ECRONICON OPEN ACCESS

EC VETERINARY SCIENCE
Case Report

Urohemoperitoneum As A Result of Multi-Organ Injury Following Vehicular Trauma in A Dog

Darby W Walmsley[1]*, Merrin A Hicks and Simon T Kudnig

Animal Referral Hospital, Essendon Fields. Hargrave Avenue, Essendon Fields, Melbourne, Australia

***Corresponding Author:** Darby W Walmsley, Animal Referral Hospital, Essendon Fields, Hargrave Avenue, Essendon Fields, Melbourne, Australia

Received: July 08, 2019; **Published:** July 26, 2019

Abstract

The authors describe the investigation and management of urohaemoperitoneum as a result of multi-organ injury following vehicular trauma in a 2-year-old spayed female Husky. Abdominal ultrasonography and abdominocentesis identified grossly haemorrhagic free peritoneal fluid with a haematocrit and total protein of 12 l/L and 11 g/L respectively, consistent for haemoperitoneum. Creatinine and potassium ratios were consistent with uroperitoneum. A positive-contrast retrograde urethrocystogram was compatible with urinary bladder wall rupture. Exploratory coeliotomy identified a ruptured bladder, avulsed left ureter, and ruptured spleen with active haemorrhage, as well mesenteric avulsion resulting in ischaemic necrosis of a segment of jejenum. Surgical intervention was achieved by bladder wall repair, ureteroneocystostomy, total splenectomy, and intestinal resection and anastomosis. The dog was successfully discharged from hospital 5 days post-operatively. Urohaemoperitoneum is a rare but possible complication following vehicular trauma, and to the authors knowledge, this is the first case report describing urohaemoperioneum in the veterinary patient.

Keywords: *urohaemoperitoneum; haemoperitoneum; haemorrhage*

Introduction

Vehicular trauma is a common and well-documented presentation in veterinary emergency medicine, with reported overall mortality in dogs as high as 36% [1,2]. The most frequent manifestation of injury includes long bone fractures, pulmonary contusion, soft tissue injury, pelvic fractures, and haemoperitoneum [2]. Intra-abdominal injury following vehicular trauma reportedly accounts for 27% of all injured regions [3], with pathological lesions most likely to involve the liver, spleen and kidney. As vehicular trauma is typically high-energy in nature, up to 71% of cases following vehicular trauma present with comorbidities [2].The development of peritoneal effusion is a common consequence following trauma, with dogs most commonly developing haemoperitoneum and uroperitoneum [4,5], however the presence of multiple effusion types is infrequently reported despite concomitant multi-organ injury.

Urohaemoperitoneum in people is a rare but possible complication following severe polytrauma and severe endometriosis [6]. To the authors knowledge, urohaemoperitoneum has not been described in the veterinary patient. We describe the presentation, investigation, and successful management of urohaemoperitoneum as a result of multi-organ injury in a dog following vehicular trauma.

Case Summary

A 2-year-old spayed female Husky cross, weighing 27 kilograms, presented to an emergency and referral hospital following vehicular trauma, occurring immediately prior to presentation. Initial visual examination findings revealed the patient to be non-ambulatory with an obtunded mentation, situated in lateral recumbency. Evaluation of vital signs identified normothermia (38.3°C), tachypnoea (respiratory

rate 40) with normal lung sounds, and mild tachycardia (140 beats per minute). Physical examination abnormalities included pale white and tacky mucous membranes, prolonged capillary refill time, weak femoral pulses, decreased skin turgor, bilaterally miotic pupils, and multiple abrasions evident over the ventral abdomen and upper left lip. Deep pain perception was present to both thoracic and pelvic limbs. No obvious fractures or luxations were evident on orthopaedic examination. A total Animal Trauma Triage score of 6 was attributed to the patient.

The patient was admitted into hospital for initial stabilisation and further investigation. Pulse oximetry on room air was 97%, with an initial systolic blood pressure[a] of 80 mmHg. Initial haematocrit (HCT) and total protein (TP) were 43 l/L and 62 g/L, respectively. Initial peripheral venous blood sampling identified a moderate metabolic acidosis (pH 7.21; reference 7.31 – 7.42), moderate hyperlactaemia (7.8mmol/L; reference (0.0 - 2.0), mild hyperchloraemia (117mmol/L; reference 105 – 115), and mild hyperglycaemia (6.4 mmol/L; reference 3.0 – 6.0). Biochemistry was also performed and revealed a mildly elevated creatinine (162 µmol/L; reference 44 – 159), ALT (371 U/L; reference 10 - 125), and AST (302 U/L; reference 0 – 50). Thoracic-Focused Assessment with Sonography for Trauma (T-FAST) and Abdominal-Focused Assessment with Sonography for Trauma (A-FAST), performed by a Board-certified Emergency and Critical Care Specialist in accordance with standard techniques [7,8] were unremarkable at the time of presentation.

