Retrospective evaluation of concurrent intra-abdominal injuries in dogs with traumatic pelvic fractures: 83 cases (2008–2013)

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Abstract

Objective – To report the occurrence of intra-abdominal injury (IA) in dogs with pelvic fractures due to blunt trauma, to evaluate for association between characterization of pelvic fractures and the presence of IA, and to evaluate for association between IA and other specific clinical conditions.
Design – Retrospective case series (2008–2013).
Setting – University teaching hospital.
Animals – Eighty-three client-owned dogs with pelvic fractures due to blunt trauma.
Interventions – None.
Measurements and Main Results – Pelvic injuries included pubic fractures (90.4%), ischial fractures (80.7%), sacroiliac luxations (57.8%), iliac fractures (43.4%), acetabular fractures (30.1%), and sacral fractures (13.3%). Thirty-one dogs (37%) had IA, which included hemoabdomen (27 dogs), uroabdomen (3), and septic abdomen (3); 2 dogs had 2 types of IA. Dogs with sacral fractures were significantly more likely to have IA than dogs without sacral fractures ($P = 0.0162$). Characterization of pelvic fractures included the direction of compression, presence of a weight-bearing bone fracture, and degree of pelvic narrowing, none of which had an association with IA ($P > 0.05$). Dogs were more likely to have IA if they had cardiac dysrhythmia ($P = 0.0002$) or hematuria ($P = 0.0001$), and were more likely to have a hemoabdomen if they had cardiac dysrhythmia ($P = 0.0005$). Dogs with hematochezia were more likely to have a septic abdomen ($P = 0.0123$). Dogs were more likely to receive a transfusion if they had AI ($P = 0.033$) or hemoabdomen specifically ($P = 0.0033$). Overall survival to discharge was 89%, which was significantly greater than survival in dogs with pelvic injury that also had septic abdomen (33%; $P = 0.0299$).
Conclusions – IA is common in dogs with pelvic fractures, especially those with sacral fractures. Pelvic fracture characterization had no bearing on the presence of IA.

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Keywords: canine, hemoabdomen, peritonitis, polytrauma, uroabdomen

Abbreviations

AFAST   abdominal focused assessment with sonography for trauma
IA   intra-abdominal injury

Introduction

Pelvic fractures account for 20%–25% of reported fractures in veterinary medicine[1] and are usually due to high force blunt trauma. Pelvic fractures are often associated with polytrauma because the high energy required to fracture the pelvis can lead to other orthopedic or soft tissue injury. Mortality in people with pelvic fractures ranges from 5% to 50%, and depends on the type of fractures and severity of associated trauma.[2] The high mortality rate in people is generally attributed to massive bleeding seen in complex pelvic fractures,[2] which has been reported uncommonly in veterinary patients.[3]

In cases with polytrauma, intrapelvic injuries can be missed because clinical sign onset may be delayed or because such injuries may not be readily identified on primary physical examination.[4,5] Abdominal focused assessment with sonography for trauma (AFAST) has increased the yield of abdominocentesis and diagnosis of abdominal effusion in trauma[6,7]; repeated AFAST has higher sensitivity than a single scan in detecting abdominal effusion.[8] Unfortunately, abdominal ultrasound is relatively insensitive in the diagnosis of intrapelvic injury associated with pelvic fractures in people because ultrasound is ineffective in imaging intrapelvic structures.[9]

Delay in the diagnosis and treatment of conditions such as uroabdomen or septic abdomen increases morbidity and mortality in people,[10–12] and can further postpone fracture repair. Delay in fracture repair predisposes to fibrous tissue formation and muscle rigidity, both of which complicate proper fracture reduction and increase morbidity.[13] Studies of trauma in veterinary medicine have reported that 12%–44% of trauma patients have hemoabdomen, 2%–3% have uroabdomen, and 38%–72% have thoracic injuries.[7,14–18] Concurrent traumatic injuries have not yet been correlated to specific pelvic fracture findings in dogs in a large scale study.

It would be helpful to know whether specific qualities of pelvic fractures should prompt more advanced diagnostic testing for concurrent intra-abdominal injury (IA) in the event that the physical examination, radiographic imaging, and AFAST fail to make a diagnosis but high clinical suspicion of IA exists. The objectives of this study were to summarize findings in a population of dogs with traumatic pelvic fractures, to describe how pelvic fracture characteristics may relate to occurrence of IA, and to describe how pelvic fracture characteristics may be associated with other specific clinical signs (hematochezia, cardiac dysrhythmias, hematuria, or thoracic trauma). Additionally, the study aimed to describe any relationship between IA and transfusion requirement, length of hospitalization, and outcome. We hypothesized that an association would exist between pelvic fracture type and occurrence of IA.

