doi: 10.17221/8682-VETMED

Secondary abdominal pregnancy with foetal mummification diagnosed using computed tomography in a dog: a case report

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ABSTRACT: An intact female Maltese dog, rescued two months previously, and weighing 2.7 kg, was presented for ovariohysterectomy. There were no typical clinical signs and evidences of parturitions. A firm abdominal mass was palpated, which was identified as a round-shaped radiopaque mass in survey radiography. The mass was tentatively diagnosed as an extrauterine foetus with mummification on computed tomography (CT). Surgical removal of the mass and ovariohysterectomy were performed. Histopathological examination yielded a final diagnosis of abdominal ectopic pregnancy.

Keywords: ectopic pregnancy; mummified foetus; vertebral column; CT; dog

Ectopic pregnancy (or extrauterine pregnancy) is referred to as abnormal pregnancy state which develops outside the uterus. In humans, it is a relatively common pathologic condition, and an incidence rate of 20.7 cases per 1000 pregnancies has been reported by Van Den Eeden et al. (2005). While it is considered rare in animals, detailed epidemiological studies have not been conducted (Corpa 2006). The diagnosis of an ectopic pregnancy is typically based on radiography, ultrasonography, and operative findings (Eddey 2012). Among the various diagnostic modalities for ectopic pregnancy, computed tomography (CT) may allow more accurate and prompt diagnosis as well as planning of treatment. This manuscript describes a case of an abdominal ectopic pregnancy with foetal mummification in a dog that was diagnosed using CT as well as the histopathological examination that was subsequently performed.

Case description

A middle-aged, intact female Maltese weighing 2.7 kg was presented to Konkuk University's Veterinary Teaching Hospital for ovariohysterectomy. There were no clinical signs or any history of past parturitions because she had been rescued two months previously.

On physical examination, an abdominal mass was palpated. There were no remarkable laboratory findings. Abdominal radiography revealed a radiopaque mass effect in the mid-abdomen. The mass was round with irregular margins and was 3 × 3 cm in size (Figure 1A). On ultrasonography, the mass appeared heterogeneous and had hyperechoic foci with acoustic shadowing, but no vascular response was detected (Figure 1B). In CT images, the mass was located in the left mid-abdomen. The mass had no connections with the internal organs, and was covered with omental fat and contained bony materials. The mass contained zones of soft-tissue and bony attenuation. The bony structures were arranged in discontinuous and consistent patterns, and the structure was assumed to represent the vertebral column of a foetus (Figure 1C). The mass did not show any contrast-enhancing areas in post-contrast images. Three-dimensional (3D)-reconstructed images showed more detailed structures (Figure 1D). Ovary, oviduct, and uterus were identified as normal. We made a tentative diagnosis of extrauterine foetal mummification. The owner

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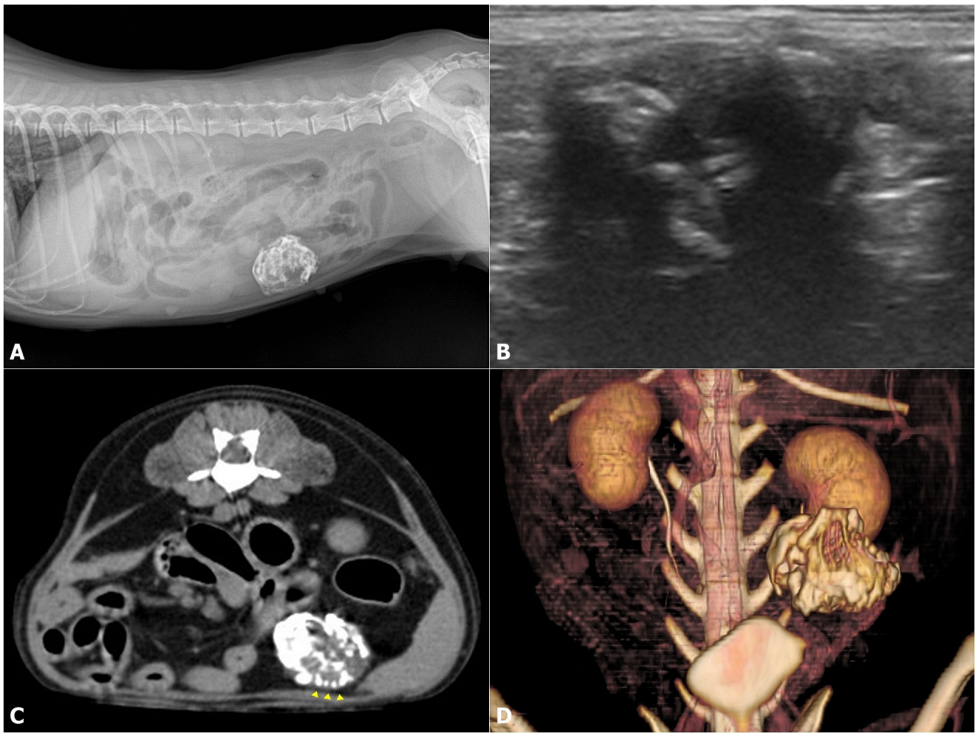