Initial therapy comprised of isotonic crystalloid bolus (Lactated Ringer's solution[b]; 40 ml/kg intravenously [IV]) in addition to7% hypertonic saline (3 ml/kg I) methadone[c] (0.2mg/kg IV every 4 hours), and amoxicillin-clavulonic acid[d] (12.5mg/kg subcutaenously [SC] every 24 hours). A transdermal fentanyl patch[e] (100mcg/kg/min) was also placed for further analgesia. Following the fluid bolus, intravenous fluid therapy was subsequently reduced and maintained at 5ml/kg/hr. Repeat venous blood sampling two hours following presentation identified a normal pH (7.36), normal blood lactate (1.2mmol/L), mild hyperchloraemia (120mmol/L), and mild hyperglycaemia (7.0mmol/L), mild anaemia (34 l/L) and normal total protein (55g/L). Survey thoracic radiography (left lateral, right lateral, ventrodorsal projections) was unremarkable, and abdominal radiography (left lateral, right lateral, ventrodorsal projections) revealed reduced abdominal serosal detail.

Following an initial stabilisation period, the patients' cardiovascular status was deemed appropriate due to normalised perfusion parameters including mentation. Secondary survey found discomfort on abdominal palpation. Multiple episodes of regurgitation were observed, with a metoclopramide[f] constant rate infusion (CRI) started at 0.08mg/kg/hour. Repeat venous blood sampling 6 hours post-presentation found a more significant anaemia of 31 l/L and mild hypoproteinaemia of 48 g/L.

Given a decreasing trend of peripheral HCT and TP in the 6 hours since admission, a repeat A-FAST was performed by the same operator and confirmed the presence of a moderate peritoneal effusion. A comprehensive ultrasound was subsequently performed with the pertinent finding to be a large amount of echogenic peritoneal fluid (Figure 1), most notable in the upper left abdominal quadrant in the region of the stomach and near the spleen. The free peritoneal fluid was measured in 4 regions: left upper quadrant (7.85cm) (Figure 1A), right upper quadrant (4.27cm) (Figure 1B), left lower quadrant (4.71cm) (Figure 1C), and right lower quadrant (4.54cm) (Figure 1D). The spleen had a diffuse mottled and heterogenous echogenicity, with a small hyperechoic nodule evident on the tail of the

[a]Ultrasonic Doppler flow detector, Parks Medical Electronics, Inc. Aloha, Oregon 97078, United States

[b]Hartmann's, Baxter Healthcare Pty Ltd, Old Toongabbie NSW, 2146, Australia

[c]Methadone, Ilium, Troy Laboratories Australia Pty Ltd, Glendenning NSW, 2761, Australia

[d]Clavulox, Zoetis Australia Pty Ltd, Rhodes NSW, 2138, Australia

[e]Durogesic 100, Janssen-Cilag Pty Ltd, Macquarie Park NSW, 2113, Australia

[f]Coag Dx Analyser, IDEXX Laboratories Australia, Rydalmere NSW, 2116, Australia

spleen. At the time of ultrasonography, no organ fracture was apparent, although the large amount of free peritoneal fluid made complete examination of the abdominal viscera challenging. Ultrasound-guided abdominocentesis yielded a grossly haemorrhagic fluid. Evaluation of peritoneal fluid (Table 1) revealed a HCT of 12 l/L, TP 11 g/L, creatinine 1521 µmol/L (reference: 44 – 159), potassium 9.1 mmol/L (reference: 3.7-5.8). Comparative peripheral blood evaluation identified a HCT of 33 l/L, TP 49 g/L (similar to 1 hour prior), creatinine 190 µmol/L, and potassium 4.4 mmol/L (Table 1). Creatinine and potassium ratios [5,6] were consistent with urinary tract leakage and uroperitoneum, with the combined presence of blood within the effusion, equal to that of 38.7% of the peripheral PCV [9] suggestive of a urohaemoperitoneum. Activated partial thromboplastin time (aPTT) was normal at 97.0 seconds (reference: 72.0 - 102.0)[g].