Materials and Methods

The medical records database at the Michigan State University veterinary teaching hospital was searched for all dogs diagnosed with traumatic pelvic fractures between January 2008 and January 2013. Medical records search terms were "pelvic fracture," "ilial fracture," "pubic fracture," "symphyseal fracture," "ischial fracture," "sacral fracture," "sacral luxation," "sacroiliac luxation," and "acetabular fracture." Dogs were eligible for study inclusion if they had sustained pelvic fractures within 24 hours of presentation, had orthogonal (lateral and ventrodorsal) pelvic radiographs available for review, and had a complete medical record available. Dogs were excluded if the pelvic fractures were not traumatic in origin, if the injury occurred >24 hours prior to admission, or if pelvic radiographs were not available for evaluation. Age, sex, breed, and body weight were recorded.

All pelvic radiographs were reviewed by 2 authors who were blinded to previous radiology reports and the presence or absence of concurrent IA. Radiographs were reviewed for the presence of pelvic orthopedic pathology, including sacroiliac luxation, sacral fracture, iliac fracture, acetabular fracture, ischial fracture, and pubic fracture. These interpretations were then compared to a previously recorded radiology report by a board-certified radiologist. If any discrepancies existed between these evaluations, a board-certified radiologist was consulted for further review of the radiographs. In addition to fracture location, the total number of pelvic fractures, direction of compression defined as lateral compression (shift of hemipelvis toward midline) or caudal-cranial compression (shift of the pelvis or hemipelvis cranially with respect to the spine), effect on the weight bearing axis (sacrum, sacroiliac joint, ilium, acetabulum), and degree of narrowing of the pelvic canal were recorded for each patient. Pelvic canal diameter ratio was calculated based on radiographic measurements as the narrowest pelvic diameter divided by the sacral width subtracted from 1 [1 − (narrowest pelvic diameter/sacral width)].[19]

Diagnosis of abdominal injuries was based on specific findings noted in the medical record. IA was classified as hemoabdomen, uroabdomen, or septic abdomen whether it originated from structures within the abdominal cavity or pelvic canal. A diagnosis of hemoabdomen required abdominocentesis yielding nonclotting hemorrhagic effusion with a PCV and total plasma protein concentration of the peritoneal fluid close to that of the peripheral blood.[20] A diagnosis of uroabdomen required paired venous and peritoneal fluid analysis with comparison of creatinine and potassium values as previously described.[21] Septic abdomen was confirmed via cytologic evidence of intracellular bacteria or direct visualization of a leaking portion of the gastrointestinal tract at the time of exploratory surgery. In addition to considering cases with hemoabdomen, uroabdomen, and septic abdomen separately, all cases with an IA were combined to form a group designated "Any IA."

Additional signs of injury noted in the medical record were recorded including presence of cardiac dysrhythmias, hematochezia, hematuria, or thoracic trauma. Hematuria diagnosis required a report of macroscopic hematuria identified in a urinalysis to rule out nonhematuric pigmenturia. Thoracic trauma was defined as

pneumothorax, hemothorax, diaphragmatic hernia, rib fractures, or pulmonary contusions. The occurrence of packed red blood cell transfusion was noted. Outcome was recorded as survival to discharge with the length of hospitalization noted, death by cardiopulmonary arrest, or euthanasia.

Statistical Methods

The data were analyzed for normality using D'Agostino's *K*-squared test and were not normally distributed. All values were presented as median and range. For all statistical analyses dogs were classified by presence and type of IA (hemoabdomen, uroabdomen, or septic abdomen). Dogs could be included in more than 1 IA group if more than 1 abdominal injury type was identified. A Fisher's exact test was used to compare the occurrence of each type of fracture, direction of compression, fracture of a weight bearing bone, occurrence of ≥50% narrowing of the pelvic canal, occurrence of transfusion, and survival to discharge. In addition, the presence or absence of cardiac dysrhythmias, hematochezia, hematuria, and thoracic trauma was compared amongst the various types of IA using a Fisher's exact test. A Mann–Whitney *U* test was used to analyze continuous data including the relationship of number of fractures, percentage pelvic narrowing, and length of hospitalization. The remaining data are presented descriptively. All statistical analyses were performed using a commercially available statistical software package.[a] Results were considered significant with $P < 0.05$.

