Received: 22 April 2025 | Revised: 14 December 2025 | Accepted: 6 February 2026

DOI: 10.1111/vsu.70091

CLINICAL RESEARCH

WILEY

Laparoscopic repair of peritoneopericardial hernias: Multicentric retrospective case series of 12 dogs and one cat

Federico Massari DVM, GPCert (SASTS), GPAdvCert (SurgOnc), DECVS (Small Animal)[1] | **Gary M. M. Kelly DVM, CertAVP, GPCert(Endo), MRCVS[2]** | **Dario Drudi DVM, DECVS (Small Animal)[1]** | **Paolo Sommaruga DVM[1]** | **Manuel Jiménez Peláez DVM, LV, MRCVS, DECVS (Small Animal)[3]**

[1]DOCVET Clinica Veterinaria Nervianese, Nerviano, Italy

[2]Vetemis Referrals, West MIdlands, UK

[3]AÚNA Especialidades Veterinarias – IVC Evidensia, Valencia, Spain

Correspondence
Federico Massari, DOCVET Clinica Veterinaria Nervianese, Via Rho 2, 20014 Nerviano (MI), Italy.
Email: federicomassari@me.com

Abstract

Objective: To date, there is little evidence on laparoscopic repair of peritoneopericardial diaphragmatic hernias (PPDH). The present study reports on surgical technique considerations, complications and outcome.

Study design: This was a multicentric retrospective cohort study of patients with laparoscopic PPDH repairs, using low-pressure CO_2 insufflation (3–4 mmHg) who were operated between October 2022 to November 2024 in two specialist centers.

Animals: Dog and cat patients were diagnosed with PPDH and treated laparoscopically using low-pressure CO_2 insufflation (3–4 mmHg). Patients were either symptomatic or their owners wished for repair.

Methods: Demographics of patients and details of surgical procedures including follow-up were reported in simple observational statistics. Details of surgical procedures included extent of PPDH, number of ports, insufflation pressure, suture use, use of thoracocentesis with an 18 gauge needle and/or drain, operating and total surgical time, anesthetic and surgical complications during and after surgery and a follow up at 6 months.

Results: Twelve canine and one feline patient were included in the study. One case required conversion to open surgery due to CO_2-induced pericardial tamponade. All patients survived and had no serious complications.

Conclusion: Full laparoscopic repair of PPDH using low insufflation pressure was successfully achieved in 92% (12/13) patients.

Clinical significance: This is the largest case series to report on outcomes of laparoscopic repairs of PPDH. Laparoscopic treatment of PPDH is a viable option without increased risk of complications.

1 | INTRODUCTION

Peritoneopericardial diaphragmatic hernias (PPDH) can be regarded as a subgroup of diaphragmatic defects and are characterized by communication between abdominal cavity and pericardial space, where organs can cause compression of the heart.[1] These are mostly congenital due to abnormal fusion of the transverse septum during embryological development.[2] The high risk breeds appear to be Weimaraner dogs and long-haired cats, particularly Maine Coons.[2] These cases are often incidental findings or have mild symptoms, possibly worsening over long period of time, leading to a late diagnosis.[2] The symptoms are also related to the herniating organs, which are most commonly involving liver, gall bladder and small intestine.[2]

Diagnosis is usually confirmed on imaging, although historically veterinarians had to rely more on physical examination findings such as inspiratory abdominal respiration and the palpation of the apex beat to determine which side thoracotomy was required.[3] Simple radiographs have always been the imaging modality of choice and are widely available, although up to 44% of cases can be missed.[4] The typical radiographic signs are bowel or liver herniating through the chest as well shift in the stomach axis, displacement of the bronchial and tracheal segments.[5] Contrast radiological studies can reveal displacement of the stomach and changes in the stomach filling.[6] Computerized tomography is useful in diagnosing diaphragmatic hernia and becomes essential in differential diagnosis of rare conditions, such as intrathoracic ectopic liver.[7]

Management can be conservative or surgical, depending on the symptoms, time of onset and comorbidities.[8] Organs have to be retracted back into their original cavity and diaphragmatic defect oversewn. This can be rather challenging due to chronic adhesions, which complicate up to 25% of PPDH cases.[2,9] Patients indicated for surgery have often a degree of respiratory or cardiovascular compromise,[8] which makes them even higher risk for general anesthesia. Timing of the surgical repair is driven by the severity of symptoms and chronic cases can be often done electively at the owner's and surgeon's convenience. Historically open surgery has been the modality of choice but with the modern advances in laparoscopy, minimally invasive management started to appear in the literature with reportedly similar outcomes to open procedures.[8,9] Complications from open PPDH herniorrhaphy are well known, ranging from pneumothorax and pneumopericardium to more serious obstructive portal hypertension and cardiac arrhythmias,[2,8,9] but there is very little on outcomes of laparoscopic correction.[10,11] The aim of this retrospective cohort study was to fill the gap in the literature and describe the technique of laparoscopic treatment of PPDH, the possible risks and outcomes in two specialist centers. The objectives were to evaluate surgical outcomes, identify intraoperative challenges, and provide recommendations for optimizing laparoscopic techniques in this context.

2 | MATERIALS AND METHODS

2.1 | Study design

This study was a retrospective observational cohort study including canine and feline patients treated for PPDH in two clinics between October 2022 and November 2024. Other inclusion criteria for the cases consisted of: (1) patient was hemodynamically stable, (2) confirmed diagnosis of PPDH based on imaging studies or intraoperatively, (3) laparoscopic repair was attempted as the primary surgical approach and (4) follow-up was available for 6 months.