	Peritoneal Effusion	Serum
Gross Appearance	Hemorrhagic	N/A
Hematocrit	12 I/L	33 I/L
Total Protein	11 g/L	49 g/L
Creatinine	1521 µmol/L	190 µmol/L
Potassium	9.1 mmol/L	4.4 mmol/L

Table 1: *Evaluation of peritoneal effusion obtained by abdominocentesis compared to serum.*

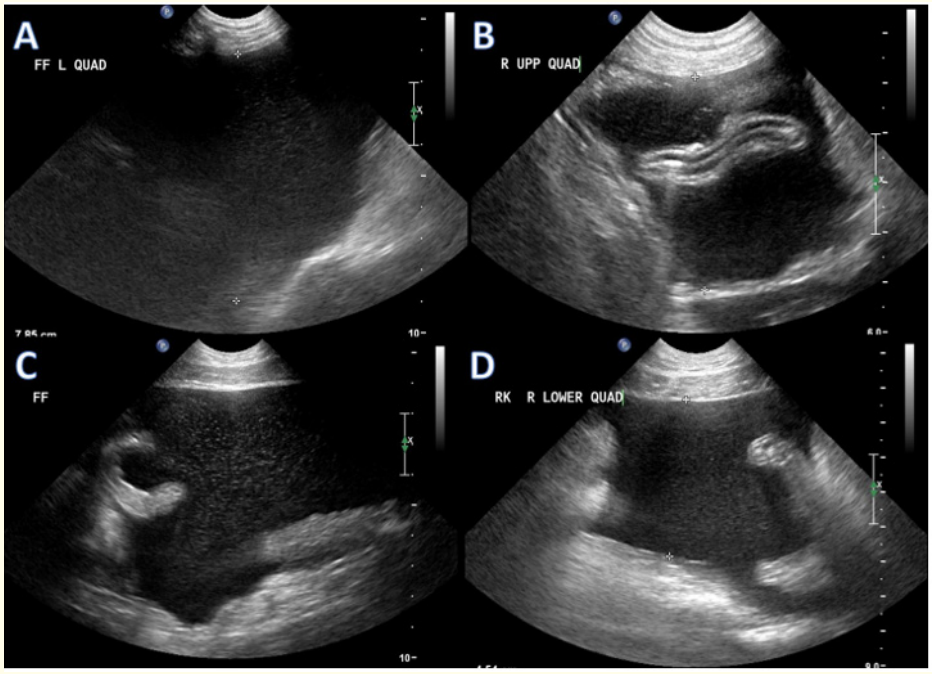

Figure 1: *Comprehensive ultrasonographic examination identifying a large volume of free abdominal fluid within the left upper (A), right upper (B), left lower (C), and right lower (D) abdominal quadrants*

[g]Metomide, CEVA Animal Health Pty Ltd, Glenorie NSW, 2157, Australia

A urinary catheter was placed using an aseptic technique, with grossly haemorrhagic urine voided. A positive-contrast retrograde cystourethrogram was performed by instilling 25ml of Iohexol contrast media[h] into the urethra and bladder. The images were reviewed by a resident in diagnostic imaging, noting a mild-moderate amount of positive contrast characterised by an amorphous appearance extending cranially and dorsally from the urinary bladder that is compatible with urinary bladder wall rupture secondary to trauma (Figure 2A). Abdominal exploratory surgery was recommended given the evidence of urinary bladder rupture as well as the high index of suspicion of persistent intra-abdominal haemorrhage.