Figure 1. (**A**) Lateral abdominal radiography. A round-shaped mass with bony opacity was identified in the ventral mid-abdomen. (**B**) Ultrasonography of abdomen. Hyperechoic foci were revealed, with no vascular response in the mass. (**C**) CT scan of abdomen. There is no evidence of continuity with any other abdominal organs except possible adherence to the ventral aspect of the abdominal wall and segments of the intestines. Bony attenuated structures arranged in discontinuous and consistent patterns were observed in the mass (arrowheads). (**D**) 3D-reconstructed CT image

elected for laparotomy to be performed for removal of the mass and ovariohysterectomy.

The patient was pre-medicated with intravenous (*i.v.*) 0.2 mg/kg butorphanol, 0.3 mg/kg midazolam, and subcutaneous (*s.c.*) 0.2 mg/kg meloxicam. General anaesthesia was induced with 6 mg/kg propofol *i.v.* and maintained with 2% isoflurane in oxygen. Routine surgical preparation was done and a midline laparotomy was performed. Abdominal exploration revealed a mass completely covered

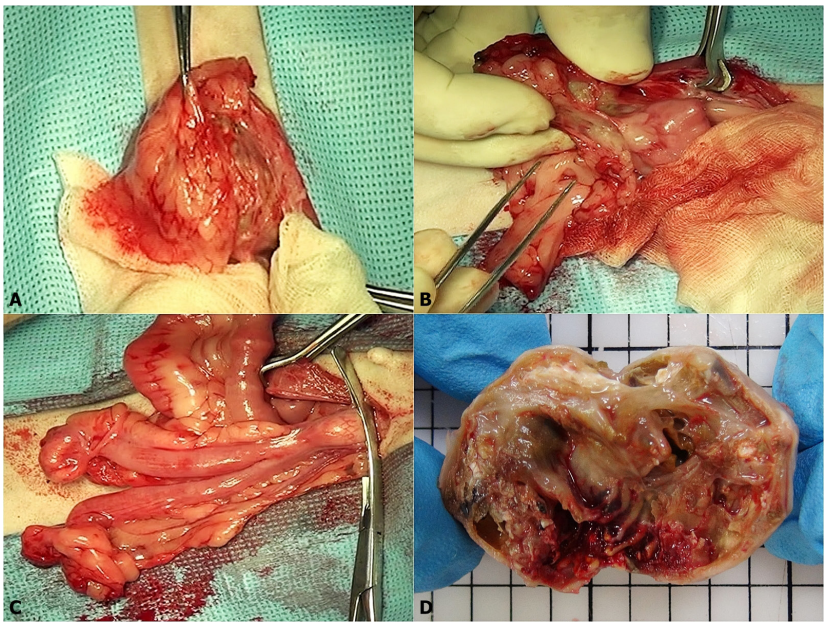

Figure 2. (**A**), (**B**) Photographs of the abdominal mass. The mass was surrounded with adherent omentum and jejunal mesentery. (**C**) Photograph of ovarian and uterine structure, which was grossly normal. (**D**) Photograph of excised mass. A dense capsule surrounds the internal tissues, which were amorphous and moderately autolysed

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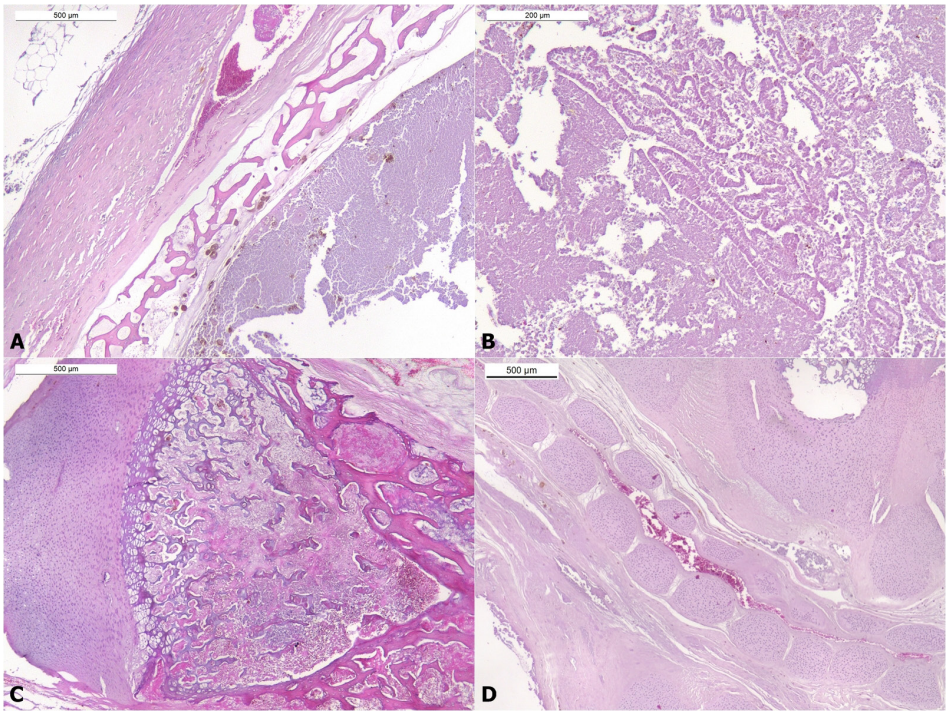

