen, allowing the performance of hepatic and splenic biopsies without relevant limitations. In a study conducted by Milech et al. (2023), the use of the multidirectional traction platform was also able to provide adequate working space and exposure for the safe performance of renal biopsies. These findings suggest that the visual limitation traditionally attributed to the gasless technique can be minimized by the use of multidirectional and self-retaining abdominal elevation devices such as the one employed in this report.

This report describes a single case and therefore has inherent limitations. The absence of a control group and of a larger case series prevents any conclusion on the safety or superiority of this technique compared with conventional laparoscopy. In addition, although the multidirectional traction platform has been previously described for diaphragmatic hernia repair and renal biopsy in dogs (Brun et al. 2022; Milech et al. 2023), none of these studies specifically addressed combined hepatic and splenic biopsy. Therefore, the present findings should be interpreted as a preliminary description of technical feasibility in a single case rather than as evidence of clinical efficacy.

4. CONCLUSION

In this single case, the use of the multidirectional traction platform for gasless videosurgery was feasible and was performed without intraoperative or postoperative complications, allowing adequate visualization of the abdominal cavity and collection of representative samples for histopathological diagnosis. The technique did not require pneumoperitoneum and therefore avoided its potential physiological effects. These findings suggest that gasless laparoscopy may be a potential alternative to conventional neoplasms. However, studies with larger numbers of cases and adequate follow-up are necessary to confirm its safety, efficacy, and applicability.

Declarations

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DECLARATION OF CONFLICT OF INTEREST

Maurício Veloso Brun, Juan Alberto Sánchez-Margallo, and Francisco Miguel Sánchez-Margallo declare that they are the inventors of the gasless device used in this research. They also declare that this did not introduce bias into the report. The other authors declare no conflicts of interest.

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception and writing of the manuscript. All authors critically revised the manuscript and approved the final version.

DECLARATION OF USE OF ARTIFICIAL INTELLIGENCE

During the preparation of this work, the authors used DeepSeek for translation assistance and ChatGPT (an AI language model by OpenAI) to create the illustrative image. After using these tools, the authors thoroughly reviewed and edited the content as needed and take full responsibility for the publication's content.

References

1. Ballegeer EA et al (2007) Correlation of ultrasonographic appearance of lesions and cytologic and histologic diagnoses in splenic aspirates from dogs and cats: 32 cases (2002–2005). J Am Vet Med Assoc 230:690–696
2. Brainard B, Hofmeister E (2018) Anesthesia practice for existing conditions. In: Johnston S, Tobias K (eds) Veterinary surgery: small animal, 2nd edn. Elsevier Inc., St. Louis, pp 288–309

3. Brun MV et al (2022) Use of a new device for gasless endosurgery in a laparoscopic diaphragmatic hernia repair ex vivo canine model: a pre-clinical study. Vet Med Sci 8:460–468. https://doi.org/10.1002/vms3.675
4. Cole TL et al (2002) Diagnostic comparison of needle and wedge biopsy specimens of the liver in dogs and cats. J Am Vet Med Assoc 220:1483–1490
5. Culp WTN, Mayhew PD, Brown DC (2009) The effect of laparoscopic versus open ovariectomy on postsurgical activity in small dogs. Vet Surg 38:811–817. https://doi.org/10.1111/j.1532-950X.2009.00572.x
6. Duque CTN, Moreno JCD (2015) Anestesia e analgesia para videolaparoscopia. In: Brun MV (ed) Videocirurgia em pequenos animais. Roca, Rio de Janeiro, pp 7–20
7. Fransson BA, Ragle CA (2011) Lift laparoscopy in dogs and cats: 12 cases (2008–2009). J Am Vet Med Assoc 239:1574–1579. https://doi.org/10.2460/javma.239.12.1574
8. Fransson BA et al (2014) Cardiorespiratory changes and pain response of lift laparoscopy compared to capnoperitoneum laparoscopy in dogs. Vet Surg 44:7–14. https://doi.org/10.1111/j.1532-950X.2014.12198.x
9. Garcia-Pereira FL (2015) Physiology, pathophysiology, and anesthetic management of patients with hepatic disease. In: Grimm KA et al (eds) Veterinary anesthesia and analgesia, 5th edn. Wiley Blackwell, Ames, pp 720–736
10. Hoekstra LT et al (2013) Effects of prolonged pneumoperitoneum on hepatic perfusion during laparoscopy. Ann Surg 257:302–307. https://doi.org/10.1097/SLA.0b013e31825d5b2b
11. Marcovich R et al (2001) A canine model to assess the biochemical stress response to laparoscopic and open surgery. J Endourol 15:1005–1008. https://doi.org/10.1089/089277901317203100
12. Mayhew P (2018) Fundamentals of laparoscopy and thoracoscopy. In: Johnston S, Tobias K (eds) Veterinary surgery: small animal, 2nd edn. Elsevier Inc., St. Louis, pp 317–324
13. Milech V et al (2023) Gasless laparoscopic renal biopsy in canine cadavers: a preclinical study. Braz J Vet Med 45. https://doi.org/10.29374/2527-2179.bjvm000523
14. Neuhaus S, Gupta A, Watson D (2001) Helium and other alternative insufflation gases for laparoscopy: a review. Surg Endosc 15:553–560. https://doi.org/10.1007/s004640080060
15. Rothuizen J, Twedt DC (2009) Liver biopsy techniques. Vet Clin North Am Small Anim Pract 39:469–480. https://doi.org/10.1016/j.cvsm.2009.02.006
16. Scott J, Singh A, Valverde A (2020) Pneumoperitoneum in veterinary laparoscopy: a review. Vet Sci 7:64. https://doi.org/10.3390/vetsci7020064
17. Shen MY et al (2008) Influence of pneumoperitoneum on tumor growth and pattern of intra-abdominal tumor spreading: in vivo study of a murine model. Hepatogastroenterology 55:947–951
18. Watkins C et al (2013) Comparison of thoracic and abdominal cavity volumes during abdominal CO_2 insufflation and abdominal wall lift. Vet Surg 42:607–612

