TRAUMATIC DIAPHRAGMATIC RuptURE IN A CAT WITH PARTIAL KIDNEY DISPLACEMENT INTO THE THORAX

A two-year-old, male, neutered, domestic shorthair cat was presented after suspected trauma. Diaphragmatic rupture with concomitant displacement of the right kidney into the thorax was diagnosed using ultrasound and intravenous urography. Avulsion of the renal pedicle and diaphragmatic rupture were confirmed and treated surgically with excellent outcome.
noted. Abdominal ultrasonographic evaluation was performed in right and left lateral recumbency with a paramedian approach. The right kidney was displayed dorsal and cranial to the normally positioned liver, and the cranial two-thirds were surrounded by a hyperechoic and hyperechoic band of air originating from the edge of the right lung (Fig 3). Corticomedullary definition was slightly blurred. No diaphragmatic contour was visible on the right but was evident on the left. Additional findings included a small volume of free fluid within the pleural space and hyperechoic particles within the urinary bladder. In order to evaluate renal function and perfusion, intravenous urography was performed on the conscious cat with 6 ml Jopamiro® 300 mg I/ml (Gerot Pharmazeutika) (450 mg I/kg). The left kidney showed a normal nephro- and pyelogram with a normal ureter. There was a discrete kidney-shaped increase in opacity in the caudodorsal thorax, suggestive of the right kidney. There was no evidence of contrast enhancement in the right renal pelvis or ureter (Fig 1). Diagnostic imaging was presumptive of diaphragmatic rupture and right renal displacement.

The cat received standard shock treatment immediately after the initial presentation (intravenous application of Hetastarch at 5 ml/kg and Ringer’s solution at 10 ml/kg [Fresenius AG] concurrently for 20 minutes). Fluid therapy was continued with Ringer’s solution at 4 ml/kg/hour for two hours before and during the diagnostic imaging. Analgesia was provided with 0·1 mg/kg methadone (Heptadon; EBEVE Pharma) given intravenously.

The cat was premedicated with 2 mg/kg intramuscular ketamine (Ketasol; Dr E. Graub AG) and 0·15 mg/kg intramuscular midazolam (Mayrhofer Pharmazeutika), and anaesthesia was induced with 5 mg/kg intravenous propofol (Fresenius AG) approximately three hours after initial presentation, after the dehydration was corrected. Anaesthesia was maintained with propofol (Fresenius AG) to effect at a mean rate of 13 mg/kg/hour. About 20 μg/kg/hour of fentanyl (Janssen-Cilag Pharm) was simultaneously infused. The patient received intermittent positive pressure ventilation during surgery. A midline coeliotomy was performed. Approximately 100 ml of sanguineous fluid was aspirated from the abdominal cavity. There was a circumferential tear in the diaphragm, located at the lumbocostal aspect on the right side, comprising 10 per cent of the circumference of the diaphragm. The right kidney was cranially displaced, and the cranial pole protruded through the diaphragmatic tear (Fig 4).
Traumatic diaphragmatic rupture in a cat

was a haematoma in the retroperitoneal space on the right side. The right ureter and the right renal vein were avulsed from the renal pedicle, and the right renal artery was thrombosed. The right renal artery was intact (Fig 5). The right kidney was normally shaped, retained a smooth, glossy surface but exhibited several petechiae. Additionally, there was an oval, partial tear (4×3 cm) of the left abdominal wall adjacent to the 13th rib, involving peritoneum and the internal abdominal oblique muscle. A right ureteronephrectomy was performed, and the distal stump of the right ureter, the right renal vein and the right renal artery were ligated with 2-metric polydioxanone (Surgicryl; SMI) and transected. The diaphragmatic rupture was sutured with a simple continuous pattern using 2-metric polyglyconate (Monosyn; B-Braun) with partial incorporation of the 12th rib (Fossum 2002). The partial rupture of the left abdominal wall was repaired with a simple continuous pattern using 2-metric polyglyconate (Monosyn; B-Braun). An abdominal lavage with Ringer’s solution was performed. The abdomen was closed with 3-metric polyglyconate (Monosyn; B-Braun) for the rectus sheath (simple continuous pattern), 1:5-metric polyglyconate (Monosyn; B-Braun) for the subcutis (simple continuous pattern) and 1:5-metric polyamide (Dafilon; B-Braun) for the skin closure (simple interrupted pattern).

