

Correction of diaphragmatic hernia using the transverse colon in a dog

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Abstract

A 3-year-old female Golden Retriever was referred with weakness, tachypnea and dyspnea. An incomplete diaphragmatic silhouette, gas-filled small intestine and pleural effusion in the thoracic cavity were revealed in radiographs, implying a diaphragmatic hernia. After laparotomy, the abdominal structures were gently retrieved into the abdomen and a defect of 2×7 cm² was found. The transverse colon was used as an autologous tissue flap for the repair of the defect. There were no complications identified for 2 years after surgery. Thus, patching with the transverse colon can be considered as an alternative for treating a defect in patients with a diaphragmatic hernia.

Keywords: colon, diaphragmatic hernia, dog, dyspnea, mesh

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Introduction

The diaphragm, a structure that separates the abdominal and thoracic organs, assists in ventilation and plays an important role in the movement of lymphatic fluid. Diaphragmatic hernia (DH) is a displacement of the abdominal structures into the thoracic cavity through a defect of the diaphragm. The condition is commonly found in dogs and cats and may be either congenital or the result of trauma (Ricco and Graham, 2007). A traumatic DH generally develops as a result of animal attack, vehicular or other blunt trauma (Wilson and Hayes, 1986). Diagnosis is usually made by physical examination followed by thoracic radiography (Stokhof, 1986). Thoracic radiographs may reveal loss of diaphragmatic silhouette, gas-filled viscera within the thorax and loss of normal lung field (Hoddinott, 2013). Dyspnea and exercise intolerance are the most common clinical signs in patients with DH (Ricco and Graham, 2007; Stokhof, 1986). Surgical repair of traumatic DH is necessary to perform reduction of abdominal structures, relieve respiratory distress and reestablish diaphragmatic function (Vesal and Meimandi Parizi, 2012). Surgical repair is generally recommended after stabilizing the patient. However, acute DH with severe dyspnea requires immediate surgery because some patients die during preoperative stabilization (Gibson *et al.*, 2005). In most cases, the defect can be closed with direct sutures. However, in some cases where primary closure cannot be accomplished, other means of repair include the use of autogenous grafts like omentum, liver or fascia, closure of the defect with muscle flaps or the insertion of prosthetic materials such as polypropylene mesh, a polytetrafluoroethylene patch or lyophilized dura mater (Andreoni and Voss, 2009; Dalla Vecchia *et al.*, 1999; Nasr *et al.*, 2010). This report describes the clinical signs, diagnosis and surgical outcomes of DH treated by patching with the transverse colon in a dog.

Case description

A three-year-old intact female Golden Retriever weighing 28 kg was referred to the Veterinary Teaching Hospital for weakness, tachypnea and dyspnea after parturition. On physical examination, the rectal temperature was 39.2°C. The heart rate and systolic blood pressure were 89 beats per minute and 145 mmHg, respectively. Complete blood counts showed leukocytosis and anemia. Biochemical profile showed decreased total protein (4.7 g/dl) and albumin (2.0 g/dl) levels and an increased alkaline phosphatase (116 IU/L) level. No abnormalities were noted from the blood electrolytes examination. Thoracic radiographs showed pleural effusion, gas-filled small intestine in the thoracic cavity and dorsal deviation of the trachea. Cardiac and diaphragmatic silhouette were not well-defined (Fig. 1). Oxygen was initially administered to the patient via an oxygen mask. Preoperative medication included tramadol (3 mg/kg IV; Maritrol, Jeil Pharm, Korea), ampicillin-sulbactam (30 mg/kg IV; Sulbacin®, Dongkwang Pharm, Korea) and cimetidine (10 mg/kg IV; H-2, JW Pharmaceutical, Korea). After a blood cross-matching test, a whole blood transfusion (total 200 ml) was performed. General anesthesia was induced with acepromazine