2.2 | Treatment administered

All patients underwent laparoscopic repair of peritoneopericardial hernia. Cases with acute presentation were stabilized before surgery and all procedures were done under general anesthesia with multimodal analgesia based on the hospital protocol: (1) Premedication by methadone 0.2 mg/kg (SemfortanVet, Dechra), cefazolin 22 mg/kg (Cefazolina Teva, Teva) and maropitant 1 mg/kg (Prevomax, Dechra); (2) induction with propofol 4–6 mg/kg (Proposure, Boehringer) and maintained with isofluorane (IsoFlo, Zoetis). All animals had transversus abdominis plane (TAP) block with bupivacaine 1.5–2 mg/kg (Bupisen, Industria Farmaceutica Gelnica Senese). Patients were mechanically ventilated with positive end expiratory pressure and monitored as per the Association of Veterinary Anesthetists.[12] Procedures were done by two Board ECVS specialists from two centres with the same hospital setting.

2.3 | Surgical technique

The standardized approach was a three-port technique in dorsal recumbency (Figure 1), using zero or 30° scope. Initial insufflation pressure was 6 mmHg for safe trocar insertion, after which it was reduced to low insufflation pressure (3–4 mmHg) for the surgery to avoid adverse effect on cardiovascular and respiratory functions.

Insufflation pressure was maintained low throughout surgery, particularly after reduction of herniated contents to avoid pneumopericardium and cardiovascular compromise. If hypotension occurred, the pressure was reduced to 3 mmHg or insufflation was temporarily discontinued to restore hemodynamic stability. Both 0° and 30° laparoscopes were employed; the 30° scope provided flexibility in viewing angles, while the 0° scope offered a direct visual field corresponding to the true axis of vision, which was useful in confined spaces.[13]

Adhesions were managed using atraumatic graspers and blunt dissection, with traction–countertraction applied to separate adhesions. Sharp dissection was limited to situations in which blunt methods were insufficient. Bipolar cautery and a vessel-sealing device (LigaSure, Medtronic) were used for vascular adhesions, with care taken to avoid the pericardium and heart.

Suturing was performed with barbed sutures (Stratafix, sizes 0 or 2–0) at an insufflation pressure of 3–

4 mmHg. An endoscopic suturing device (Autosuture Endo Stitch, Covidien) was used for radial diaphragmatic defects, while transverse sutures between diaphragmatic pillars were placed when the defect did not involve the ventral region. For small patients (e.g., cats and dogs <5 kg), the Endo Stitch also facilitated intracorporeal knot tying.

In selected cases, an 18 gauge catheter was placed intraoperatively to maintain controlled decompression and prevent tension pneumopericardium. During suturing, either the catheter or a MILA drain was used to prevent CO_2 accumulation in the pericardial space and to allow evacuation once the diaphragm was sealed. The MILA drain was left in situ postoperatively (Figure 1) and was positioned within the space of the original hernia sac, which represented the pericardial cavity at the site of the congenital defect. Decision for pericardiectomy was considered on a case-to-case basis.

To stratify the level of surgical challenge authors suggested grading of the defects as per Table 1.

2.4 | Measured outcome

Authors reported type and grade of diaphragmatic defect, number of ports, insufflation pressure, needle holder and

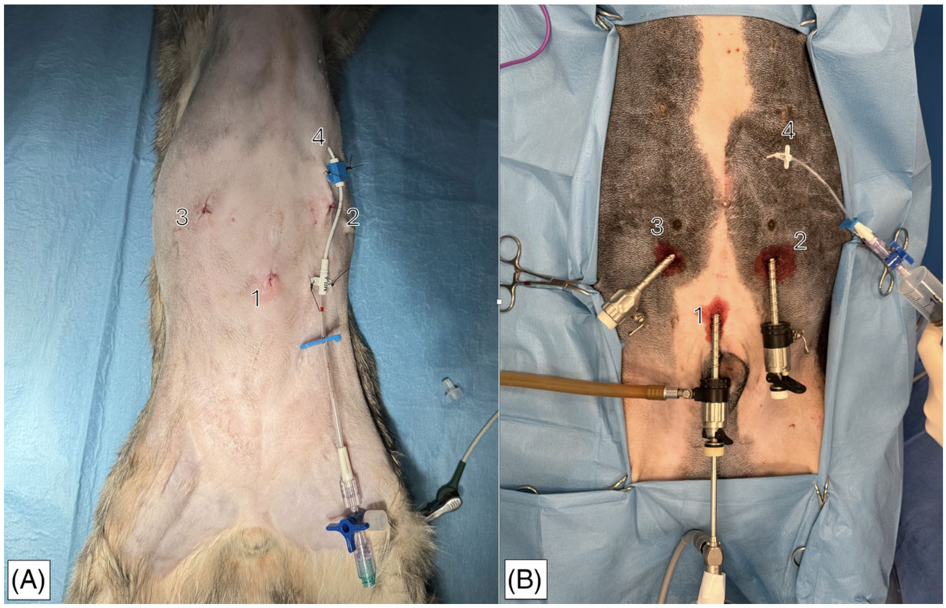

FIGURE 1 Port placement demonstration in feline (A) and canine patient (B). Port numbering: 1. Primary/camera port caudal to the umbilicus, 2. and 3. Paramedial working ports, 4. Pericardiocentesis drain.

