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## Review Article

### Pericardial Cardiac Herniation and Strangulation in a Young Labrador Retriever

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## Abstract

Biventricular cardiac herniation through a rent in the apical pericardium in a two-year-old male Labrador retriever is described. The dog had no known history of thoracic surgery or trauma; nor did it have any history of other comorbidities. This case is compared to rare human pericardial rupture and heart luxation which is associated with high mortality and is a significant antemortem challenge diagnostically. In the veterinary literature, this is the first description of pericardial cardiac herniation.

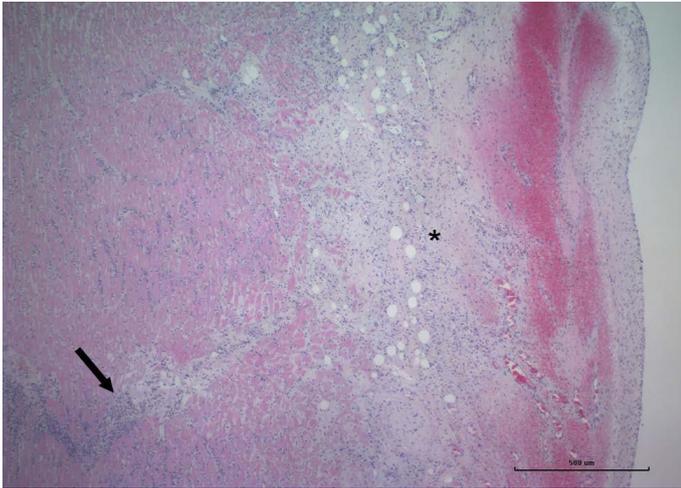
**Keywords:** Heart; Canine; Pericardial Hernia; Trauma; Tamponade

**Text:** An approximately 30 kg, two-year-old intact male Labrador retriever with a body condition score of three out of five and mild postmortem autolysis was examined at necropsy. The dog was examined because of a history of sudden death with few premonitory signs. Orally, mild dental tartar was present on both dental arcades. Within the thorax, the lungs were red-brown, moist, and exuded clear fluid on sectioning. The pericardium had an approximately 8 cm diameter hole at its apex which formed a constricting band around the heart approximately 5-6 mm distal to the atrioventricular junction (figure 1). Most of the heart's apex and ventricles were herniated through the pericardial defect; there was a clear line of demarcation between normal-appearing heart base and reddened, swollen (congested) apical myocardium at the point of pericardial constriction. Within the intact pericardium at the heart base, the pericardial space contained approximately 3-5 ml of serosanguineous fluid. In the abdomen, the liver had rounded margins, was enlarged 10 to 20%, and exuded copious sanguineous fluid on sectioning (congested). No other significant gross lesions were seen. Non-cardiac histologic lesions included pulmonary edema and hepatic congestion. Sections of heart confirmed apical epicardial congestion in addition to epicardial fibrosis, myocardial

atrophy and fibrosis, mild pyogranulomatous inflammation, and myocardial necrosis at the site of pericardial stricture (figure 2).



**Figure 1.** The pericardium had an approximately 8 cm diameter hole at its apex which formed a constricting band around the heart approximately 5-6 mm distal to the atrioventricular junction. Most of the heart's apex and ventricles are herniated through the pericardial defect. There was a clear line of demarcation between normal-appearing heart base and reddened swollen (congested) apical myocardium at the point of pericardial constriction. Bar = 1 cm.



**Figure 2.** Epicardial congestion, hemorrhage, and fibrosis (\*) overlies myocardial atrophy and fibrosis, mild pyogranulomatous inflammation, and myocardial necrosis at the site of pericardial stricture (arrow). Bar = 500  $\mu$ m.

As alluded to previously, the only signs seen prior to death included four days of lethargy and 24 to 48 hours described by the dog's owner as "difficulty getting comfortable." No evidence of thoracic trauma or previous thoracic surgery was noted by the owner or seen during necropsy. Given the constellation of findings, the dog was thought to have died from a cardiac tamponade-like phenomenon associated with a progressively constricting pericardium causing right ventricular collapse. Evidence of left heart failure was also present (pulmonary edema) suggesting that left ventricular function was compromised.

To our knowledge, this is the first published case of pericardial cardiac herniation in a dog. Although rare, transpericardial cardiac herniation and luxation have been described numerous times in the human literature [1-10]. The phenomenon in humans often results in complete cardiac herniation and luxation (levorotation [1-3] or dextrorotation [4]) from the normal cardiac position in the thorax. In those cases where there is fatality from partial herniation of the heart through a pericardial tear, the pathophysiology mimics cardiac tamponade [5]. Pericardial constriction-induced right ventricular tamponade is quite common in heart herniation; in one case series half the pericardial tears with heart herniation resulted in constriction of the heart [6]. Most cases of pericardial rupture in humans are associated with trauma, but at least one case of herniation in a transplant patient has been described [7]. Pericardial rupture can lead to either acute cardiac displacement and hemodynamic instability or can occur with some delay after inciting trauma [1,2,8]. Additionally, concurrent pericardial rupture and other heart chamber rupture can often complicate diagnosis of the heart rupture due to lack of the tamponade effect provided by an intact pericardial sac [9].

Antemortem recognition of pericardial tears and concurrent cardiac anomalies is a diagnostic challenge in humans even without primary cardiac damage – especially without an index of suspicion that such trauma has occurred. In the minority of cases that arrive at the hospital with vital signs,

a variety of imaging modalities have been used to try to document pericardial injury. Published imaging techniques confirming pericardial trauma and subsequent cardiac compromise include thoracic radiography [10], multidetector computed tomography [10], video-assisted thoracoscopy [3], echocardiography [2], and magnetic resonance imaging [11]. Despite frequent use of such imaging, the majority of human diagnoses are not made until the time of emergency thoracotomy [1,4,12]. An even greater proportion of diagnoses are not made until autopsy. In the present case, there was no evidence of current or past trauma, nor was there any history of thoracic surgery. Nevertheless, the pericardial defect was thought to have arisen due to past trauma; however a congenital anomaly cannot be excluded. As seen in humans with cardiac herniation and strangulation, the cause of death in this dog was thought to be cardiac tamponade.

There are several reasons why this rare human entity would be even rarer in dogs. Many of the cases in humans result from vehicular accidents where there is blunt trauma to the sternum with deformation and rapid acceleration and deceleration shearing forces [4]. Dogs are much more likely to sustain trauma to the lateral thorax where pulmonary structures provide more of a cushion against pericardial injury. Given the significant diagnostic challenge in humans with this condition, antemortem diagnosis in this dog would have been very difficult without exploratory thoracotomy.

## Conclusion

In summary, this is the only case of published pericardial defect with biventricular cardiac herniation described to date in the veterinary literature.

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