Methadone (0.2mg/kg IV) was administered for premedication, and the patient induced with Propofol[i] (4mg/kg IV). Anaesthesia was maintained with Isoflurane[j]. A fentanyl[k] CRI (10mcg/kg/hr IV) was administered intra-operatively. A midline ventral coeliotomy was performed from xiphoid to pubis. A large amount of grossly haemorrhagic fluid was immediately visible and suctioned from the abdomen. The pertinent findings of exploratory coeliotomy included a ruptured bladder in two places (at the apex and on the left side adjacent to the apex) (Figure 3B), an avulsed left ureter (Figure 3B), splenic rupture with active haemorrhage (Figure 3A), a rupture of the mesenteric attachment to a segment of jejunum with ischaemic necrosis of the affected segment of jejunum (Figure 3C), generalised peritonitis and swelling of the retroperitoneal space. Using a ligasure vessel sealing device[l], the omental vessels to the spleen were ligated and divided. The splenic artery was ligated with a 3/0 PDS[m] encircling suture and a 3/0 PDS transfixation suture. The splenic vein was double ligated with 3/0 PDS encircling sutures. A small hole at the apex of the bladder was identified and sutured with 4/0 PDS in a simple interrupted pattern. The main defect in the bladder was debrided and enlarged, exposing the mucosal surface of the dorsal aspect of the bladder. The remaining segment of the left ureter was exposed, the end of the ureter transected and brought through into the lumen of the bladder. The ureter was then spatulated and sutured to the bladder mucosa using simple interrupted 5/0 PDS sutures. The bladder defect was then closed with 4/0 PDS in a simple continuous pattern. To reduce tension on the ureter, a cystopexy was performed with the urinary bladder sutured to the left abdominal wall using multiple 3/0 PDS mattress sutures. The right ureter appeared to be intact. The segment of avascular jejunum was isolated. The arcuate vessels to the affected segment were divided with the ligasure and crushing clamps were placed and the affected segment was removed. The mesenteric borders were apposed and a functional end-to-end anastomosis performed with a Gastrointestinal Anastomosis (GIA)[n] 50 stapler. The ends of the anastomosis were stapled with a TA 55 3.5mm stapler[o] (Figure 2B) and oversewn with a 4/0 PDS simple continuous suture (Figure 3D). The distal aspect of the anastomosis was reinforced with a simple interrupted 3/0 PDS suture. The abdomen was flushed copiously and a routine multilayer closure performed. An indwelling urinary catheter was placed. Post-operative analgesia was maintained with a fentanyl CRI (3mcg/kg/hr, IV) and a transdermal fentanyl patch, with voluven[p] boluses implemented due to intra-operative hypotension.

[h]Omnipaque, GE Healthcare Australia Pty Ltd, Parramatta NSW, 2150

[i]Lipuro 1%, Braun Australia Pty Ltd, Bella Vista NSW, 2153, Australia

[j]Isoflo, Zoetis Australia Pty Ltd, Rhodes NSW, 2138, Australia

[k]Sublimaze, Janssen-Cilag Pty Ltd, Macquarie Park NSW, 2113, Australia

[l]Ligasure™, Medtronic Corperate, Macquarie Park NSW, 2113, Australia

[m]PDS, Johnson and Johnson Pacific Pty Ltd, Broadway NSW, 2007, Australia

[n]GIA Stapler, Medtronic Corperate, Macquarie Park NSW, 2113, Australia

[o]TA stapler, Medtronic Corperate, Macquarie Park NSW, 2113, Australia

[p]Voluven, Fresenius Kabi Australia Pty Ltd, Mount Kuring-gai NSW, 2080, Australia

Post-operatively, the patient developed progressive hypotension, unresponsive to fluid boluses, was managed with a noradrenalin[q] CRI (6ug/kg/hour IV). Further, no urination was observed overnight. Repeat A-FAST (1 day following surgery) revealed a large volume of free fluid within all four quadrants of the abdomen, with bladder visibility decreased. Abdominocentesis yielded a serosangiounous fluid, and analysis of peritoneal fluid identified a TP of 12 g/L, elevated potassium (8.8 mmol/L), and elevated creatinine (940 umol/L). When creatinine-potassium ratios were compared with serum values, the effusion was consistent with persistent uroperitoneum. Under fentanyl sedation (3 mcg/kg, IV) and subcutaneously-administered Lignocaine[r], a Jackson Pratt drain[s] was placed 2 cm caudal and 2 cm lateral to the umbilicus, with 1.2L of free abdominal fluid drained immediately following placement. An indwelling urinary catheter was also placed to allow for monitoring of urine output during the post-operative period. Urine sediment evaluation identified the presence of cocci (1 per high powered field). Repeat positive contrast intravenous pyelogram and urethrocystogram performed at day 2 post-operatively confirmed appropriate integrity of the bladder wall with no evidence of contrast leakage (Figure 2B). The authors suspect that the most likely cause for ongoing uroperitoneum to be leakage from the bladder repair sites during the early postoperative period. Oral amoxicillin-clavulonic acid (12.75mg/kg) was added to the treatment protocol under the suspicion of a urinary tract infection. The dog was otherwise bright, alert, afebrile, stable, and eating. No further regurgitation was evident, and therefore the metoclopramide CRI was ceased. Transdermal fentanyl (100mcg/kg/hr) was ongoing, with firocoxib[t] (2mg/kg orally) were administered supplementarily.