TABLE 1 Peritoneopericardial hernia surgical difficulty classification (PPDH-SDC).

	Grade	Description	Surgical repair/technical aspects
Suitable for laparoscopic repair	A – Simple	Minimal/no adhesions; omentum or small liver lobes; reducible; no effusion	Routine repair
	B – Intermediate	Mild adhesions; large liver lobe, gallbladder, or stomach (reducible); mild effusion	Adhesiolysis, possible liver lobectomy, moderately challenging hernia reduction
	C – Complex	Dense and /or vascular adhesions; difficult reduction; small/fibrotic hernia ring; possible pericardiectomy	Advanced adhesiolysis, diaphragmatic reconstruction
NOT suitable for laparoscopic repair	D – Complicated (incarcerated/ischemic)	Irreducible organs; ischemia/necrosis; significant effusion; systemic signs	Emergency surgery, organ resection
	E – Critical (life-threatening)	Strangulation; shock; gastric involvement; cardiac compression	Life-saving emergency intervention

TABLE 2 Anesthesia and hospitalization details.

Breed	Age	Symptoms	Hematologic abnormalities	\Intraoperative anesthesiological complications	Total Anesthesiological time	Postoperative medication	Thoracic drain MILA	ICU[a] recovery	Days of hospitalization
Golder Retriever	0.25	Abdominal bulging, mild symptom	RBC 3.89×10^{12}/L WBC 27.2×10^{9}/L	None	95	Meloxicam 0.2 mg/kg	24 h	12 h	2
Weimaraner	0.85	Acute dyspnea after RTA	ALT 242 U/L	Bradycardia related to heart tamponade, resolved with conversion to open surgery	120	Meloxicam 0.2 mg/kg, Cephazolin 20 mg/kg, Methadone 2 mg/kg	36 h	12 h	3
French Bulldog	1	Incidental	None	None	100	Prednisolone 1 mg/kg, Omeprazole 1 mg/kg, Maropitant 1 mg/kg	None	Not required	1
English Bulldog	1.5	Juvenile dyspnea, mild	None	None	90	Meloxicam 0.2 mg/kg	24 h	12 h	2
French Bulldog	7.55	Incidental	None	None	90	Prednisolone 1 mg/kg, Omeprazole 1 mg/kg, Maropitant 1 mg/kg	None	12 h	2
German Pointer	1	Incidental	None	None	120	Meloxicam 0.2 mg/kg, Co-amoxiclav 20 mg/kg, Methadone 1 mg/kg	None	12 h	2
Weimaraner	1.15	Acute collapse (hunting)	None	None	110	Meloxicam 0.2 mg/kg, Cephazolin 20 mg/kg, Methadone 2 mg/kg	36 h	12 h	2

TABLE 2 (Continued)

Breed	Age	Symptoms	Hematologic abnormalities	\Intraoperative anesthesiological complications	Total Anesthesiological time	Postoperative medication	Thoracic drain MILA	ICU[a] recovery	Days of hospitalization
Labrador Retriever	0.6	Incidental	None	Mild hypotension	110	Meloxicam 0.2 mg/kg, Co-amoxiclav 20 mg/kg, Methadone 1 mg/kg	None	12 h	1
Yorkshire Terrier	3	Incidental	ALT 312 U/L WBC 26.3×10^9/L	None	125	Meloxicam 0.2 mg/kg, Cephazolin 20 mg/kg, Methadone 1 mg/kg	None	12 h	2
Weimaraner	1.25	Incidental	None	None	125	Meloxicam 0.2 mg/kg, Cephazolin 20 mg/kg	None	12 h	2
Cross Breed	0.75	Incidental	None	Mild hypotension	135	Meloxicam 0.2 mg/kg, Co-amoxiclav 20 mg/kg, Methadone 1 mg/kg	None	12 h	2
French Bulldog	0.9	Incidental	None	Mild hypotension	160	Meloxicam 0.2 mg/kg, Co-amoxiclav 20 mg/kg, Methadone 1 mg/kg	None	12 h	2
DSH	1.9	Incidental	None	None	60	Meloxicam 0.2 mg/kg	None	Not required	2

Abbreviations: ALT, alanintransaminase; DSH, domestic short hair; ICU, intensive care unit; RBC, red blood cells; RTA, road traffic accident; WBC, white blood cells.

[a]Intensive care refers to observations done by nursing staff at least every 30 min, including continuous monitoring where possible. In the routine setting (after ICU care oor when not required) observations were done in at least 4-hourly intervals.

TABLE 3 Surgical findings and intraoperative data.