Figures



Figure 1

Multidirectional traction platform for gasless positioned for laparoscopic procedure combining hepatic biopsy with splenic biopsy.

Source: personal archive

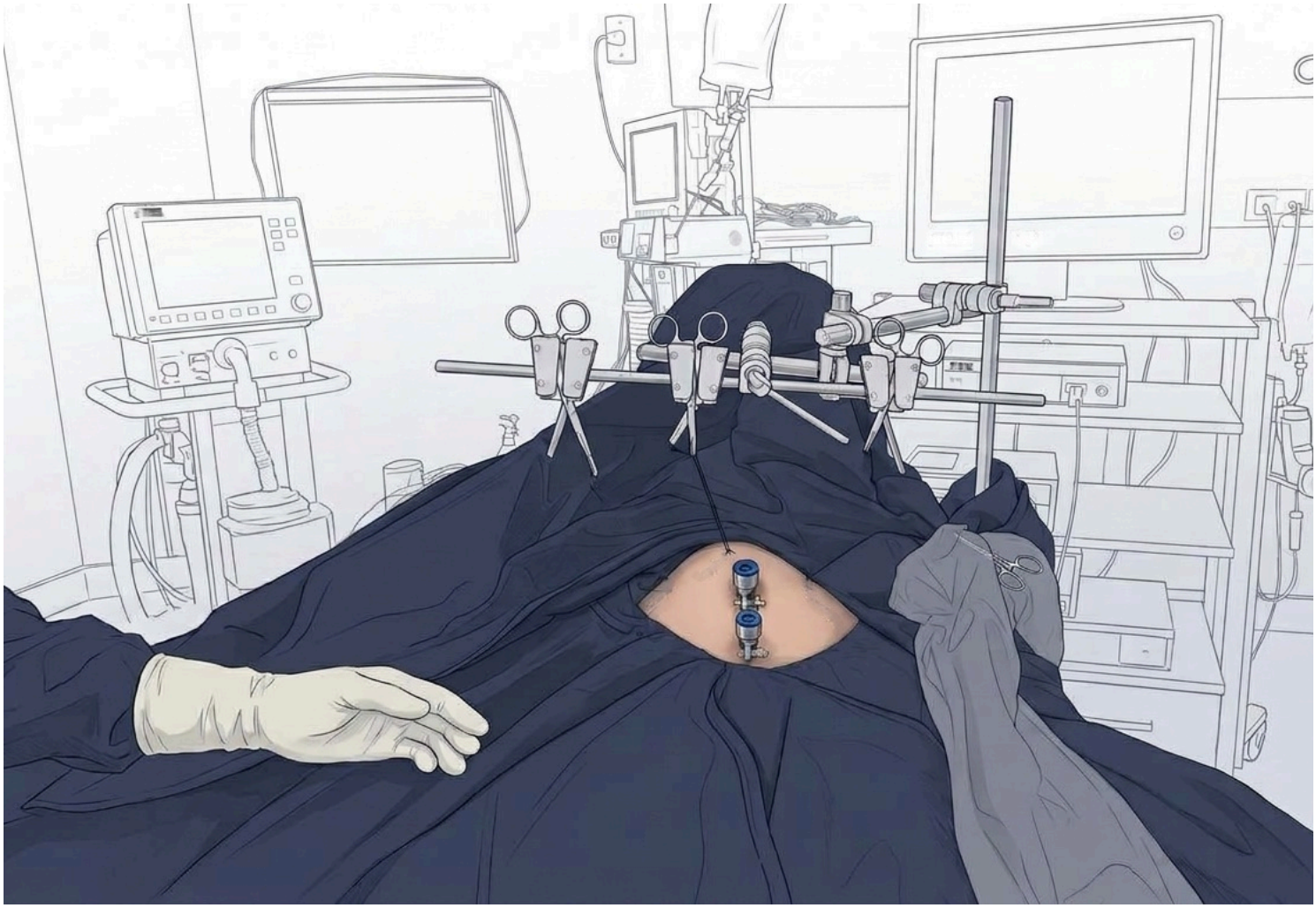


Figure 2

Schematic drawing illustrating the positioning of the laparoscopic portals and of the transparietal traction suture secured to the multidirectional traction platform for combined hepatic and splenic biopsies via gasless laparoscopy in a dog.

