

< Case Report >

Radiological assessment of pectus excavatum in a Pekingese dog

Sung-Jin Cho¹, Sunhwa Hong², Yung-Ho Chung³, Okjin Kim^{2*}

¹Family Animal Clinic, Gunsan 573-350, Korea

²Center for Animal Resource Development, Wonkwang University, Iksan 570-749, Korea

³Department of Companion Animal and Animal Resources Science, Joongbu University, Geumsan 312-702, Korea

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Abstract

Pectus excavatum (PE) is a ventral chest wall deformity, also known as funnel chest, sunken chest, chondrosternal depression or koilosternia. The 4 months old, 1.3 kg intact-female Pekingese dog was evaluated for acute semicoma and convulsion. The client reported that this patient have had chronic loss of appetite, intermittent dyspnea and palpable sunken breast. The other littermates did not show any abnormalities. On physical examination, cachexia (BCS 1/5), concave sternum, flatten thoracic cavity and cardiac murmur were observed. On radiographic study, the caudal sternum cave to vertebrae and narrowing thoracic cavity. The severities of thoracic deformity were evaluated by deformation indices such as-Frontosagittal index (FSI) and vertebral index (VI). Moderate to severe PE was founded by the radiological measurements.

Key words : Pectus excavatum, Funnel chest, Sunken chest, Koilosternia, Dog

INTRODUCTION

Pectus anomaly is a deformity of the thoracic wall in which several ribs and sternums grow abnormally, producing a convex (carinatum) or concave (excavatum) appearance to the ventral aspect of chest wall (Fossum, 2002; Williams and Crabbe, 2003). Pectus excavatum (PE) is a ventral chest wall deformity, also known as funnel chest, sunken chest, chondroserval depression or koilosternia. PE has been reported in animals, most frequently in cats (Crigel and Moissonnier, 2005; Fossum et al, 1989a; Fossum et al, 1989b; Green and Lindo, 1968; McAnulty and Harvey, 1989; Risselada et al, 2006) and dogs (Ellison and Halling, 2004; Fossum et al, 1989a; Fossum et al, 1989b; Pearson, 1973), but it is considered to be an uncommon abnormality. The exact mechanism involved is unknown (Boudrieau et al, 1990; Fossum, 2002; Fossum et al, 1989a; Smallwood and Beaver, 1977). Unbalanced overgrowth in the costochon-

dral regions that push the sternum inward seems to be the most prevalent theory for its pathogenesis in humans (Crump, 1992; Fonkalsrud, 2003). A postmortem dissection performed on a cat with PE showed that the primary abnormality involved the ventral portion of the diaphragm (Smallwood and Beaver, 1977).

No genetic defect has been found to be directly responsible for the development of PE (Boudrieau et al, 1990; Williams and Crabbe, 2003). However, familial occurrence of the pectus anomaly has been reported in humans (Creswick et al, 2006; Fonkalsrud, 2003; Williams and Crabbe, 2003) and in littermate dogs (Ellison and Halling, 2004; Fossum et al, 1989a; Pearson, 1973). Among the littermates that have been reported, 3 were setter cross breed (Pearson, 1973), 2 were pugs (Fossum et al, 1989a), and 2 were Welsh terriers (Ellison and Halling, 2004). A pedigree study of 34 human families provided evidence of an inherited disorder, probably multi-factorial, although some families showed apparent Mendelian inheritance (Creswick et al, 2006). In a retrospective study, 7 of 8 affected dogs

*Corresponding author: Okjin Kim, Tel. +82-63-850-6668,
Fax. +82-63-850-7308, E-mail. kimoj@wku.ac.kr

were brachycephalic breeds; no predisposition was evident (Fossum et al, 1989a). In addition, an association between flat chest and PE has been suggested in cats (Sturgess et al, 1997). Because of the potential for heritability, some authors have recommended that animals with PE be neutered (Shires et al, 1988). The deformity is usually congenital (Fossum, 2002; Fossum et al, 1989a).

Respiratory distress is the clinical sign most frequently observed by the owner (Fossum et al, 1989a), probably because the deformity becomes more pronounced during growth (Smallwood and Beaver, 1977). Chest asymmetry is quite variable (Fonkalsrud, 2003; Shires et al, 1988) and respiratory distress may be associated with displacement of the organs or restriction of ventilation (Fonkalsrud, 2003). The deformity is generally in the caudal part of the sternum (Fossum, 2002; Fossum et al, 1989a), but it was also reported in the cranial part in 2 dogs (Ellison and Halling, 2004).