Results

One hundred thirty-three dogs were identified with traumatic pelvic fractures. Seventeen dogs were excluded due to lack of availability of pelvic radiographs, and 33 were excluded because injury occurred >24 hours prior to presentation. The remaining 83 dogs had a median age of 2.1 years (range, 0.05–14.8 years) and were evenly distributed between males and females (30 neutered males, 12 intact males, 29 spayed females, 22 intact females). Median weight was 20 kg (range, 1.58–56.8 kg). Thirty-two breeds were represented, with mixed breed dogs (18) and Labrador Retrievers (9) the most common. Eighty (96.4%) dogs were hit by a vehicle including 71 cars, 5 tractors, 2 all-terrain vehicles, 1 bus, and 1 backhoe. Two dogs had unknown trauma, and 1 jumped out of a moving vehicle but was not struck by a vehicle.

Thirty-one dogs (37.3%) had any IA, defined as hemoabdomen (27), uroabdomen (3), and septic abdomen (3). Two dogs had 2 injuries each (both hemoabdomen and septic abdomen). All dogs with hemoabdomen or uroabdomen were diagnosed with abdominocentesis. Fifty-four of 83 (65%) dogs had results of an AFAST available in the record. Of these, 23 were positive consisting of 19/27 hemoabdomens, 3/3 uroabdomens, and 3/3 septic abdomens. Two dogs with hemoabdomen had an initial AFAST that was negative but subsequently had abdominocentesis that diagnosed a hemoabdomen without the results of serial AFAST recorded. Of the 29/83 that did not have AFAST results in their records, 6 had hemoabdomen diagnosed via abdominocentesis and 23 did not have IA identified during hospitalization. One dog had intracellular bacteria noted in cytologic evaluation of peritoneal fluid after abdominocentesis prompted by AFAST had revealed hemoabdomen. Septic abdomen was identified via alternate methods in the other 2 dogs including 1 dog in which free peritoneal gas was found on computed tomography, and 1 dog with a circumferential laceration of the rectum palpated on rectal examination. In all dogs with septic peritonitis, the colon or rectum was diagnosed as the source during exploratory surgery.

Pubic fracture was the most common pelvic fracture, affecting 75 (90.4%) dogs, followed by ischial fractures in 67 (80.7%), sacroiliac luxations in 48 (57.8%), iliac fractures in 36 (43.4%), acetabular fractures in 25 (30.1%), and sacral fractures in 11 (13.3%). Dogs with sacral fractures were more likely to have IA (8/11) than dogs without sacral fractures (23/72, $P = 0.0162$). There was no association between IA presence or type and any other fracture location (Table 1).

Single fractures occurred in 8 dogs. The remaining 75 dogs had >1 fracture site with 10/83 dogs with 2 fractures, 33/83 with 3 fractures, 25/83 with 4 fractures, and 7/83 with 5 fractures. There was no correlation between the number of fractures or the degree of pelvic canal compression and the presence or type of IA. The direction of compression was caudal-cranial in 29 dogs (34.9%) and lateral in 54 dogs (65.1%). There was no difference between the occurrence of caudal-cranial or lateral-lateral compression and the presence or type of IA. The weight-bearing axis was affected in 72 dogs (86.7%). The presence or absence of a fracture within the weight-bearing axis was not associated with presence or type of IA. The median pelvic canal diameter ratio was 0.11, indicating an 11% narrowing of the pelvic canal laterally compared to the sacral width, with a range of –50% (widening) to +69% (narrowing). There was no association between degree of compression and presence or type of IA. Seven of the 83 dogs had ≥50% pelvic compression, and this degree of compression was not associated with presence or type of IA.

Certain clinical signs were associated with IA in dogs with pelvic fractures. Thirteen of 83 (15.7%) dogs were diagnosed with cardiac dysrhythmias. Dogs with

Table 1: Occurrence of intra-abdominal injury with fracture location

	All IA (N = 31)	P value	Hemoabdomen (N = 27)	P value	Uroabdomen (N = 3)	P value	Septic abdomen (N = 3)	P value
Sacral fracture (N = 11)	8, 72.7%*	0.0162	6, 54.5%	0.1633	1, 9.1%	0.35	1, 9.1%	0.35
Sacroiliac luxation (N = 48)	21, 43.8%	0.1761	18, 37.5%	0.344	3, 6.25%	0.2595	2, 4.2%	1
Iliac fracture (N = 36)	14, 38.8%	0.8225	13, 36.1%	0.638	1, 2.8%	1	2, 5.6%	0.572
Acetabular fracture (N = 25)	9, 36%	1	9, 36%	0.7990	0, 0%	0.55	0, 0%	0.55
Ischial fracture (N = 67)	24, 35.8%	0.5762	22, 32.8%	1	2, 3.0%	0.479	2, 3%	0.479
Pubic fracture (N = 75)	27, 36%	0.4638	25, 33.3%	1	2, 2.7%	0.265	2, 2.7%	0.26

*$P < 0.05$.
Data presented as number of dogs, percentage of dogs with that fracture and the corresponding abdominal injury.
IA, intra-abdominal injury.

