

TREATING PPDH IN CATS AND DOGS

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ROGER WILKINSON, ANDREW CHANCE explore how congenital peritoneopericardial diaphragmatic hernia (PPDH) can be dealt with

CONGENITAL peritoneopericardial diaphragmatic hernia (PPDH) is a condition in which the peritoneal cavity communicates directly with the pericardial sac, allowing herniation of abdominal viscera into the pericardium.

Acquired PPDH is not seen in cats and dogs – they have complete separation between the diaphragm and pericardium under normal circumstances ([Figure 1](#)). The liver is the organ most commonly displaced into the pericardium, but the omentum, small intestine and/or stomach may be involved ([Figure 2](#)).

PPDH defects are found in the ventral part of the diaphragm, in the area where the developing liver interacts with the foetal septum transversum. Disordered development in this area may result in a complex of abnormalities, including missing, fused or deformed sternabrae, pectus excavatum, incomplete xiphoid, PPDH, cranial midline abdominal (“umbilical”) herniation, intrapericardial cysts and congenital heart defects (such as ventricular septal defect). The possibility of PPDH should always be considered when dealing with a patient with a large umbilical or cranial abdominal hernia (or a history that indicates a repair of such a defect – [Figure 3](#)) or sternal malformation. Congenital diaphragmatic defects resulting in communication between the pleural cavity and peritoneum is one of the more common birth defects in man, but it is rare in cats and dogs.

Prevalence

PPDH may not be uncommon, especially in cats. Estimates of prevalence in the general population range from up to one in every 1,850 cats and one in every 5,200 dogs. However, many cases are asymptomatic and may be detected as an incidental finding during diagnostic procedures prompted by other conditions, particularly in ageing animals. In one series, 27 out of 67 cats were diagnosed as incidental findings.

Affected animals may become symptomatic if abdominal viscera migrate into the pericardium and cause gastrointestinal or circulatory compromise. Typically, these patients present symptoms in the first few years of life. Weimaraners, cocker spaniels and Persian, Himalayan or domestic longhair cats may be at greater risk.

Viscera

Entrapment of abdominal viscera within the pericardium may lead to the development of signs in a previously asymptomatic animal. The range of possible presenting complaints is extensive, and PPDH cases are sporadically encountered unexpectedly during the investigation of many types of problems. Malaise, ill thrift, weight loss, anaemia, weakness, hypoperfusion, tachypnoea, respiratory distress, fever, vomiting, diarrhoea and anorexia are all reported.

Pleural and/or abdominal effusions may result from right heart failure caused by compression of the heart. Thoracic auscultation may reveal asymmetric muffling of cardiac sounds. Typically, the condition of such patients deteriorates over a period of a few days and weeks. Really acute presentations are uncommon.

Radiography

On radiography, affected animals typically have an enlarged, rounded cardiac silhouette, and a continuous diaphragm cannot be defined ([Figure 4](#)).

Because the dimensions of the viscera contained within do not fluctuate, the margins of the silhouette appear sharper than in patients with generalised cardiomegaly or heart failure, in which the margins move with the cardiac cycle.

Other radiographic signs of heart failure, such as pulmonary oedema or distention of pulmonary veins, are absent in PPDH cases. A radiographic finding, described as the dorsal peritoneocardial mesothelial remnant, has been described in cats with PPDH. This appears as a curvilinear soft tissue density between the caudal aspect of the cardiac silhouette and the diaphragm on a lateral view ([Figure 5](#)).

If gas-filled gut loops are present in the pericardium, the diagnosis is relatively straightforward ([Figure 5](#)). The abdomen may appear relatively empty if, for example, the liver or small intestine are displaced.

Positive contrast peritoneography is a relatively simple tool that is usually, although not invariably, diagnostic ([Figure 6](#)) – especially in young animals that have not developed adhesions. In dogs with a ventral midline hernia, a few millilitres of contrast are needed to be introduced into the hernial sac.

Echocardiography

Echocardiography is probably the diagnostic tool of choice in suspected PPDH. There is frequently a degree of pericardial effusion. The presence of liver, omentum or small intestine within the pericardium and adjacent to the heart with no intervening diaphragm or pericardium is diagnostic ([Figure 7](#)). Where liver lobes are entrapped, there may be evidence of blood stasis or thrombosis in the hepatic veins ([Figure 8](#)). Devitalisation of affected viscera may be apparent as a change in echodensity.