Figure 3. Photomicrographs of tissues from the excised mass. (**A**) Photomicrographs of fibrous outer capsule (staining: H&E; magnification: × 40). (**B**) Photomicrographs of epithelial cells in autolysed tissues resembling intestine and gland components (staining: H&E; magnification: × 100). (**C**) Photomicrographs of chondroid and osteoid structures (staining: H&E; magnification: × 40). (**D**) Photomicrographs of cord-like structures resembling embryonal vertebral column (staining: H&E; magnification: × 40)

with adherent omentum (Figure 2A) and jejunal mesentery (Figure 2B). Careful dissection was performed using Metzenbaum scissors and an electric surgical knife to remove the regions adhering to the mass. There were no direct blood vessels supplying the mass, and no serious haemorrhage associated with dissection of the mass from the abdominal cavity. The mass was resected from the abdomen. After the abdominal cavity had been inspected to ensure that no remarkable findings remained, ovariohysterectomy was performed. Ovary and uterus seemed grossly normal and hence were not subjected to histopathological examination (Figure 2C). The abdominal cavity was flushed several times with sterile saline and closed routinely. The patient was prescribed 22 mg/kg cefazolin *i.v.* and 0.2 mg/kg meloxicam *s.c.* for three days as post-operative treatment. Subsequently, 22 mg/kg cephalexin hydrate and 2.2 mg/kg celecoxib were orally administered twice daily for seven days. Ten days after the surgery, at the time of suture removal, the patient had recovered and exhibited normal vitality.

The excised mass was round-to-oval in shape, and was firmly attached to adipose tissue. On the cut section, a dense, firm capsule was observed surrounding the amorphously shaped autolysed internal tissues (Figure 2D). Histopathological examination revealed a relatively thick outer fibrous capsule surrounding the eosinophilic, acellular autolysed tissues (Figure 3A). These autolysed tissues contained variable amounts of cytoskeletal residues of epithelial cells resembling intestinal and gland components (Figure 3B). In addition to autolysed tissues, chondroid and osteoid structures were identified which resembled embryonal endochondral ossification (Figure 3C). These chondroid and osteoid structures were arranged in a cord-like fashion, mimicking a vertebral column (Figure 3D).

On the basis of imaging, operative findings and histopathological examination, a final diagnosis of an abdominal ectopic pregnancy was made.

DISCUSSION AND CONCLUSIONS

Ectopic pregnancy occurs when a foetus attaches in an abnormal location outside the uterus (Corpa 2006). Regarding localisation, two types of ectopic

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pregnancies are recognised: tubal and abdominal ectopic pregnancies (Corpa 2006). A tubal ectopic pregnancy occurs when a fertilised oocyte is implanted within the oviduct (Corpa 2006). A tubal ectopic pregnancy is the most common type of ectopic pregnancy in humans, but is rarely found in domestic animals because of the different physiology of the uterus between humans and animals (Hunter 1994; Corpa 2006). An abdominal ectopic pregnancy occurs when the foetus becomes settled in the abdominal cavity (Corpa 2006). All reported cases of ectopic pregnancy in dogs were abdominal ectopic pregnancies (Eddey 2012). Abdominal ectopic pregnancies are categorised into primary or secondary depending on their aetiology (Corpa 2006). Primary abdominal pregnancies occur as a result of implantation of a fertilised egg on the peritoneal or omental surface (Corpa 2006). Primary abdominal pregnancy is usually not diagnosed in domestic animals (Corpa 2006). Because of differences in placental anatomy, it is probably even impossible for them to develop a primary abdominal pregnancy (Segura Gil et al. 2004; Corpa 2006). Histologically, trophoblastic growth or neovascularisation into the supporting tissue are characteristics of a primary abdominal pregnancy (Berghella and Wolf 1996). A secondary abdominal pregnancy is a condition in which a foetus enters the abdominal cavity because of rupture of the uterine wall, usually as a result of trauma or injury (Hajurka et al. 2005; Corpa 2006). On histological examination, the foetuses are usually found to have a well-organised surrounding fibrous membrane and moderately autolysed internal organs (Corpa 2006). Histological evidence of placentation, an extrauterine foetus, and rupture of uterine structures are required to differentiate primary and secondary abdominal pregnancies (Corpa 2006). All cases lacking histological evidence of trophoblastic growth or neovascularisation should be classified as secondary abdominal pregnancies (Berghella and Wolf 1996).