Vertebral deformities, cardiomegaly, and malposition of the heart may be detected (Boudrieau et al, 1990; Fossum, 2002; Fossum et al, 1989a; McAnulty and Harvey, 1989) in association with PE. In humans, PE may occur as the only abnormality or in association with other syndromes, such as that of Marfan and Ehlers-Danlos (Crump, 1992; Fonkalsrud, 2003). In a retrospective study, the heart was displaced to the right in 2 dogs and to the left in 3 dogs and 4 cats (Fossum et al, 1989a). In another reported case in a cat, the cardiac silhouette was shifted into the right hemithorax (Risselada et al, 2006). In humans, heart murmurs and electrocardiogram (ECG) abnormalities, such as right-axis deviation and depressed ST segments have been asso-

ciated with displacement and rotation of the heart in PE (Crump, 1992; Fonkalsrud, 2003). Elevation of the ST segment could have been secondary to the ventricle hypertrophy and the sinus tachycardia could have been associated with stress (Tilley, 1992). However, in this report, no cardiac murmurs, ECG and echocardiographic abnormalities were detected.

The pre- and post operation frontosaggital and vertebral indices of the chest are measured according to Fossum and Ohno's method and widely employed in quantitative assessment of the degree of surgical correction (Fossum et al, 1989b). 3 common chest wall deformities (CWD) are known. 1) PE is sternal depression and concave chest; 2) Pectus carinatum (PC) is sternal protrusion and convex chest; 3) Flat chest (FC) is flattening rib cage. CWD result from costochondral unbalanced overgrowth, but the exact mechanism is unknown. CWD can be corrected surgically (Fossum et al, 1989b).

Here, we describe the usefulness of radiological assessment of thoracic deformity in a dog. This case was diagnosed as PE in a Pekingese dog.

CASE REPORT

The 4 months old, 1.3 kg intact-female Pekingese dog was evaluated for acute semicomma and convulsion. The client also explained that this patient had chronic loss of

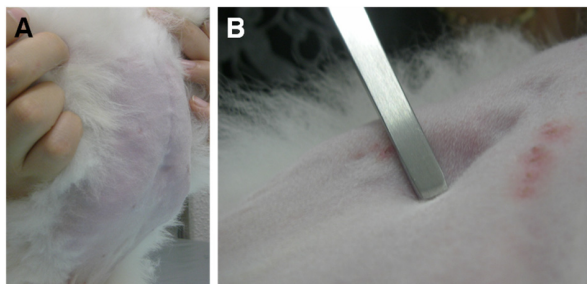


Fig. 1. The photography show flatten chest (A) and marked skin dimple on the caudal sternum (B).

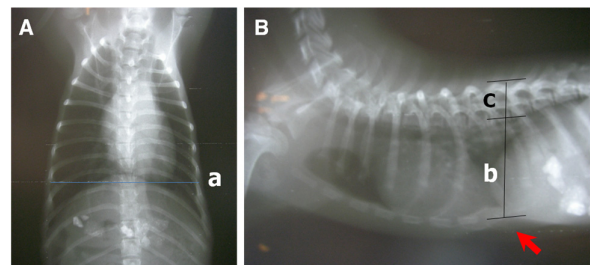


Fig. 2. Ventrodorsal (A) and right lateral thoracic radiographs of a 4 month old Pekingese with pectus excavatum. Mild deviation of the cardiac silhouette to the left hemithorax is present (A). The depression of the caudal sternum (arrow) resulting in dorsal compression of the cardiac silhouette and trachea against the thoracic spine are visible (B). a: the width of the chest, b: the depth of the thoracic wall, c: diameter of T10 body.