Treatment

Treatment of symptomatic PPDH is surgical. Conservative management led to death in two out of 22 cases in one published feline case series. In cases diagnosed at a young age, it has been suggested that early repair at eight to 16 weeks of age is advisable ([Figure 9](#)). At this age, there certainly seems to be fewer adhesions to overcome. The possibility of later entrapment and compromise of herniated organs is avoided and the flexibility of tissues involved facilitates the restoration of normal anatomy.

Pre-operatives

Pre-operative treatment with a broad-spectrum antibiotic is advisable. Strangulated liver lobes often contain a cocktail of bacteria and their toxins, which would be released at surgery.

The diaphragmatic defect is accessed through a cranial midline laparotomy. Care should be taken when incising, as the herniated viscera are immediately ventral to the incision site.

Due to variable malformation of the sternum and ribs associated with PPDH, in some animals it may be necessary to extend the laparotomy incision cranially into the sternum, or to cut through ribs, to achieve adequate access ([Figure 10](#)). In some cases, engorgement of entrapped viscera or adhesions may complicate their return to the abdomen. If there has been significant vascular compromise, release of the affected organ may result in a sudden surge of vasoactive agents into the general circulation and an abrupt deterioration in circulatory parameters. This can be the most dangerous part of the procedure, especially since many patients will be small (young) and often in suboptimal body condition. Such scenarios may be anticipated in advance when entrapped viscera appear abnormal on ultrasonography or when a pericardial tap reveals sanguinous exudate.

Reconstruction of the diaphragm is performed after debridement of the margins of the defect. The

pericardial sac should not be closed. Postoperative complications are not uncommon. Fever is common and may result from pyrogenic agents released from previously entrapped viscera.

Once the patient has survived the immediate postoperative period, the prognosis for a normal lifespan is generally excellent, unless there are associated congenital heart defects; these are not common, however.



Figure 1. Acquired PPDH is not seen in dogs and cats. However, Weimaraners are among several dog breeds that are at risk from congenital PPDH.

Photo: ISTOCKPHOTO/JASON BOESELAGER.