(0.02 mg/kg SC; Sedaject®, Samu median, Korea) and propofol (5 mg/kg IV; Provive 1%, Myungmoon Pharm, Korea). After inducing anesthesia, the patient was intubated and positive pressure ventilation attempted. Anesthesia was maintained with isoflurane (Terrell™, Piramal Critical Care, Inc., USA). After surgical preparation of the ventral part of the chest and abdomen, ventral midline laparotomy was performed and revealed a large defect of the dorsal portion of the diaphragm (Fig. 2A). The gas-filled small intestine, some parts of the stomach, the omentum and the liver were gently detached from surrounding tissues and repositioned into the abdomen. After repositioning the abdominal structures, a defect of approximately 15 cm as well as a 2 × 7 cm² was confirmed in the dorsal part of the right diaphragm. Half of the defect was closed using 1-0 polyglyconate (Maxon™, U.S Surgical Corp., USA) by simple interrupted suture. However, the defect of 2 × 7 cm² could not be closed with only primary sutures. Thus, the transverse colon was used to repair the residual defect of the hernia (Fig. 2B). A longitudinal incision was made in the transverse colon to a length similar to the defect. Care was taken not to penetrate the lumen of the transverse colon. Each edge of the seromuscular incision was sutured separately to the defect. A simple interrupted suture using 1-0 polyglyconate was applied. A thoracostomy tube was placed into the thoracic cavity to remove residual air and pleural effusion. After intraperitoneal lavage, routine closure was performed. Postoperative analgesia was provided with tramadol (3 mg/kg IV) and ketamine (3 µg/kg/min IV; Ketamin®, Yuhan Corporation, Korea). Oxygen was delivered to the patient via an intranasal tube for 3 days. The chest tube was removed 7 days after surgery. Vital signs were stable and there were no complications associated with the surgery. No signs of herniation of the abdominal contents and intact thoracic cavity were confirmed by radiography. The gas-filled transverse colon was found near the diaphragm (Fig. 3). The dog was discharged from hospital 9 days after the surgery and no complications were found during 2 years of follow-up.

Discussion

DH can occur after blunt trauma in small animals due to severe changes in abdominal and thoracic pressure (Gibson *et al.*, 2005). The primary cause of the diaphragmatic rupture in this patient was thought to be a sudden increase of intra-abdominal pressure during parturition. Overall, the distribution of the left-sided and right-sided DH is uniform in dogs and cats (Stokhof, 1986; Wilson and Hayes, 1986). In this case, the defect was found in the right diaphragm. Although no pathognomonic sign had been identified, respiratory signs predominate and 38% of affected animals are reported to suffer from dyspnea and exercise intolerance (Stokhof, 1986). Although the defect of DH can be reduced primarily, some defects are too large to repair. In some chronic hernias, the muscles around the edges may be rolled over, atrophied and contracted by scar tissue, becoming difficult to close only with sutures. Some options for closing the defect include omental or muscle flaps,

autologous fascia, liver, periosteum, small intestinal submucosa, synthetic implants or collagenous xenografts (Andreoni and Voss, 2009; Durrani *et al.*, 2011; Sandoval *et al.*, 2006). A variety of materials including reinforced silastic, marlex mesh and teflon sheets have been used to close the defect (Grethel *et al.*, 2006). Synthetic prosthetic materials used to repair diaphragmatic defects in infants do not grow as the patients grow up and their use can be associated with restricted chest wall development and a recurrence of the hernia (Dalla Vecchia *et al.*, 1999; Smith *et al.*, 2004). Furthermore, using autogenous grafts or muscle flaps is complex and requires prolonged surgical time and may lead to bleeding complications (Dalla Vecchia *et al.*, 1999). The transverse colon is a freely movable

organ and has a relatively thicker and wider muscular tissue compared to other intestines. The tensile strength of colon is higher than other intestines except for the duodenum in normal dogs (Ogurtan *et al.*, 2001). Therefore, in this patient, a tissue flap using the transverse colon was applied to close the diaphragmatic defect and no complications related to DH were observed for 2 years after the surgery. The limitation of using the transverse colon for repairing the defect in DH is that it is difficult to apply on the left-sided DH due to the adjacent organs. Although further study is needed as only one case was evaluated in this study, the transverse colon can be considered as a potential autologous organ candidate for repairing a defect in DH.