Patient number	Surgical Time (min)	Extra surgical procedure	Herniating content	PPDH-SDC	0° or 30° Scope used	Insufflation pressure for surgery	Ports (number and size)	Intraoperative intrathoracic needle insertion[a]	Type of needle driver used	Surgical suture material	Postoperative complications as per Follette et al.[16]	Long term follow-up with X-rays
1	60	None	Large hernia with intestine and falciform fat without adhesions	Grade B	0° excellent view	3 mmHg	3 × 5 mm	Yes	Angled needle driver	Stratafix 0 (sternal cleft), Stratafix 2–0 (diaphragm)	Skin oedema over the sternal cleft (Grade 2 – Incident managed with a change in operative tactics without consequences for the patient)	Successful outcome, no complications
2	75	Skin flap	Intestine, falciform fat (moderate volume with adhesions, impossible to retract the intestine through the small defect and valve effect, converted)	Grade C	30° suboptimal view	3–4 mmHg	3 × 5 mm	No (technically impossible)	Converted before suturing	Not applicable	Delayed wound healing (grade 1 – Incident managed with minimal change in operative tactics with no consequences to the patient)	Successful outcome, no complications
3	65	BOAS, laparoscopic spay	Falciform fat	Grade A	30°	4 mmHg	2 × 5 mm, 1 × 10 mm	No (not required)	Endo Stitch	V Lock 2–0	None	Successful outcome, no complications
4	60	None	Intestine, falciform fat and omentum	Grade A	30°	4 mmHg	3 × 5 mm	No (not required)	Angled needle drivers	Stratafix 2–0	None	Successful outcome, no complications
5	75	Hiatal hernia correction	Falciform fat, moderate adhesions	Grade B	30°	4 mmHg	2 × 5 mm, 1 × 10 mm	No (not required)	Endo Stitch	V Lock 2–0	None	Successful outcome, no complications
6	50	None	Liver right middle lobe, gallbladder, stomach, spleen, omentum	Grade C	30° excellent view	2–3 mmHg	3 × 5 mm	No (not required)	Straight needle driver	V Lock 2–0	None	Successful outcome, no complications
7	60	None	Sickle-shaped fat adherent to the pericardium	Grade C	30°	4 mmHg	3 × 5 mm + extra 5 mm[b]	No (not required)	Angled needle driver	Stratafix 2-0	None	Successful outcome, no complications

TABLE 3 (Continued)

Patient number	Surgical Time (min)	Extra surgical procedure	Herniating content	PPDH-SDC	0° or 30° Scope used	Insufflation pressure for surgery	Ports (number and size)	Intraoperative intrathoracic needle insertion[a]	Type of needle driver used	Surgical suture material	Postoperative complications as per Follette et al.[16]	Long term follow-up with X-rays
8	45	None	Liver right middle lobe, gallbladder, the spleen, omentum	Grade C	30° excellent view	2–3 mmHg	3 × 5 mm	No (not required)	Angled needle driver	V Lock 2–0	None	Successful outcome, no complications
9	65	None	Small intestines and omentum	Grade A	30° excellent view	2–3 mmHg	3 × 5 mm	No (not required)	Angled needle driver	V Lock 2–0	None	Successful outcome, no complications
10	45	None	Spleen, omentum small intestine	Grade B	30° excellent view	2–3 mmHg	3 × 5 mm	No (not required)	Angled needle driver	V Lock 2–0	None	Successful outcome, no complications
11	55	None	Left lateral liver lobe, small intestine, omentum	Grade B	30° excellent view	2–3 mmHg	3 × 5 mm	No (not required)	Angled needle driver	PDS II 2–0 Ethicon	None	Successful outcome, no complications
12	50	BOAS	Small intestines and omentum	Grade A	30° excellent view	2–3 mmHg	3 × 5 mm	No (not required)	Angled needle driver	V Lock 2–0	Delayed wound healing (grade 1)	Successful outcome, no complications
13	35	None	Right liver lobe	Grade 3[b] Large volume with friable liver	0° excellent view	2–3 mmHg	3 × 5 mm	No (not required)	Endo Stitch	V Lock 2–0	None	Successful outcome, no complications

Abbreviations: DSH, domestic short haired (cat); F, female; FN, female neutered; M, male; MC, male castrated; PPDH, peritoneopericardial diaphragmatic hernia.
[a]Indicated only selected case where pleural space has been opened or breached (high risk of tension pneumothorax during laparoscopic repair).
[b]Added a paraxiphoid port to work in video-assisted mode and free the falciform fat from the peridardial residue. In cases where Endostitch was used, a 10 mm port was required.

suture use, use of thoracic needle and postoperative chest drain, anesthetic and surgical complications as per Follette et al.[14] surgical time and follow up at 10 days and 6 months postoperatively with radiographs to confirm successful correction.

2.5 | Statistical analysis

Measured outcomes are reported in a simple observational manner in number of cases, percentages of the total or subcohorts. Demographics are reported in generic numbers, percentages and means.

3 | RESULTS

3.1 | Patients

Thirteen patients (12 dogs and 1 cat) were included in the study with weight range 4.6–33 kg.

Population details are presented in Table 2.

3.2 | Treatment

All cases (13/13) were treated laparoscopically and one case (7.7%) had to be converted to open surgery due to tension pneumopericardium and bradycardia. A full report is presented in Table 3.

3.3 | Outcome

Hospitalization and anesthetic details are presented in Table 2. Surgical outcomes are presented in Table 3. No serious complications were reported as per Follette et al.[14,15]:

- Grade 1 – Incident managed with minimal change in operative tactics without consequences for the patient (2 cases of delayed wound healing/15.5%)
- Grade 2 – Incident managed with changes in operative tactics without consequences for the patient (1 seroma/7.7%)
- Grade 3 – Incident with further non-life-threatening consequences (0/0%)

