Veterinary Record caseReports

TITLE OF CASE
Novel peritoneopericardial diaphragmatic hernia in a dog

SUMMARY

A 23 month old German Shepherd Dog (GSD) with chronic intermittent gastrointestinal signs, presented following acute deterioration compatible with gastrointestinal obstruction and suspected peritoneopericardial diaphragmatic hernia (PPDH). Physical examination revealed depression, abdominal pain, decreased pulse quality, reduced heart sounds and tachypnoea with a shallow breathing pattern. Radiography confirmed PPDH and a granular, 1.3 cm mineral opacity cranial to the cardiac silhouette within the cranioventral thorax. Celiotomy and median sternotomy revealed strangulated jejunum within the cranial mediastinum, cranial to the pericardium. This was resected and herniorrhaphy performed. Post operatively the dog became normal. Midline fusion defects, including the pericardium, can be associated with PPDH and in such cases sternotomy may be required. This is the first report of surgical management of strangulated intestine secondary to an initially conservatively managed PPDH. Mineral opacity on radiography associated with PPDH may represent chronic partial obstruction. This possibly represents a second GSD with Cantrell's Pentalogy.

BACKGROUND

Peritoneopericardial diaphragmatic hernia (PPDH) is the most common congenital pericardial defect in dogs and cats[1]. Incomplete development of the septum transversum leads to persistent communication between the peritoneal cavity and pericardium. Most commonly, the liver, gall bladder and small intestine are reported to herniate[2]. Umbilical herniae, absent sternebrae and less frequently pectus excavatum and intracardiac defects[1] are associated with PPDH.

CASE PRESENTATION

A 23 month old male neutered German Shepherd Dog presented to Queen Mother Hospital for Animals (QMHA) with a life long history of poor weight gain, intermittent vomiting and diarrhoea, which had previously been self-limiting. Past medical history included herniorrhaphy of a ventral midline deficit at 3 months. The referring veterinary surgeon reported visualising the liver upon skin incision during herniorrhaphy.

Four weeks prior to referral, the dog presented to the referring veterinarian due to vomiting and lethargy, he was treated supportively with intravenous fluids for 24 hours. Abdominal radiographs (unavailable for review) reported no abnormality. The dog re-presented three weeks later with vomiting and was managed with intravenous fluid therapy, ranitidine (Zantac; GlaxoSmithKline) and maropitant (Cerenia; Pfizer). Repeat radiography revealed an enlarged cardiac silhouette with a superimposed gas filled viscous. There was an acute deterioration in spite of treatment, prompting emergency referral.

On presentation to QMHA, the dog was of depressed mentation. Physical examination revealed decreased pulse quality, tachycardia, reduced left sided heart sounds, tachypnoea and shallow breathing pattern. Abdominal palpation was painful and subjectively empty; there was a palpable scar immediately caudal to the xiphoid. Body condition score (BCS) was 3/9 and weight was 31.2kg.

INVESTIGATIONS

Venous blood gas analysis was within normal limits other than: hyperlactataemia (2.8mmol/L; reference range 0.6-2.5mmol/L), hypokalaemia (3.2mmol/L; 3.6-4.6mmol/L) and hypochloraemia (104mmol/L; 106-120mmol/L). Coagulation analysis revealed an elevated activated partial thromboplastin time (110.0 seconds; reference range 72.0-102.0 seconds) with a normal prothrombin time (14.0 seconds; reference range 11.0-17.0 seconds).

Radiography confirmed the diagnosis of PPDH; a markedly enlarged cardiac silhouette containing fat, soft tissue and gas opacities. Within the cranial abdomen the liver was reduced in volume and ventral diaphragm outline was poorly visible. The trachea was deviated dorsally. A 1.3 cm speckled mineral opacity was noted in the cranioventral thorax dorsal to the second sternebrae. A sternal defect was present, with only 4 sternebrae identifiable. Intestinal obstruction and possible strangulation was suspected due to the appearance of multiple, variably sized, dilated small intestinal loops (Figure 1).

TREATMENT

Medical stabilisation prior to exploratory surgery consisted of intravenous (iv) fluid therapy (compound sodium lactate) and methadone (Comfortan; Dechra) 0.1 – 0.2mg/kg iv, every four hours. Intraoperative analgesia consisted of fentanyl (Fentadon; Dechra) and lidocaine (Hameln) continuous rate infusions and intercostal loco-regional anaesthesia using ropivacaine (Naropin; Aspen). Cefuroxime (Zinacef; GlaxoSmithKline) 20mg/kg iv was administered at 120 minute intervals perioperatively for prophylactic antibiosis.