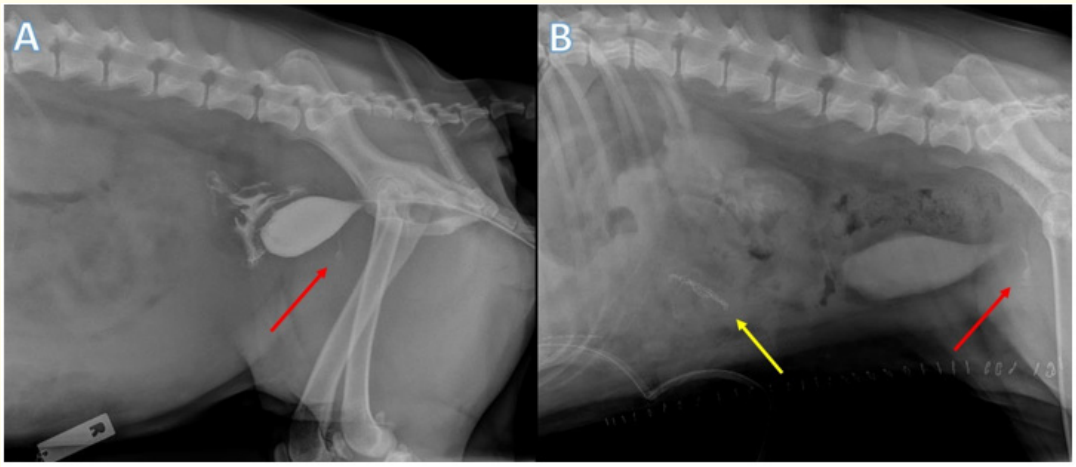

Figure 2: *Positive-contrast retrograde cystourethrogram, as seen on lateral abdominal radiographic projections, identifying positive contract extending cranially and dorsally from the urinary bladder pre-operatively (A), and absence of leakage of positive contrast post-operatively (B).*

** Yellow arrow indicates the location of end-to-end anastomosis utilising the GIA and TA Stapler. ** Red arrow indicates the location of a mineral opacity, unrelated to the urinary bladder, which is apparent within the caudal left abdominal wall on ventrodorsal projection. Suspect foreign material (eg. gravel) following vehicular trauma.*

[q]Adrenaline-Link, Link Medical Products Pty Ltd, Warriewood NSW, 2102, Australia

[r]Lignocaine 20, Ilium, Troy Laboratories Australia Pty Ltd, Glendenning NSW, 2761, Australia

[s]Jackson Pratt Drain, Medline Internationl Two Pty Ltd, Marsden Park NSW, 2765 Australia