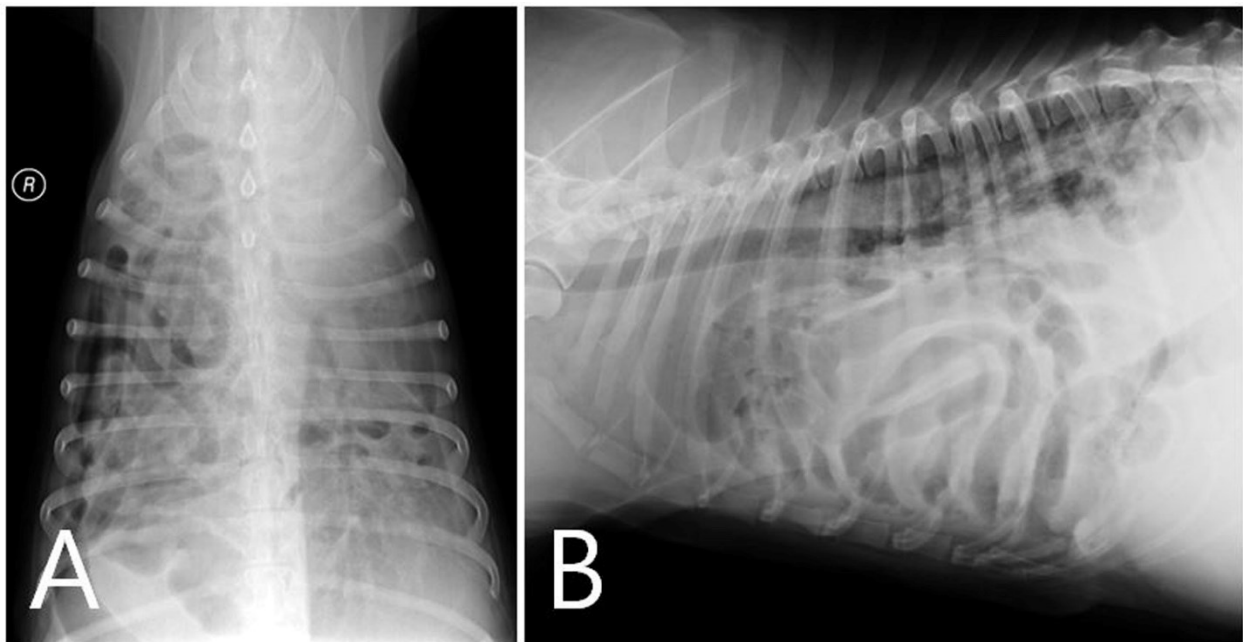


Figure 1 Plain radiographs showing incomplete diaphragmatic silhouette and herniated small intestine and pleural effusion in the thorax from dorsoventral (A) and lateral (B) views.

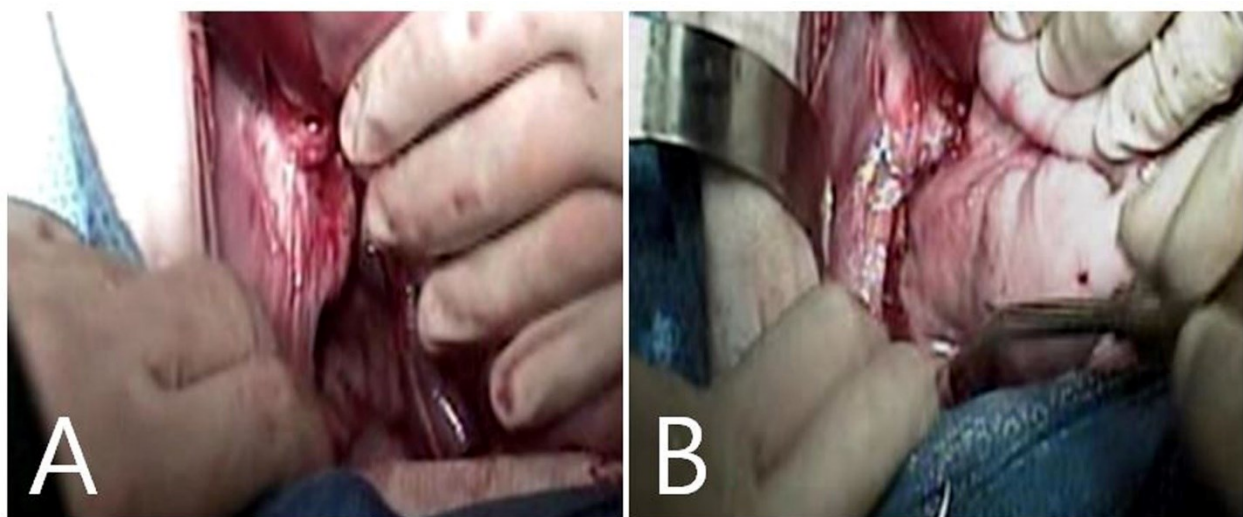


Figure 2 The defect of 2×7 cm² was observed in the dorsal part of the right diaphragm (A) and was repaired with the transverse colon (B).