Table 2: Associations between intra-abdominal injury and other clinical conditions

	All IA (N = 31)	P value	Hemoabdomen (N = 27)	P value	Uroabdomen (N = 3)	P value	Septic abdomen (N = 3)	P value
Hematochezia (N = 6)	3, 50%	0.666	2, 33.3%	1	0, 0%	1	2, 33.3%*	0.0128
Hematuria (N = 15)	7, 46.7%*	0.0001	6, 40%	0.549	1, 6.7%	0.235	1, 6.7%	0.4546
Dysrhythmia (N = 13)	11, 84.6%*	0.0002	10, 76.9%*	0.0005	0, 0%	1	2, 15.4%	0.0625
Thoracic trauma (N = 25)	10, 40%	0.8069	10, 40%	0.4443	0, 0%	0.5502	2, 8%	0.2144

*$P < 0.05$.
Data presented as number of dogs, percentage of dogs with that clinical condition and the corresponding intra-abdominal injury.
IA, intra-abdominal injury.

dysrhythmia were more likely to have IA (11/13) than dogs without dysrhythmia (20/70; $P = 0.0002$), and dogs with dysrhythmia were more likely to have hemoabdomen (10/13) than dogs without dysrhythmia (11/70; $P = 0.0005$). Dogs with dysrhythmia were no more likely to have uroabdomen or septic abdomen than dogs without dysrhythmia. Six dogs had hematochezia. Dogs with hematochezia were more likely to have a septic abdomen (2/6) than dogs without hematochezia (1/77; $P = 0.0123$). Presence of IA, uroabdomen, or hemoabdomen was not associated with hematochezia. Fifteen dogs had macroscopic hematuria. Dogs with hematuria were more likely to have IA (7/15) than dogs without hematuria (24/68; $P = 0.0001$). There were no associations between IA type and hematuria. Thoracic injuries were identified in 25/83 (31%) dogs. There was no association between presence or type of IA and the presence of thoracic injury (Table 2).

A total of 13/83 (15.7%) dogs received a packed red blood cell transfusion while in hospital. Dogs were more likely to receive a transfusion if they had any IA (10/31; $P = 0.0033$) or hemoabdomen specifically (10/27; $P = 0.0005$). Dogs with uroabdomen or septic abdomen were no more likely to receive a transfusion than those without. The median length of hospitalization was 3 days (range, 0–28 days). There was no significant difference in length of hospitalization for dogs with any IA (4 days;

range, 0–28), hemoabdomen (4 days; range, 0–18), uroabdomen (10 days; range, 1–28), or septic abdomen (3 days; range, 0–18). Seventy-four (89.2%) dogs survived to discharge, with 8/9 nonsurviving dogs euthanized and 1/9 experiencing cardiopulmonary arrest. There was no association between survival to discharge and IA (26/31), hemoabdomen (23/27), or uroabdomen (3/3). Dogs with septic abdomen were significantly less likely to be discharged alive (1/3) compared to dogs without septic abdomen (73/80; $P = 0.0299$). Outcome comparisons are summarized in Table 3.

Discussion

IA is common in dogs that sustain traumatic pelvic fractures, with 31/83 (37.2%) of dogs found to have IA in this study. An association was identified between sacral fractures and IA. It is possible that a greater force is necessary to cause sacral injuries, which could explain more concurrent injury.