[t]Previcox, Merial Australia Pty Ltd, North Ryde NSW, 2113, Australia

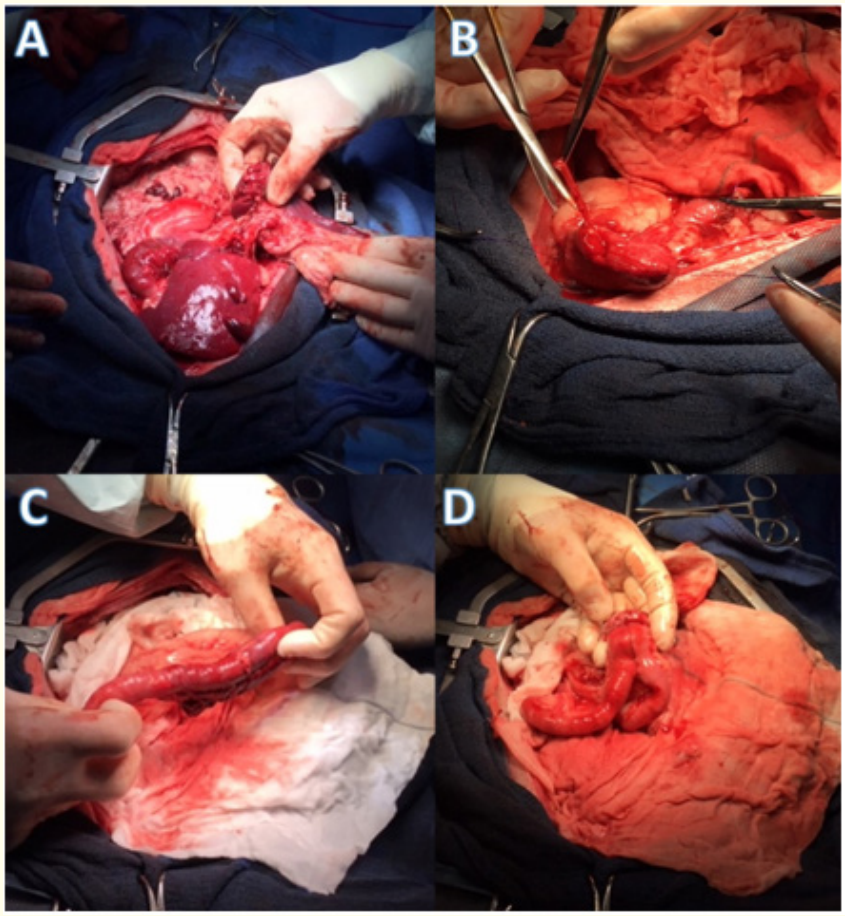

Figure 3: *Intra-operative images following ventral celiotomy that identify a splenic rupture (A), ruptured urinary bladder and avulsed left ureter (B), and mesenteric avulsion resulting in ischemic necrosis of a segment of jejenum (C). The segment of jejnum was resected and an end-to-end anastomosis performed using a GIA and TA Stapler (D).*

Ultrasonographic examination of the abdomen at day 3 postoperatively found only a small volume of abdominal effusion present. Repeat venous blood gas demonstrated a mild hypokalaemia (3.6 mmol/L), mild hyperchloraemia (116 mmol/L), and a mild hyperglycaemia (7.2 mmol/L). Clinically, the patients' vital parameters remained within normal limits and mentation markedly improved from preoperatively. Output from the Jackson Pratt drain ranged between 2.72 – 3.62 ml/kg/hour overnight before reducing to 0.25 – 0.63ml/kg/hour by day 4. The Jackson Pratt drain and urinary catheter remained indwelling until day 4 post-operatively when peritoneal effusion was no longer clinically significant and urine output remained consistently between 1-2ml/kg/hr.

Continued clinical improvement, absence of ongoing abdominal effusion, and near complete resolution of all laboratory abnormalities prompted discharge from hospital on day 5. The patient was discharged with oral amoxicillin-clavulonic acid (12.75 mg/kg) and firocoxib (2 mg/kg), returning for reexamination 14 days following discharge. The owner was pleased with the patients' progress at this time, expressing no concerns at the time of follow-up. Additional telephone follow-up 4 months following surgery confirmed that the patient was doing well at home, with no complications reported.

Discussion

Peritoneal effusion is a recognised and common sequalae to intra-abdominal trauma, with respective management strategies described elsewhere [4,5,9]. Concurrent intra-abdominal injuries has been infrequently reported to result in combined abdominal effusions [10]. Haemoperitonium is the most common type of abdominal effusion following blunt trauma, occurring in 12-44% of trauma patients [1,2,4,9,10,13], followed by uroperitoneum in 2-3% of trauma cases [1,2,5,9,10,16,19].

Motor vehicle trauma is the leading traumatic aetiology of haemoperitoneum, with the liver and spleen most commonly and most severely affected by blunt trauma [11,12]. Lacerations to both the liver and spleen following blunt trauma often lead to severe and life-threatening abdominal haemorrhage because of their high degree of vascularity. Although a less common cause, isolated renal trauma can additionally result in haemoperitoneum [11]. The urinary bladder is similarly susceptible to damage following blunt trauma, and although somewhat protected by the pelvis when empty, caudoventral abdominal trauma accompanied by urinary bladder distension can rapidly increase intra-peritoneal pressure and result in urinary bladder muscle fibre stretching and urine leakage [10]. Further, traumatic pelvic fractures may result in uroperitoneum through rupturing of the bladder, proximal urethra, and ureter(s) [5,9,10]. Interestingly, the development of secondary haemoperitoneum was much more likely than that of uroperitoneum following intrapelvic trauma [10].

Reports suggest that, although the need for emergency surgical intervention in response to traumatic haemperitoneum can be rare [13], emergency surgery is warranted if a patient cannot be stabilised by volume expansion, blood products and counter-pressure [4]. An increasing trend in the abdominal HCT that parallels a decreasing trend in the peripheral HCT indicates ongoing or active haemorrhage that warrants investigation by exploratory laparotomy if the patient is unresponsive to conservative management. Mortality associated with haemoperitoneum following blunt trauma has been reported in dogs with encouraging results. Mongil., *et al.* [11] noted an overall survival rate of 67% for patients treated by surgical intervention, with such results similarly supported by Lux., *et al.* [13]. with an overall survival rate of 83.4% for those managed surgically. Mongil., *et al.* [11] also identified that the decision to perform an exploratory laparotomy was not found to correlate with survival.