Exploratory celiotomy revealed herniation of the jejunum, two liver lobes and the gall bladder cranially through a central ventral diaphragm defect. Bilateral circumferential ventral phrenotomies were required to reduce the liver lobes and gall bladder. Affected liver lobes were pale and atrophic with an irregular surface. Jejunal loops were palpable within the pericardial sac. The majority of the jejunum was reducible, but part of mid jejunum was unable to be withdrawn from the thoracic cavity transdiaphragmaticly. The celiotomy was extended into a median sternotomy. The three most caudal sternebrae were osteotomised with an oscillating saw. The pericardial sac was visibly dilated. Ventral pericardiotomy was performed revealing a large amount of jejunum. The majority of the remaining jejunum was reduced into the abdominal cavity but a firmly adhered loop of jejunum was herniated through a separate additional pre-existing cranial pericardial defect into the cranial mediastinum. Reduction of the jejunum was only achievable by division of the cranial pericardium and mediastinum on the ventral aspect extending into the hernial sac. The jejunum within the cranial mediastinum was strangulated and non-viable therefore an enterectomy and hand sutured end-to-end anastomosis was performed with simple interrupted 1.5 metric polydioxanone suture (PDS).

The pericardium was closed with 2 metric PDS using a simple continuous pattern and a single lumen narrow bore chest tube (MILA) with multiple fenestrations was placed. The circumferential diaphragm incisions were closed with 3 metric PDS and the ventral central congenital defect was closed with 3 metric Prolene in a continuous pattern. The osteotomised sternebrae were closed with 7 metric cerclage wire in a cruciate pattern. The transitional xiphoid process was apposed with 4 metric PDS in a cruciate pattern. Abdominal closure was routine with simple continuous 3.5 metric PDS closure of the linea alba and 2 metric Monocryl (Ethicon) used for continuous subcutaneous and intradermal closure.

Postoperative analgesia included morphine via an epidural catheter with additional intravenous fentanyl and lidocaine continuous rate infusions initially. Dose rates were adjusted according to pain scoring protocols (Modified Glasgow Pain Scale)[3]. The thoracic drain was aspirated every four hours, minimal fluid was produced after the second aspiration, the thoracic drain was removed 48 hours postoperatively. The dog was discharged three days after drain removal.

OUTCOME AND FOLLOW-UP

Surgical recovery was without complication and all previously noted clinical signs resolved. Thirty months post operatively, telephone interview with owner and referring veterinary surgeon revealed the dog continued to be free of all previously noted clinical signs, had gained weight and maintained a normal BCS.

DISCUSSION

This case highlights several previously unreported findings. Strangulation of bowel has been described as a possible sequela with other hernia types, while there are reports of incarcerated bowel including with jejunal torsion secondary to PPDH[4], the authors have been unable to find any primary veterinary literature describing strangulation of the small intestine secondary to PPDH[5, 6]. There is however one report of a successful outcome of intestinal strangulation secondary to PPDH in the human literature[7]. Surgical and conservative management of PPDH has been described, with treatment in part, being based on the degree of clinical signs[8]. This case may subsequently influence treatment strategy when managing a PPDH with intestinal herniation.

Preoperative orthogonal radiographs revealed mineral deposition within the cranioventral thoracic cavity, also visible on the referral radiographs. It is possible that this represents a gravel sign: a clustered mineral opacity that can develop orad to a chronic gastrointestinal obstruction[9]. Given the chronic history of intermittent gastrointestinal signs, it is likely this dog had a chronic partial obstruction secondary to the PPDH. Alternative possibilities include dystrophic calcification secondary to chronic inflammation, reduced venous return, necrosis of the strangulated portion of jejunum[9] or it is possible this is an unrelated incidental finding. The mineralised tissue was not visualised at surgery, however, was likely removed with or within the enterectomy. The significance of this mineralised area remains unclear, but chronic lesions could be considered when such signs are identified preoperatively.

The authors are unaware of any previous cases of PPDH describing herniation through the pericardium to the cranial mediastinum, where in this case, the jejunal loop was strangulated. A cranial mediastinal abnormality is not completely unexpected as multiple midline deficits can be encountered concurrently with PPDH. While PPDH form from abnormalities in septum transversum formation, midline congenital defects are commonly seen concurrently and are considered the result of abnormal embryogenesis[5]. It is plausible this cranial mediastinal abnormality is a variation on these concurrent abnormalities. Such deficits may prevent the reduction of a PPDH through a celiotomy approach alone and should be considered when retrieval of viscera is not possible with gentle manual manipulation.