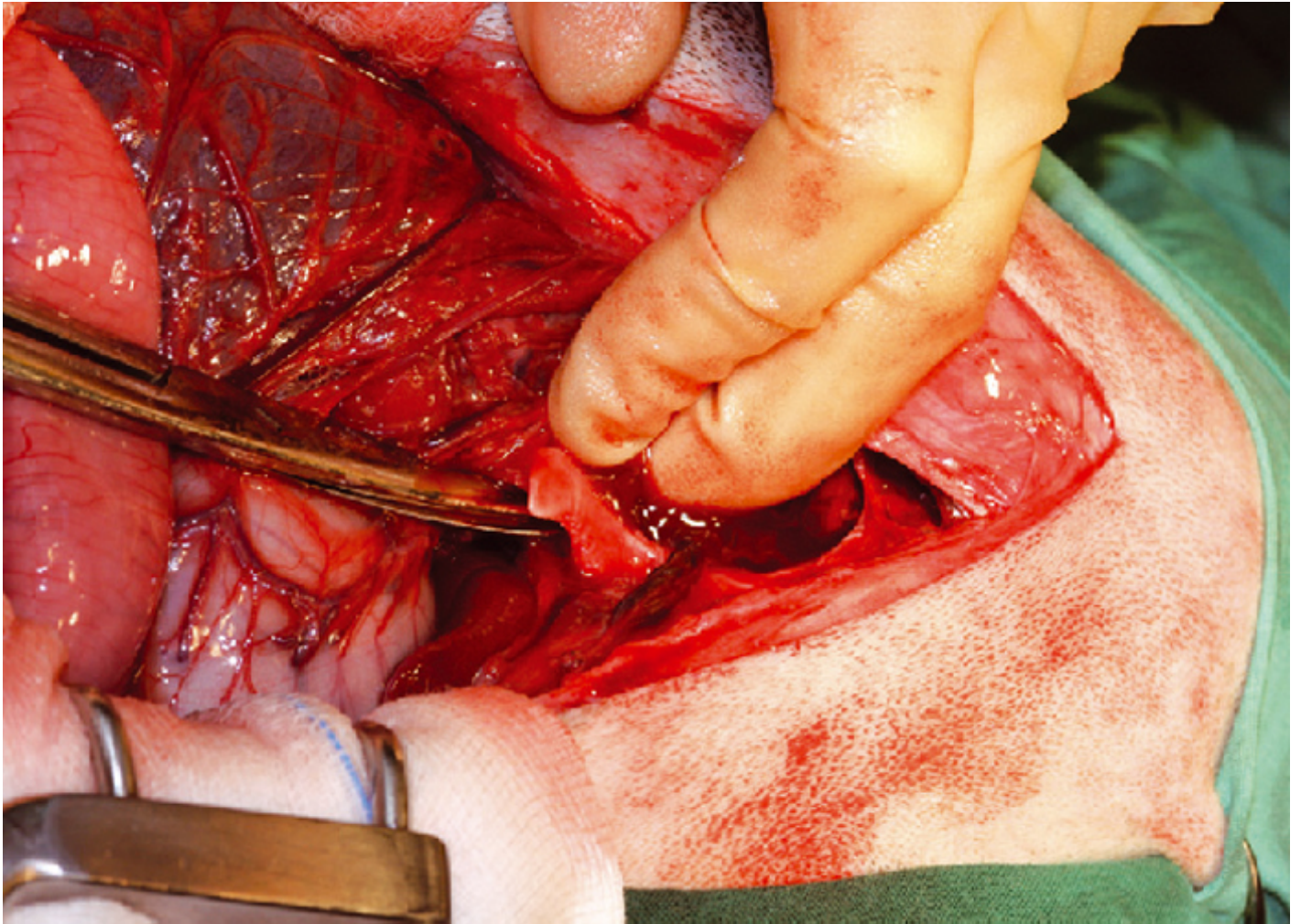


Figure 10. Malformed ribs and sternbrae may have to be negotiated or resected to gain adequate access.