Conservative management of uroperitoneum in veterinary patients with urinary diversion is often advocated during initial stabilisation prior to attempting surgical intervention, although this often prolongs hospitalisation and may increase the risk of electrolyte derangements and impaired cardiac and renal function [9]. Delayed diagnosis and treatment of urinary bladder rupture in people beyond 24 hours significantly increased mortality rate [14], with death usually occurring in dogs within 3 days if left untreated [15]. When trauma additionally involves the ureters, immediate surgical intervention is recommended if the patient has cardiovascular stability [5]. Although mortality in cats with uroperitoneum has been reported to be as high as 42% [16], the presence of concomitant injuries has been associated with increased mortality, particularly within the perioperative period [5].

The presence of trauma-associated acute mesenteric avulsion involving the jejunum was another feature identified during emergency surgical exploration. The successful treatment of mesenteric avulsion has been reported by intestinal resection of the distal jejunum and proximal ileum and subsequent anastomosis [17], with similar intra-operative findings and technique employed for the resection and anastomosis of the jejunum in this instance. The incidence of mesenteric injury following trauma in people can be as high as 10%, with the superior mesenteric artery and vein most commonly affected, as well as the small bowel injured approximately 5 times as frequently as that of the large bowel [18].

A diagnosis of urohaemoperitoneum was confirmed on evaluation of the abdominal effusion utilising previously recommended uroperitoneum and haemoperitoneum guidelines [4,5,9]. The presence of grossly haemorrhagic abdominal effusion with a HCT 10 - 25% that of the peripheral blood was considered diagnostic for hemoperitoneum [9], and the presence of urine within the effusion confirmed by identifying effusion-peripheral creatinine and potassium ratios >2:1 and >1:1, respectively. The relatively low effusion HCT of 12%, despite large volumes of abdominal fluid and a declining peripheral PCV, raised suspicion that more than one type of body fluid may be present in the abdomen, creating a dilutional effect, and thus creatinine and potassium ratios of the peritoneal effusion were performed.

Urohaemoperitoneum in people is a rare but possible complication following severe polytrauma and severe endometriosis [6]. To the authors knowledge, urohaemoperitoneum has not been described in the veterinary patient. Urohaemoperitoneum during pregnancy is associated rupturing of uterine vessels and concomitant rupturing of the uterus [6]. Reports have documented the presence of multiple effusion in dogs with pelvic fractures following blunt trauma [10], with the combined presence of septic peritonitis with haemoabdomen negatively affecting survival to discharge. The authors believe this association can be similarly ascribed to the combined presence of both haemoperitonem and uroperitoneum and patient prognosis. In the diagnosis of intra-abdominal injury in human trauma patients, ultrasonography is considered the best modality for initial investigation, with computed tomography recommended as gold standard for the diagnosis of trauma-related injuries. Identifying solid organ injury via abdominal ultrasound has a sensitivity of only 80% in people [3], llustrating the importance of thorough visual assessment of all abdominal organs upon surgical exploration. Further, an interesting finding of the case was an initial AFAST that was negative for abdominal effusion, however subsequently performed AFAST scans identified the presence of peritoneal effusion. This has similarly been described by Hoffberg., *et al.* [10] who reported two dogs with haemoabdomen that had an initially negative AFAST with subsequent diagnosis of haemoabdomen on abdominocentesis. Pertinent findings on exploratory laparotomy, including urinary bladder rupture and mesenteric avulsion, was an avulsed left ureter and a splenic rupture with active haemorrhage. These injuries independently corrected by surgical intervention are associated with relatively high survival rates, although mortality is typically increased when instigated by a high-energy polytraumatic event [10].Total splenectomies are associated with relatively high perioperative[13] and postoperative survival rates when performed following traumatic haemoperitoneum, and are frequently recommended over partial splenectomy due to perceived improved surgical ease. Ureteral reimplantation via ureteroneocystostomy has similarly provided satisfactory outcomes for patients with distal ureteral masses, extramural ectopic ureters, uretoliths, and traumatic rupture [19], nd was successfully utilised in this instance to restore appropriate urogenital function.

Conclusion

Urohaemoperitoneum is a rare but possible complication following vehicular trauma. To the authors knowledge, this is the first case report describing urohaemoperioneum in the veterinary patient, characterised by the presence of multiple effusion types as a result of multi-organ injury, including splenic rupture, mesenteric avulsion, and ureteral and urinary bladder rupture. Diagnosis was achieved by ultrasound and subsequent evaluation of peritoneal effusion yielded by abdominocentesis. Initial stabilisation was essential for improved patient morbidity, however, the identification of uroperitoneum made ongoing conservative management ineffective, and thus warranting surgical exploration. Surgical treatment of the traumatic injuries was corrective and, when combined with appropriate emergency medical management, resulted in a satisfactory patient outcome.