The most commonly identified IA was hemoabdomen, which was found in 32.5% of dogs with pelvic fractures in this study. Hemoabdomen is a common injury that has been reported in 11%–44% of canine trauma cases.[7,14–17] The discrepancy in the range can be partially attributed to the more recent use of AFAST and serial AFAST, which have improved the ability to

Table 3: Transfusion, length of hospitalization, and survival to discharge

	All IA (N = 31)	P value	Hemoabdomen (N = 27)	P value	Uroabdomen (N = 3)	P value	Septic abdomen (N = 3)	P value
Transfusion (N = 13)	10, 32.3%*	0.0033	10, 37.0%*	0.0005	0, 0%	1	2, 66.7%	0.06
Length of hospitalization	4 (0–28)	0.0853	4 (0–18)	0.1119	10 (1–28)	0.1904	3 (0–18)	0.9507
Survival to discharge	26, 83.9%	0.2835	23, 85.2%	0.4634	3, 100%	1	1, 33.3%*	0.0299

*$P < 0.05$.

Data presented as number, percentage regarding dogs receiving a transfusion; as median (range) days of hospitalization; and as number, percentage of dogs surviving to discharge for each intra-abdominal injury category.

IA, intra-abdominal injury.

diagnose traumatic effusions.[8,22,23] Hemoabdomen and pelvic fractures are commonly concurrently reported in dogs; such traumatic hemoabdomens are likely due to the overall force of trauma rather than secondary to the pelvic fractures.[24,25] A study by Lisciandro, et al revealed that dogs with pelvic fractures were more likely to have a positive AFAST score than a negative AFAST score.[6] To the authors' knowledge, there have been no previous reports evaluating the association between specific pelvic fractures and hemoabdomen. While occurrence of hemoabdomen did not have any relationship with location or number of pelvic fracture, direction of compression, effect to the weight bearing axis, or degree of pelvic canal compression, patients with hemoabdomen were more likely to receive a transfusion or have cardiac dysrhythmias. The presence of dysrhythmias and need for transfusion should prompt the clinician to evaluate dogs with pelvic trauma closely for the presence of a hemoabdomen.

Uroabdomen was relatively uncommon in dogs with pelvic fractures, comprising 3.6% of this population. This finding is similar to those from studies that evaluated general canine trauma populations and reported uroabdomen in 1.6%–3% of dogs.[7,14,17,21,24] Two studies have evaluated the occurrence of uroabdomen in dogs with pelvic fractures, with varying results. Denney reported uroabdomen in 2.4% of dogs while evaluating medical versus surgical repair of pelvic fractures,[26] whereas Selcer reported that 12% of dogs with pelvic trauma had rupture of the urethra or bladder.[27] The latter study prospectively performed contrast urinary tract radiography in all dogs with pelvic fractures, which increased the likelihood of identification of urinary tract injuries. This protocol likely led to the higher incidence of uroabdomen reported in this study. One investigation found lower urinary tract rupture resulting in uroabdomen or uroretroperitoneum in 6.6% of people with pelvic fractures, and reported an association between urinary tract rupture and pubic symphyseal widening, sacroiliac luxation, and sacral fractures.[28] Similarly, a study by Kolata proposed a relationship between lower urinary tract rup-

ture and pubic fractures in dogs.[24] In the present study, uroabdomen resulted from bladder rupture (1), bladder and urethral rupture (1), and unknown site since no surgery was performed (1). There was no correlation between uroabdomen and any specific fracture type, number, direction of compression, fracture of a weight bearing bone, or degree of pelvic compression in this study. Small numbers of uroabdomen leading to type II error was likely a contributor to the lack of statistical association between uroabdomen and pelvic fractures.

Like uroabdomen, septic abdomen associated with pelvic fractures is an uncommon but serious injury. It may occur due to direct laceration or avulsion of a hollow viscus in the pelvic canal or may present more delayed due to blunt bowel injury or entrapment of intestines into a hernia.[24,29,30] Though there is a 10% incidence of mesenteric injury[29] and a 5.7% incidence of gastrointestinal injury[23] reported in trauma in people, a similar frequency has not been reported in dogs. One large trauma study reported only a 0.33% incidence of mesenteric injury.[24] Gastrointestinal injury secondary to pelvic fracture is considered rare.[31] The frequency of direct injury of a hollow viscus in the general canine trauma population has not been reported but 1 study reported that rectal perforation occurred in <1% of dogs with pelvic fractures.[32] Traumatic lesions to the colon have been reported in <2% of people with pelvic fractures and perforating lesions to the colon occur even less commonly.[33] A study that correlated human rectal injury with pelvic fractures found an incidence of 2.2% and a correlation with pubic symphyseal widening and SI luxation.[28] In our study, 3/83 (3.6%) dogs had a septic abdomen. They were all due to colonic/rectal trauma but there was no specific fracture characteristic that correlated with the occurrence of septic abdomen. Dogs with hematochezia were more likely to have a septic abdomen, so this physical examination finding should warrant further testing to look for gastrointestinal tract perforation. Septic abdomen was the only characteristic that negatively affected survival to discharge, but the small case population precludes generalization to all patients.