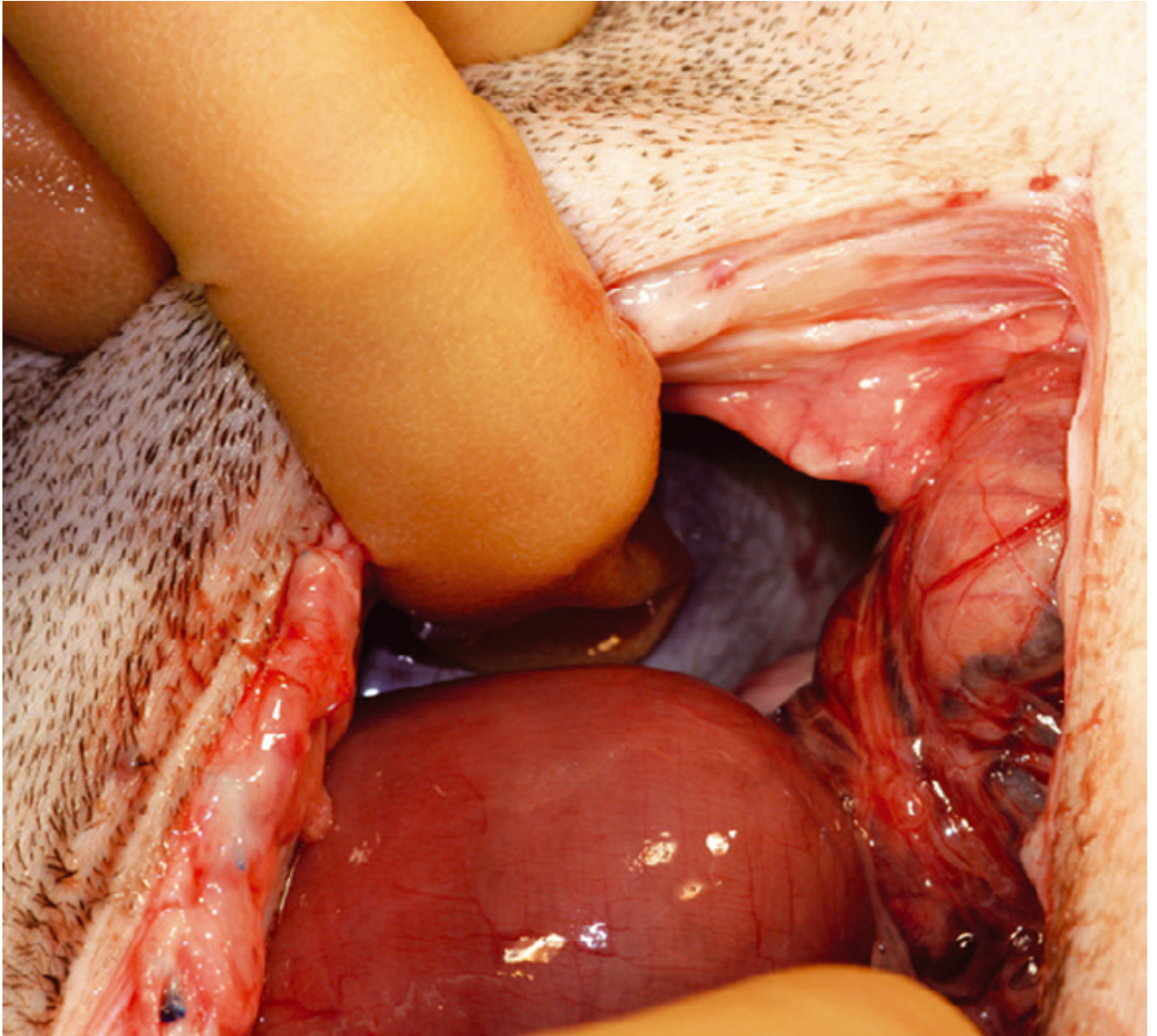


Figure 2. PPDH defects occur in the ventral part of the diaphragm. In this case, the omentum and

small intestine are entrapped within the pericardium.



Figure 3. This bulldog has had a large cranial midline abdominal hernia repaired as a pup. Veterinary surgeons should be aware of the possibility of concurrent PPDH in such cases.

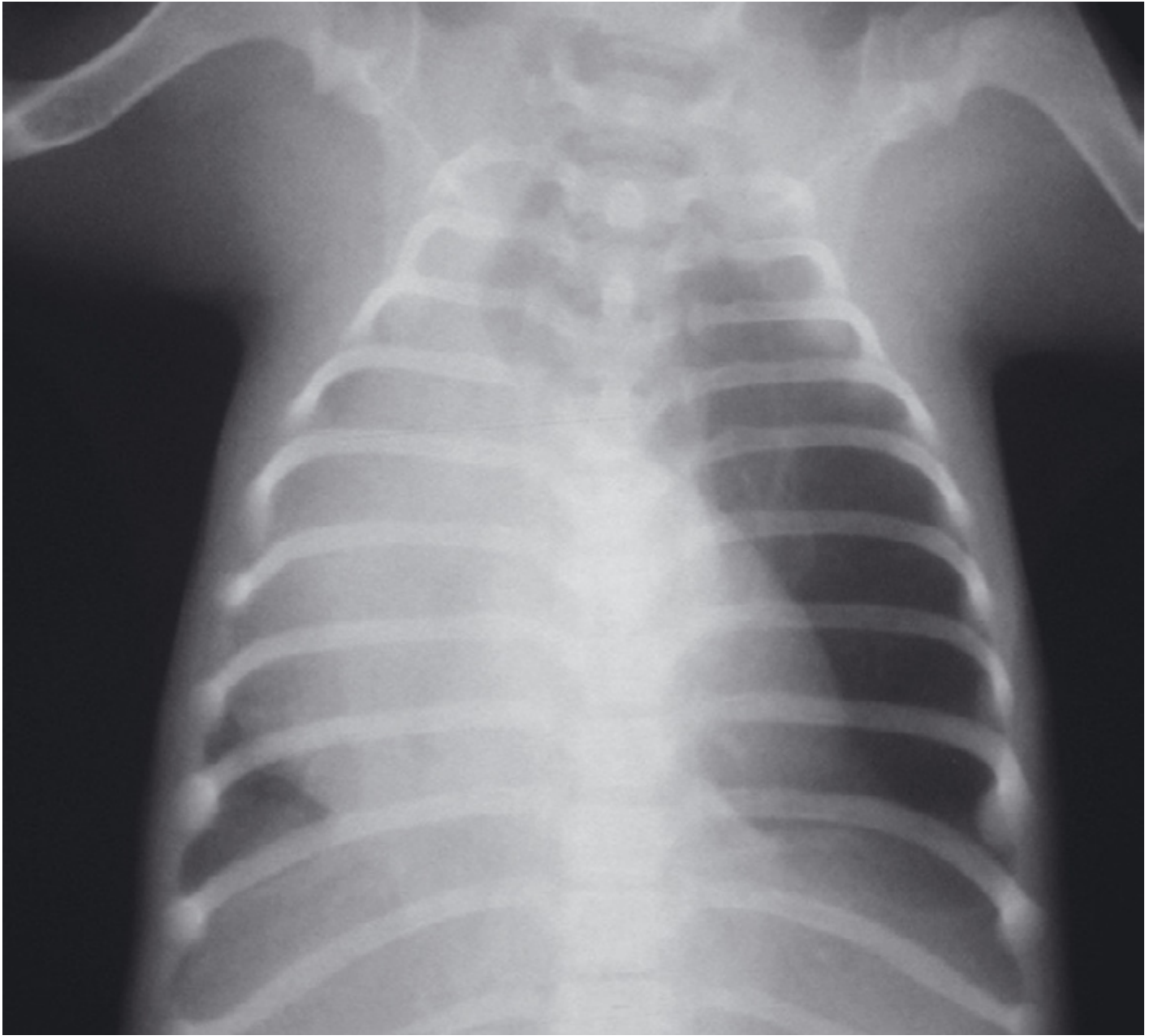


Figure 4. A dorsoventral chest x-ray of an eight-week-old pup with PPDH. Note that the cardiac silhouette is very large, is incompletely separated from the diaphragm and has sharp margins.