Histopathological follow-up revealed a morphologically intact kidney. For the next five days, the cat was maintained on intravenous fluid therapy, reduced gradually from 4 ml/kg/hour to 2 ml/kg/hour (Ringer’s solution; Fressenius AG), owing to reduced appetite and water intake. Normal urination was noted. Postoperative pain was managed with intravenous application of 30 μg/kg buprenorphine thrice a day (Temgesic; Shering), and 20 mg/kg clavulanico-acid-potentiated amoxicillin (Clavamox; Sandoz GmbH) was intravenously administered prophylactically twice a day for five days. The cat was discharged one week after surgery and fully recovered at the one month follow-up. Excision arthroplasty of the luxated left hip was performed three months later, and the postoperative recovery was uneventful.

DISCUSSION

Respiratory compromise, concurrent injuries of organs situated within the thoracic and abdominal cavities as well as external injuries and internal haemorrhage with development of hypovolaemic shock are common and potentially life-threatening complications of traumatic diaphragmatic herniation (Worth and Machon 2005).

A “gold standard” for the early diagnosis of this condition has not been established as yet, and it still appears to pose a diagnostic dilemma (Nau and others 2001). On many occasions in human medicine, diaphragmatic rupture has been missed, causing delayed diagnosis in up to 17 per cent of cases (Beauchamp and others 1984). In a review of diaphragmatic hernias in dogs and cats, only 66 of 116 cases were diagnosed within 30 days of trauma (Wilson and others 1971). In another study, 50 cats and dogs of 250 cases were diagnosed with a diaphragmatic hernia of duration of more than two weeks (Minihan and others 2004). Acute traumatic diaphragmatic hernias may escape detection because owners may be unaware that a traumatic incident has occurred, as the condition may be asymptomatic and because a definitive radiographic diagnosis can be difficult to establish (Minihan and others 2004).

Plain radiographs of the thorax and abdomen are recommended for severely traumatised patients (Hunt and Johnson 2003). In the presented case, the radiographs showed an ovoid soft tissue opacity in the region of the right thorax (Figs 1 and 2), which was highly suggestive of the right kidney as it could not be clearly visualised in its normal position on abdominal films. As described by other authors, ultrasonography using a transhepatic approach (Spattini and others 2003) added complimentary information. This scanning technique confirmed a diagnosis of right renal displacement craniodorsally to the liver and revealed it to be surrounded by the right lung containing gas. Serum biochemistry showed mild elevation of creatinine values, and the kidneys did not exhibit severe ultrasonographic changes. Although renal function cannot be fully evaluated solely by serum biochemistry, it can give an idea whether the kidney was affected by the traumatic event. Integrity of the urinary tract might be assessed by intravenous urography, assuming filtration occurs. In this case, lack of contrast enhancement in the right kidney led to two possibilities. Either renal blood supply to the right kidney and, consequently, renal function to concentrate and excrete urine were decreased or there was an avulsion of the renal pedicle with contrast leakage, which was diluted by the free thoracic fluid, possibly blood, urine or both. The avulsion of the renal pedicle may have led to leakage of urine from the ureter and to haemorrhage from the renal vein. However, the authors did not assess the sanguineous fluid aspirated from the abdominal cavity. The preoperative drop of PCV suggested an acute blood loss, although dilution caused by intravenous fluid therapy or a combination of both could not be excluded.

The preferred surgical approach to traumatic diaphragmatic hernia rupture repair is midline coeliotomy (al-Nakeeb 1971, Garson and others 1980). However, some authors recommend thoracic approaches (Minihan and others 2004). Surgical exploration in the presented case revealed the right kidney to be craniodorsally displaced, leading to complete avulsion of the renal vein and the corresponding ureter; however, the renal artery withdrew this displacement and remained intact. Ureteronephrectomy was
performed as the damage of the renal parenchyma could not be intraoperatively evaluated; thus the function of the kidney was uncertain. The technique of ureteral anastomosis, especially in cases of avulsion of the renal pedicle, is technically demanding and previous reports demonstrated a high rate of postoperative complications (Weisse and others 2002), and therefore, it was not performed.

Based upon concurrent soft tissue injuries and having classified the surgical procedure as clean contaminated, the authors opted for prophylactic use of antimicrobial drugs in this patient.

Avulsion of the kidney after blunt trauma is rarely identified in practice. If there is no acute blood loss, kidney avulsion is often overlooked and misdiagnosed (Marolf and others 2002, Störk and others 2003).

**Conclusion**

Early recognition and timely surgery performed on a stabilised patient were most likely essential prerequisites for successful outcome in this case. Nevertheless, because of the compounding injuries and because of the scarcity of information regarding this rare condition in veterinary literature, prognosis in such patients should be kept guarded.

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**References**