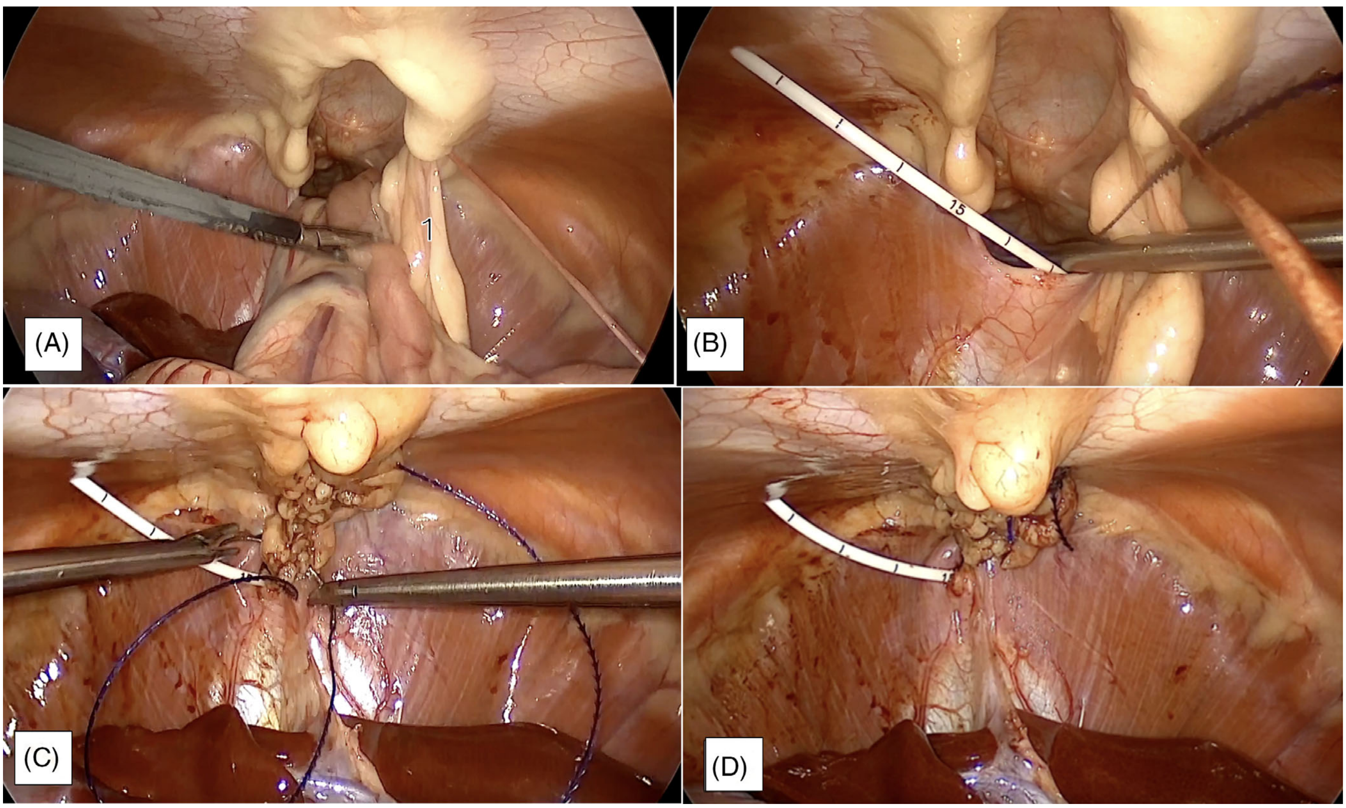

FIGURE 2 Laparoscopic view of cranial abdomen, repair of ventral defect (1) containing intestines and falciform ligament, liver (2) was intact. (A) Gentle traction-countertraction to disengage filmy adhesions. (B) Once hernial content repositioned, MILA drain is inserted to allow open pneumopericardium during suturing and evacuation of remaining CO_2 from the pericardium postoperatively. (C) Endostitch autosuture device used to repair PPDH with barbed suture material (V-Loc). (D) Diaphragmatic defect repaired, drain left in situ.

- Grade 4 – Incident with life-threatening consequences (0/0%)
- Grade 5 – Incident resulting in death (0/0%)

Imaging confirmed successful correction at 6 months in all 13 patients. Most common surgical challenge were adhesions, particularly when they were dense/fibrous, involving liver or heart base. In one case it was necessary to partially resect a liver lobe due to bleeding. The blood loss was within 10% of the calculated patients' volume and no patient needed blood transfusion. No pericardiectomy was performed, based on clinical judgment of the respective surgeons. Grading and hernial content is presented in Table 3 and Figures 2–4.

4 | DISCUSSION

This study represents the most comprehensive published case series series of PPDH repaired by minimally invasive approach. Authors showed that with low insufflation pressure of 3–4 mmHg peritoneopericardial diaphragmatic hernias can be corrected laparoscopically with successful outcome. The surgical time, postoperative outcomes immediately and on long-term follow up are very good, comparable to open surgery. This study also offers new peritoneopericardial hernia surgical difficulty classification (PPDH-SDC), which can be used in the future publications to standardize comparison.

The shortcomings of this study were its retrospective design and limited number of cases due to low diagnostic rate/incidence of PPDH (average 3 cases per year). The authors included only cases suitable for laparoscopic repair, thereby excluding PPDH-SDC grade D (complicated) and E (critical) cases. The classification itself is limited by a degree of subjective assessment from the operating surgeon, although authors did their best to stratify the categories based on objective criteria. The patients were operated on by two ECVS Diplomate specialists with expertise in minimally invasive surgery, which makes these findings difficult to extrapolate to other surgeons whose learning curve in laparoscopy is in the earlier stages. It is, however, sufficient to demonstrate that in skilled hands the technique is feasible, safe and time-efficient and overall comparable to open procedures with similar outcomes.