In the present case, no cicatricial tissue was grossly visible in the uterus, but histopathological examination of ovarian and uterine structures was not performed to search for microscopic evidence of uterine pathology. The myometrium is known to be regenerative with little or no scar tissue (Corpa 2006). Given the state of the foetus in the abdomen, there would have been enough time for the injured uterus to heal. In addition, there was no vascularisation into the foetal tissues and the histopathological characteristics of the foetus were similar to those usually described for foetuses in secondary abdominal pregnancies. Considering these observations, this case should be regarded as a secondary abdominal ectopic pregnancy.

Clinical signs of ectopic pregnancy are variable, and sometimes include gastrointestinal tract disorders such as abdominal distension, anorexia, vomiting, and diarrhoea (Peck and Badame 1967; Corpa 2006; Eddey 2012). These clinical signs are usually thought to be related with extraneous infections, mechanical disturbance of abdominal organs, or necrosis of the tissue of the ectopic foetus (Corpa 2006). In most of the reported cases, including the present case, dogs carrying extrauterine foetuses are apparently healthy and diagnosis of the ectopic pregnancy is usually an incidental finding.

An abdominal ectopic pregnancy should be included in the differential diagnosis if an intact female dog presents with an abdominal mass, particularly a teratoma, either with or without the presence of clinical signs (Buergelt and Russell 2004; Eddey 2012). In humans, diagnosis of ectopic pregnancy includes analysis of serum β-human chorionic gonadotropin and progesterone levels, ultrasonography, diagnostic laparoscopy, and endometrial biopsy, among others (Corpa 2006; Sivalingam et al. 2011). Although ultrasonography is the most preferred method in the diagnosis of ectopic pregnancy, CT or magnetic resonance imaging (MRI) can also provide sufficient evidence to make a diagnosis if clinical prediction has not been confirmed (Anderson et al. 2009; Kao et al. 2014). CT and MRI methods allow more accurate and rapid diagnosis by dint of sectional imaging (Febronio et al. 2012; Kao et al. 2014). Indeed, CT and MRI play increasingly important roles in the diagnosis of ectopic pregnancies (Febronio et al. 2012). In animals, diagnosis of ectopic pregnancies is made on the basis of radiography, ultrasonography, and operative findings (Eddey 2012). In the present case, there were no clinical signs or known history of parturitions. Furthermore, the abdominal ectopic foetus was calcified and autolysed, resulting in an uncertain radiographic or ultrasonographic diagnosis. However, the vertebral column of the foetus was identified using CT, and this was confirmed on histopathological examination. As a result, an ectopic pregnancy was diagnosed. As an additional investigative method in ectopic pregnancy, CT may assist in the diagnosis and planning of treatment. Histopathological examination is also recommended.

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In human ectopic pregnancies, various types of management are acceptable: surgical treatment, medical treatment, and expectant management (Corpa 2006; Sivalingam et al. 2011). The only recommended treatment in the literature for canine ectopic pregnancies is surgical resection of the ectopic foetus, regardless of ovariohysterectomy (Corpa 2006). Considering the outcomes in the small number of reported cases, prognosis following surgical resection of the foetus is excellent (Peck and Badame 1967; Shamir and Shahar 1996; Buergelt and Russell 2004; Shino et al. 2005; Desai and Tiwari 2009; Eddey 2012).

In conclusion, canine ectopic pregnancies are rarely diagnosed and have been reported only a limited number of times. The patient described in this case had a secondary abdominal ectopic pregnancy with no scar tissue grossly visible in the uterus. The ectopic pregnancy was diagnosed successfully using CT. To the best of our knowledge, this is the first case report in which ectopic pregnancy has been diagnosed using CT in dogs. This suggests that CT may be useful as an additional diagnostic method of ectopic pregnancies in veterinary medicine. An ectopic pregnancy should be included in the differential diagnosis of a dog presenting with an abdominal mass. Surgical resection of the foetus is recommended whether clinical signs are present or not.

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Received: 2015–04–29
Accepted after corrections: 2015–12–09

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