Acknowledgements

The authors would like to thank Dr. Michelle Lau for her assistance with reviewing radiographs associated with the case.

Funding

No funding or other financial support was received for this paper.

Conflict of Interest

There is no financial or other conflict of interest of any author related to a company or product used in the report.

Bibliography

1. Kolata R and Johnston D. "Motor vehicle accidents in urban dogs: a study of 600 cases". *Journal of the American Veterinary Medical Association* 167.10 (1975): 938-941.

2. Streeter E., *et al.* "Evaluation of vehicular trauma in dogs: 239 cases (January – December 2001)". *Journal of the American Veterinary Medical Association* 235.4 (2009): 405-408.

3. Walters A., *et al.* "Evaluation of the agreement between focused assessment with sonography for trauma (AFAST/TFAST) and computed tomography in dogs and cats with recent trauma". *Journal of Veterinary Emergency and Critical Care* 28.5 (2018): 429-435.

4. Herold L., *et al.* "Clinical evaluation and management of hemoperitoneum in dogs". *Journal of Veterinary Emergency and Critical Care* 18.1 (2008): 40-53.

5. Stafford J and Bartges J. "A clinical review of pathophysiology, diagnosis and treat of uroabdomen in the dog and cat". *Journal of Veterinary Emergency and Critical Care* 23.2 (2013): 216-229.

6. Chiodo I., *et al.* "Urohemoperitoneum during pregnancy with consequent fetal death in a patient with deep endometriosis". *Journal of Minimally Invasive Gynecology* 15.2 (2008): 202-204.

7. Boysen S., *et al.* "Evaluation of a focused assessment with sonography fro trauma protocol to detect free abdominal fluid in dogs involved in motor vehicle accidents". *Journal of the American Veterinary Medical Association* 225.8 (2004): 1198-1204.

8. Lisciandro G., *et al.* "Evaluation of a thoracic focuses assessment with sonography for trauma (TFAST) protocol to detect pneumothorax and concurrent thoracic injury in 145 traumatized dogs". *Journal of Veterinary Emergency and Critical Care* 18.3 (2008): 258-269.

9. Silverstein D and Hopper K. "Small Animal Critical Care Medicine; Second Edition". Elsevier Saunders St. Lois Missouri (2015): 63043.

10. Hoffberg J., *et al.* "Retrospective evaluation of concurrent intra-abdominal injuries in dogs with traumatic pelvic fractures: 83 cases (2008-2013)". *Journal of Veterinary Emergency and Critical Care* 26.2 (2016): 288-294.

11. Mongil C., *et al.* "Traumatic hemperitoneum in 28 cases: a retrospective review". *Journal of the American Animal Hospital Association* 31.3 (1995): 217-222.

12. Ressel L., *et al.* "Blunt force trauma in veterinary forensic pathology". *Veterinary Pathology* 53.5 (2016): 941-961.

13. Lux C., *et al.* "Perioperative outcome in dogs with hemoperitoneum: 83 cases". *Journal of the American Veterinary Medical Association* 242.10 (2013): 1385-1391.

14. Cass A and Luxenburg M. "Features of 164 bladder ruptures". *Journal of Urology* 138.4 (1987): 743–745.

15. Burrows C and Bovee K. "Metabolic changes due to experimentally induced rupture of the canine urinary bladder". *American Journal of Veterinary Research* 35.8 (1974):1083–1088.

16. Aumann M., *et al.* "Uroperitoneum in cats: 26 cases (1986–1995)". *Journal of the American Animal Hospital Association* 34.4 (1998): 315–324.

17. Rollings C., *et al.* "Traumatic mesenteric avulsion and subsequent septic peritonitis in a dog". *Journal of Veterinary Emergency and Critical Care* 11.3 (2001): 211-215.

18. Pennington CJ., *et al.* "Microvascular repair of jejunal and ileal vessels for near complete mesenteric avulsion after seat-belt injury". *Journal of Trauma* 48.2 (2000): 327-329.

19. Johnston S Tobias K. "Veterinary Surgery Small Animal; Second Edition". Elsevier Saunders St. Lois Missouri (2018): 63043.

Volume 4 Issue 6 August 2019