Laparoscopic correction of PPDH is not well documented in the literature; however, from anecdotal reports, surgeons have encountered severe hypotension due to insufflation-related vagal simulation and bradycardia as well as direct or indirect CO_2 pressure on the heart in PPDH,[16] which is something authors encountered in one case (7.7%). Another issue with insufflation pressure is a potential creation of tension pneumopericardium by one-way insufflation

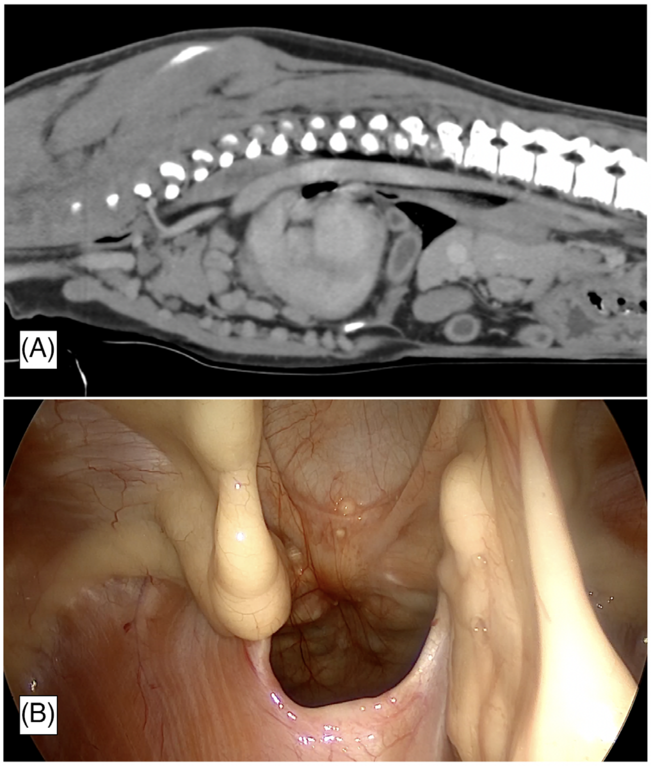

FIGURE 3 Sternal defect. (A) Computed tomography (CT) lateral view demonstrating sternal defect in the diaphragm. (B) Defect in the diaphragm showing malfusion of the diaphragm with the anterior wall.

of the chest cavity, usually aggravated by small size of defect or large volume of abdominal tissues protruding through. This issue can be resolved by a closed insertion of a chest drain or needle to allow open pneumopericardium without the pressure gradually building up. Furthermore, it has been suggested to consider reducing insufflation pressure to 3–4 mmHg once ports have been inserted and generally not exceeding 8 mmHg at any point.[16] This seems to be the lowest pressure to allow sufficient space for decent view, while minimizing cardiovascular compromise. Admittedly, even 3 mmHg of intrapleural pressure was shown in one study to cause decreased venous return with a risk of mild hypotension so caution is always advised.[17,18]

Most authors advise not closing the pericardial sac routinely, as doing so may increase the risk of postoperative effusion or tamponade.[19] Pericardiectomy is primarily indicated when significant pericardial disease is present, particularly when chronic herniation has caused pericardial inflammation, adhesions, or constrictive pericarditis, for which subtotal pericardiectomy has been shown to improve hemodynamic function.[20] Pericardial tissue may also require resection or modification when it is distorted or incorporated into the hernia defect, as demonstrated in cases using pericardial flaps to reconstruct recurrent PPDH.[21] Although evidence is sparse in both dogs and cats, these reports support pericardiectomy