Source: image generated by artificial intelligence

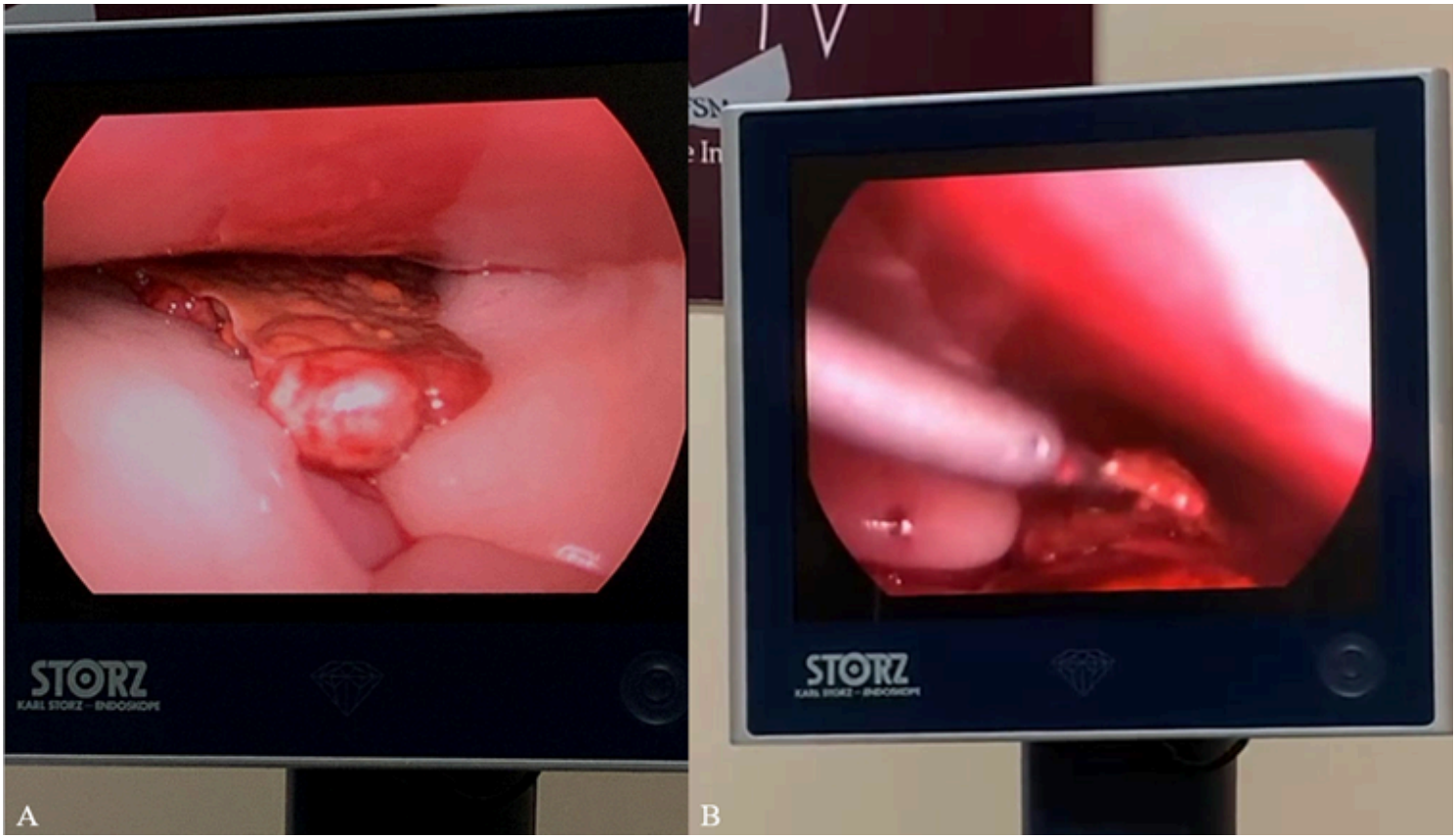


Figure 3

a - Laparoscopic appearance of the abdominal cavity, demonstrating adequate working space provided by the gasless technique and macroscopic changes in the liver. b – Collection of hepatic fragment by means of laparoscopic biopsy forceps.

Source: personal archive