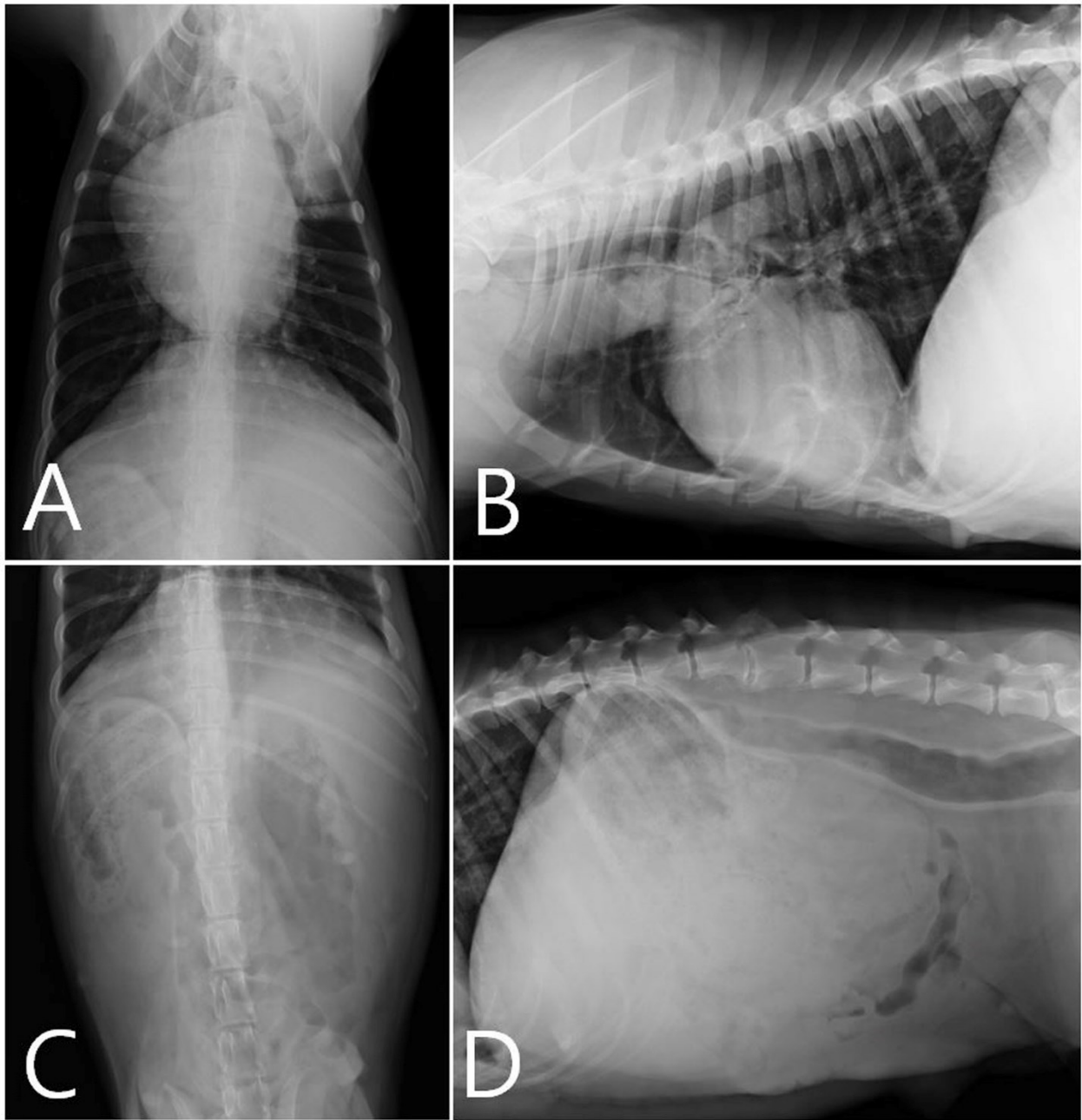


Figure 3 Plain radiographs of the thorax (A and B) abdomen (C and D) 7 days after the surgery. No signs of herniation of the abdominal contents were found and the gas-filled transverse colon was seen near the diaphragm.

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