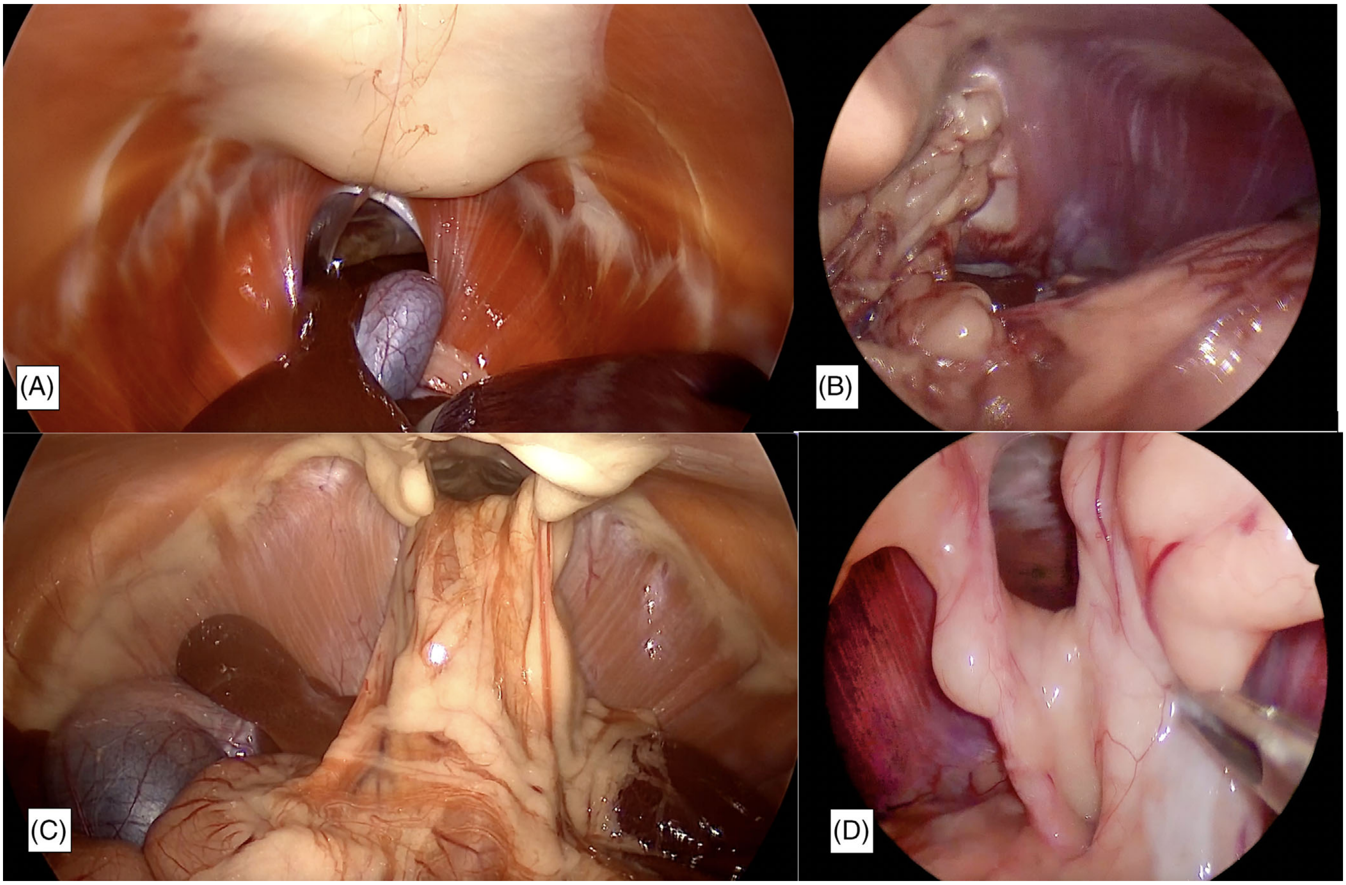

FIGURE 4 Two cases of radial defects (A, B) and peripheral defects (C, D). (A) Hernia at the beginning of surgical repair showing liver herniation with involvement of the gall bladder. (B) Omentum herniating through radial defect. (C) Peripheral diaphragmatic defect containing small bowel and omentum. (D) Defect with vascular omental adhesions.

as a selective adjunct, reserved for patients with documented pericardial pathology rather than as a routine component of PPDH repair.

Another factor to consider is the conformation of the chest. In deep chested patients with ventral PPDH defects, suturing can be done in the naturally created space where the sternum directly lifts, reducing the need for extra lateral space for maneuvering instruments. Expanding on this principle, in "gasless" laparoscopy insufflation can be completely avoided by using a mechanical device to raise the abdominal wall upwards and allow laparoscopic visualization without insufflation.[22]

This study, albeit with limited numbers, has significant implications for the future practice. These findings should encourage surgeons with laparoscopic skills to consider this approach as the first-line approach in stable patients. More research would, however, be beneficial to better stratify the case selection and multicentric cooperation would be advantageous to account for interobserver variability in surgical skills and technique. The occurrence of CO_2-induced pericardial tamponade emphasizes the need for careful intraoperative monitoring and readiness to address complications promptly.

Finally, careful selection of suitable candidates is essential. In this cohort, predominantly simple and intermediate cases were treated, which corresponded with a low incidence of conversion to open surgery and intraoperative complications. PPDH-SDC grades A and B are ideal candidates for laparoscopic repair, grade C is left to the surgeon's discretion, and, in the authors' opinion, grades D and E should primarily be considered for an open approach.

In conclusion, laparoscopic repair of PPDH in dogs and cats with PPDH-SDC grades A, B and C is a safe and effective approach, offering excellent outcomes with minimal morbidity. Using barbed sutures shortens suturing time and together with magnified image and close visualization of tissues makes laparoscopic approach a valid alternative to an open surgery.

AUTHOR CONTRIBUTIONS

Massari F, GPCert SASTS, Diplomate ECVS: Was the lead surgeon and contributed to the acquisition of data, revision of the manuscript for important intellectual content, final approval of the version to be published, and is accountable for all aspects of the work. Kelly GMM, CertAVP, GPCert(Endo), MRCVS: Provided data review and analysis, drafting of the manuscript, final approval of the version to be published, and is accountable for all aspects of the work. Drudi D, DVM Diplomate, ECVS: As part of the surgical team contributed to data collection and analysis, drafting the manuscript including images and figures, final approval of the version to be published, and is accountable for all aspects of the work. Sommaruga P, DVM(behi): As part of the surgical team contributed to design of the study, data collection, critical revision for intellectual content and final approval of the version published, and is accountable for all aspects of the work. Peláez MJ, LV, MRCVS, Diplomate ECVS: Was a lead surgeon and contributed to the design and acquisition of data, revising the manuscript for important intellectual content and final approval of the version to be published, and is accountable for all aspects of the work.