The midline deficit described in the history likely represents a subxiphoid or ventral hernia given its location and report of the hernial sac containing hepatic parenchyma. The description of a subxiphoid hernia is akin to the description of epigastric herniae in human literature[10]. Epigastric herniae are, in humans, associated with divarification of the rectus abdominis muscle which may have been present in this case but previous herniorrhaphy and the associated fibrosis prevented confirmation. Furthermore human divarification of the rectus muscle can be associated with sternal and diaphragmatic defects (such as pectus excavatum and PPDH), known as Cantrell's Pentalogy [11, 12, 13]. Cantrell's Pentalogy is a rare congenital condition constituting five congenital abnormalities; deficiency of the diaphragm, a midline supraumbilical abdominal wall defect, a defect in the diaphragmatic pericardium, numerous intracardiac abnormalities, and sternal defects, although rarely are all five present together [14]. It is possible this case represents an incomplete form of Cantrell's Pentalogy explaining the subxiphoid hernia, sternal abnormalities, PPDH and cranial pericardial defect.

Cantrell's Pentalogy has been previously reported in a German Shepherd Dog which had a caudal sternal cleft, divarification of the rectus abdominus muscle, patent ductus arteriosus, ventral diaphragmatic and caudoventral pericardial defects, and persistent left cranial vena cava[15]. A three stage classification system, adapted from human literature, was described in that report categorising their case as incomplete expression of Cantrell's Pentalogy [13, 15].

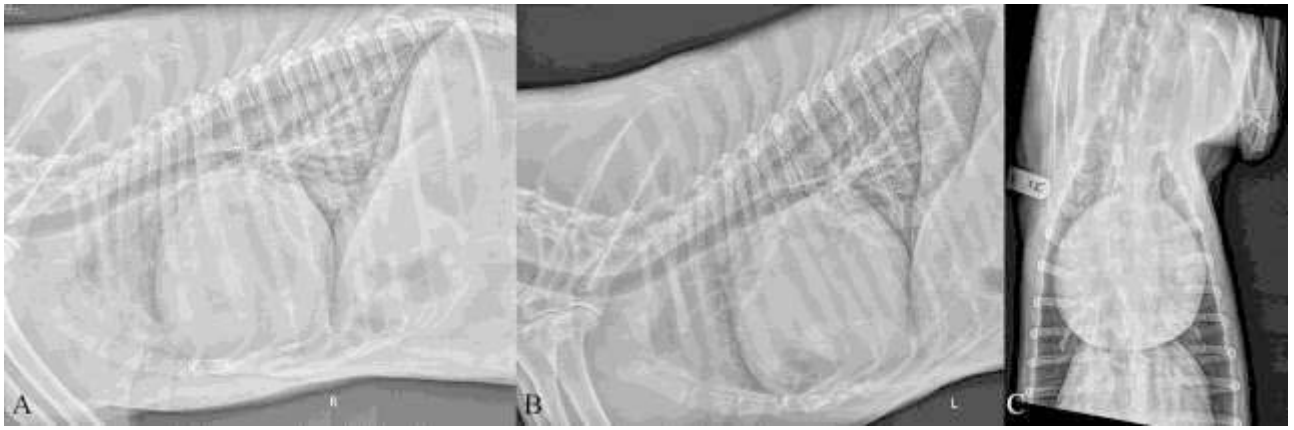
The cranial pericardial defect described here could represent another manifestation of the midline fusion anomaly seen in Cantrell's Pentalogy which would be an unclassified lesion in the modified system. Due to the absence of a cardiac murmur, echocardiography, which could help clarify, was not performed. Given the broad definition of incomplete expression of Cantrell's Pentalogy, the rarity of this disease and the relative frequency in which sternal abnormalities and midline hernias are also seen with PPDH[1, 4, 13]; it is possible that all these abnormalities are associated midline fusion defects with the cranial pericardial defect an additional novel defect rather than this representing a second case of Cantrell's Pentalogy. Peritoneopericardial diaphragmatic herniae are associated with midline fusion defects and median sternotomy may be required to facilitate herniorrhaphy, especially if other midline deficits are present as in this case. Treatment recommendations should reflect current signs but intestinal strangulation is a possible sequalae of conservative management. Although uncommon, mineral opacity on radiography could reflect the location of an obstruction.

LEARNING POINTS/TAKE HOME MESSAGES

When considering management options for PPDH cases, there should be an awareness that intestinal entrapment can result in strangulation Sternotomy may be required for safe reduction of viscera, particularly if additional midline deficits are present PPDH may be associated with multiple congenital abnormalities. This possibly represents a second German Shepherd Dog with Cantrell's Pentalogy

FIGURE LEGENDS

Figure 1. Preoperative thoracic radiographs. (A) Right lateral, (B) left lateral and (C) ventrodorsal views. Showing an enlarged cardiac silhouette containing mixed opacities, dorsal deviation of the trachea and poor definition of the diaphragm ventrally. There are dilated small intestinal loops and a 1.3 cm speckled mineral opacity in the cranioventral thorax dorsal to the second sternebra best visualised on the right lateral view.



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