Evidence collected in people is often used to create models for veterinary patients. Unfortunately, human pelvic fractures are a poor model for canine pelvic fractures, particularly considering direction of compression. Pelvic compression in people is usually in the anterior-posterior plane, which can lead to displacement of the anterior aspect of the pelvic ring (pubis) into the pelvic canal. Anterior-posterior compression in people is associated with increased incidence of concurrent injuries such as urethral rupture.[34,35] One study found that 75% of rectal injuries, 72% of bladder injuries, and 65% of urethral injuries were associated with anterior-posterior compression pelvic fractures in people.[28] In the current study, there were no dogs with anterior-posterior pelvic compression. The majority of dogs had lateral compression and the remainder had caudal-cranial compression, both of which commonly lead to ventral pubic bone displacement, away from the pelvic canal. This difference may explain why pubic fractures were not associated with concomitant IA as they are in people.

There was no association found between the number of pelvic fractures and the occurrence of abdominal injuries. Dogs with pelvic fracture usually have multiple fractures due to the rigid box-like nature of the pelvis. There were more instances of solitary pelvic fractures than expected, including nondisplaced sacral fractures, fractures of the ischial tuberosity, or fractures in young animals with open growth plates allowing for more pelvic mobility. The lack of association between number of pelvic fractures and presence of IA may be because greater fracture number may not indicate greater traumatic force.

A high degree of pelvic canal narrowing has been associated with complications in cats. Specifically, $\geq 50\%$ compression of pelvic canal diameter has been associated with increased incidence of obstipation in cats.[36] The authors wondered whether $>50\%$ compression may be associated with a higher rate of any intrapelvic injury; therefore, this study evaluated the relationship between pelvic canal compression and presence of IA as both a continuous and a categorical (pelvic canal compression $\geq 50\%$) variable. There was no association between degree of pelvic compression and presence or type of IA. Absence of a relationship may be because lateral pelvic compression tends to cause ventral displacement of the pelvic floor out of the canal. In this situation, though there is large lateral compression of the pelvic canal as calculated by the formula, this may not be reflective of true changes to the volume of the pelvic canal. Further studies could evaluate the change in cross-sectional area of the pelvic canal to determine if it is associated with IA.

This study has several limitations. The identification of IA may have been compromised by the retrospective nature of the study. Though it is general protocol to perform serial AFAST examinations on all trauma patients at the study institution, the results of these examinations may not be consistently recorded. Furthermore, many different clinicians perform AFAST, including interns, emergency and critical care medicine residents, and Diplomates of the American College of Veterinary Emergency and Critical Care who may have different ability to detect and sample peritoneal fluid. Thus, small volumes of peritoneal fluid may not have been detected or sampled, which would decrease the overall prevalence of hemoabdomen and influence the analysis. Retrospectively it is difficult to determine which animals had repeated AFAST, and whether the results changed with time. Because serial AFAST has been reported to increase the sensitivity of detection, injuries could be missed if only 1 AFAST were performed. However, the prevalence of hemoabdomen in this study is similar to previous reports.

Because of this study's retrospective nature, abdominal fluid was cytologically evaluated and paired venous blood and peritoneal samples were performed only at clinician discretion. Though some could have theoretically been missed, the numbers of dogs in the uroabdomen and septic abdomen categories were likely accurate. Few patients were euthanized without diagnostic tests or hospitalization, and an initially missed diagnosis of uroabdomen or septic abdomen would likely be discovered during the course of hospitalization. There were low numbers of dogs with septic abdomen and uroabdomen, potentially contributing to type II error. Additionally, though dogs with a septic abdomen had poorer survival, the low number of such cases precludes generalization to the overall dog population. Finally, overall survival was high (89.2%), which may in part be because dogs without radiographs were not included, which would exclude a population that was euthanized at presentation for financial or prognostic reasons.

Conclusions

Dogs with traumatic pelvic fractures often suffer from polytrauma including IA. Thirty-seven percent of dogs with pelvic fractures in this study were found to have concurrent IA. This finding supports the need for diagnostic testing to identify concurrent injuries. Additionally, the presence of a sacral fracture, cardiac dysrhythmias, hematochezia, and hematuria may prompt additional investigation for IA. This study highlights the need for larger prospective studies evaluating factors that predict clinically significant injuries following trauma in dogs.

Footnote

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