Table 1. Characterization of pectus excavatum on based on frontosagittal index and vertebral index in dog

Diagnostic index	FSI	VI
Normal	0.7~1.3 (1.00)	12.6~18.8 (15.0)
Mild PE	2.0	>9.0
Moderate PE	2.0~3.0	6.0~9.0
Severe PE	>3.0	<6.0
This case	2.39	7.6

PE: pectus excavatum. FSI=ratio between the width of the chest (Fig. 2A, a) and the depth of thoracic cavity (Fig. 2B, b) at T10. VI=ratio between the depth of the thoracic wall (Fig. 2B, b+c) and diameter of T10 body (Fig. 2B, c).

appetite, intermittent dyspnea and palpable sunken breast. The other littermates are did not show any abnormality. On physical examination, the dog was detected a cachexia (BCS 1/5), concave sternum, flatten thoracic cavity and cardiac murmur (Fig. 1). On radiographic study, the caudal sternum cave to vertebrae and narrowing thoracic cavity (Fig. 2). The severities of thoracic deformity were evaluated by deformation indices (Table 1). Frontosagittal index (FSI) and vertebral index (VI) were measured according to Fossum and Ohno's method (Fig. 2).

The degree of PE was evaluated by imaging exam (CT and radiography). Two radiological measurements (FSI= a/b and VI= $c+b/c$) were used in veterinary. In this case, the indices parameters are like this $a=7.9$; $b=3.3$; $c=0.5$ cm. The radiological measurements results of this case are moderate to severe PE (Table 1).

DISCUSSION

Hypothyroidism PE or funnel chest is an uncommon congenital anomaly of the chest wall, characterized by the dorsal deviation of the caudal sternum and associated costal cartilages or a ventral to dorsal narrowing of the entire thorax (Fossum, 2007). This defect has been reported in both dogs and cats, and can usually be diagnosed within the first few days following birth (Fossum et al, 1989a). Abnormal alignment of the sternum and costal cartilages are responsible for compressive cardiopulmonary dysfunction resulting in exercise intolerance, tachypnea, cyanosis, cardiac murmur,

arrhythmias, or respiratory distress (Fossum, 2007; Soderstrom et al, 1995). PE-associated cardiopulmonary dysfunction may be life threatening.

As reported by other authors, the frontosagittal and vertebral indices are important in defining the degree of the deformity (mild, moderate, or severe), as well as the response to the treatment (Boudrieau et al, 1990; Fossum et al, 1989a; Fossum et al, 1989b). Based on suggested values for determining the severity of the pectus anomaly (Boudrieau et al, 1990; Fossum et al, 1989a) as well as on the intensity of clinical signs, in this case, the indices parameters are like this $a=7.9$; $b=3.3$; $c=0.5$ cm. The radiological measurements results of this case are moderate to severe PE. Some anesthetic precautions are necessary during the surgical procedure for treating PE due to the age of the animal and the respiratory distress, such as avoiding an extended period of fast, maintaining body temperature, using anesthetic drugs that are easily metabolized, and using endotracheal intubation to provide airway access (Boudrieau et al, 1990; Fossum, 2002).

Corrective treatment using an external splint, as used in this case, may alleviate the impaired ventilatory performance when done in young animals, since the costal cartilages and sternum are pliable (Fossum et al, 1989b; McAnulty and Harvey, 1989; Shires et al, 1988). Possible complications with the method are damage to the internal thoracic vessels, heart, or lungs during the passage of the needle around the sternum (Fossum, 2002); fatal reexpansion due to pulmonary edema (Soderstrom et al, 1995); and postoperative skin abrasions, suture abscesses, and dermatitis (Fossum et al, 1989b). However, none of these was observed in the present case. 14-day duration has been indicated for the splint to remain in place, since overcorrection of the sternum may occur from longer placement (Boudrieau et al, 1990). The splint was maintained successfully for 20 days in this case. A pin inserted longitudinally through the manubrium in association with an external splint (Crigel and Moissonnier, 2005), or a plate applied to the ventral side of the sternum (Risselada et al, 2006) are alternative techniques that have been reported for use in young cats. In the case of older animals or those treated unsuccessfully with external splinting, surgical proce-

dures, such as partial sternectomy (Fossum, 2002) or osteotomy with external fixation (Shires et al, 1988), may be used.

Controversy remains as to whether the operative correction should be considered in all patients presenting with the pectus anomaly (Fossum, 2002), since untreated PE may be progressive (Fossum et al, 1989a) or have a spontaneous resolution (Crump, 1992; Ellison and Halling, 2004). Probably the age of the animal, the clinical signs, and the severity of deformity are important factors in this decision. Although compression of the thorax by the owner was recommended, as suggested in another report (Fossum et al, 1989b), the benefit from this procedure is questionable and probably should be limited to cases without significant deformity of the sternum.

This study showed radiological assessment is critical in the severity determination of PE.

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