FUNDING INFORMATION

Authors received no funding or support grants for this research.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

REFERENCES

1. Nikiphorou X, Chioti R, Patsikas MN, Papazoglou LG. Peritoneopericardial diaphragmatic hernia in the dog and cat. *J Hellenic Vet Med Soc*. 2018;67(3):189-194. doi:10.12681/jhvms.15638
2. Banz AC, Gottfried SD. Peritoneopericardial diaphragmatic hernia: a retrospective study of 31 cats and eight dogs. *J Am Anim Hosp Assoc*. 2010;46(6):398-404. doi:10.5326/0460398
3. Stokhof AA. Diagnosis and treatment of acquired diaphragmatic hernia by thoracotomy in 49 dogs and 72 cats. *Vet Q*. 1986;8(3):177-183. doi:10.1080/01652176.1986.9694040
4. Minihan AC, Berg J, Evans KL. Chronic diaphragmatic hernia in 34 dogs and 16 cats. *J Am Anim Hosp Assoc*. 2004;40(1):51-63. doi:10.5326/0400051
5. Hyun C. Radiographic diagnosis of diaphragmatic hernia: review of 60 cases in dogs and cats. *J Vet Sci*. 2004;5(2):157-162. doi:10.4142/jvs.2004.5.2.157
6. Lojszczyk-Szczepaniak A, Komsta R, Debiak P. Retrosternal (Morgagni) diaphragmatic hernia. *Can Vet J*. 2011;52(8):878-883.
7. Jeong J, Chang J, Lee S, Kim K, Kim J, Eom K. Radiographic and computed tomographic findings of intrathoracic ectopic liver in a dog. *Vet Radiol Ultrasound*. 2024;65(6):750-754. doi:10.1111/vru.13422
8. Morgan KRS, Singh A, Giuffrida MA, et al. Outcome after surgical and conservative treatments of canine peritoneopericardial diaphragmatic hernia: a multiinstitutional study of 128 dogs. *Vet Surg*. 2020;49(1):138-145. doi:10.1111/vsu.13360
9. Burns CG, Bergh MS, McLoughlin MA. Surgical and nonsurgical treatment of peritoneopericardial diaphragmatic hernia in dogs and cats: 58 cases (1999–2008). *J Am Vet Med Assoc*. 2013;242(5):643-650. doi:10.2460/javma.242.5.643
10. Devereux EA, Scharf VF. Surgical technique and complications associated with laparoscopic pleuroperitoneal diaphragmatic herniorrhaphy in a dog. *Vet Rec Case Rep*. 2023;11(3):e657. doi:10.1002/vrc2.657
11. Scharf VF, Iannettoni M, Anciano C. Laparoscopic peritoneopericardial herniorrhaphy in 2 dogs. *Can Vet J*. 2022;63(9):947-952.
12. Bailey K, Briley J, Duffee L, et al. The American College of Veterinary Anesthesia and Analgesia Small Animal Anesthesia and sedation monitoring guidelines 2025. *Vet Anaesth Analg*. 2025;52(4):377-385. doi:10.1016/j.vaa.2025.03.015
13. Robertson E, Twedt D, Webb C. Diagnostic laparoscopy in the cat. *J Feline Med Surg*. 2014;16(1):5-16. doi:10.1177/1098612X13516567
14. Follette CM, Giuffrida MA, Balsa IM, et al. A systematic review of criteria used to report complications in soft tissue and oncologic surgical clinical research studies in dogs and cats. *Vet Surg*. 2020;49(1):61-69. doi:10.1111/vsu.13279
15. Strasberg SM, Linehan DC, Hawkins WG. The accordion severity grading system of surgical complications. *Ann Surg*. 2009;250(2):177-186. doi:10.1097/SLA.0b013e3181afde41
16. Scharf VF. Laparoscopic treatment of peritoneal–pericardial diaphragmatic hernia. *Vet Clin North Am Small Anim Pract*. 2024;54(4):661-670. doi:10.1016/j.cvsm.2024.02.003
17. Polis I, Gasthuys F, Gielen I, et al. The effects of intrathoracic pressure during continuous two-lung ventilation for thoracoscopy on the cardiorespiratory parameters in sevoflurane anaesthetized dogs. *J Vet Med A Physiol Pathol Clin Med*. 2002;49(3):113-120. doi:10.1046/j.1439-0442.2002.00404.x
18. Daly CM, SwalecTobias K, Tobias AH, Ehrhart N. Cardiopulmonary effects of intrathoracic insufflation in dogs. *J Am Anim Hosp Assoc*. 2002;38(6):515-520. doi:10.5326/0380515
19. Wilkinson R, Chance A. Treating PPDH in cats and dogs. *Vet Times*. 2008;38(28):10-12.
20. Murphy LA, Russell NJ, Dulake MI, Nakamura RK. Constrictive pericarditis following surgical repair of a peritoneopericardial diaphragmatic hernia in a cat. *J Feline Med Surg*. 2014;16(8):708-712. doi:10.1177/1098612X13517113
21. Smolec O, Vnuk D, Brkljača Bottegaro N, et al. Repair of recurrent peritoneopericardial hernia in a dog using polypropylene mesh and an autologous pericardial flap: a case report. *Vet Arh*. 2018;88(3):427-435. doi:10.24099/vet.arhiv.170330a
22. Brun MV, Sánchez-Margallo JA, Machado-Silva MA, Sánchez-Margallo FM. 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*. 2022;8(2):460-468. doi:10.1002/vms3.675

How to cite this article: Massari F, Kelly GMM, Drudi D, Sommaruga P, Jiménez Peláez M. Laparoscopic repair of peritoneopericardial hernias: Multicentric retrospective case series of 12 dogs and one cat. *Veterinary Surgery*. 2026;1-11. doi:10.1111/vsu.70091