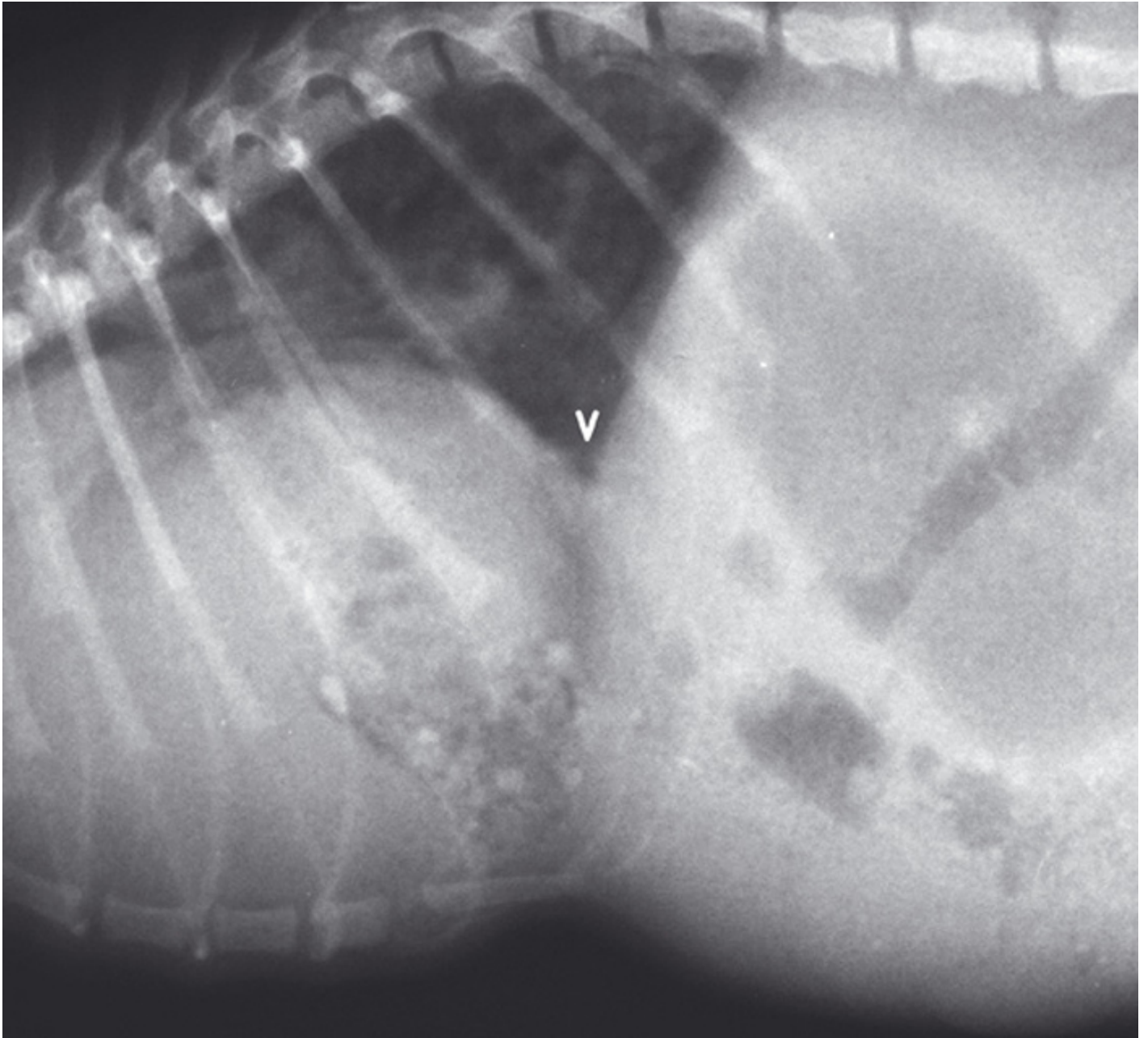


Figure 5. A lateral chest x-ray of a cat with PPDH. Loops of small intestine are sitting in the pericardium. The arrow points to the dorsal peritoneocardial mesothelial remnant.

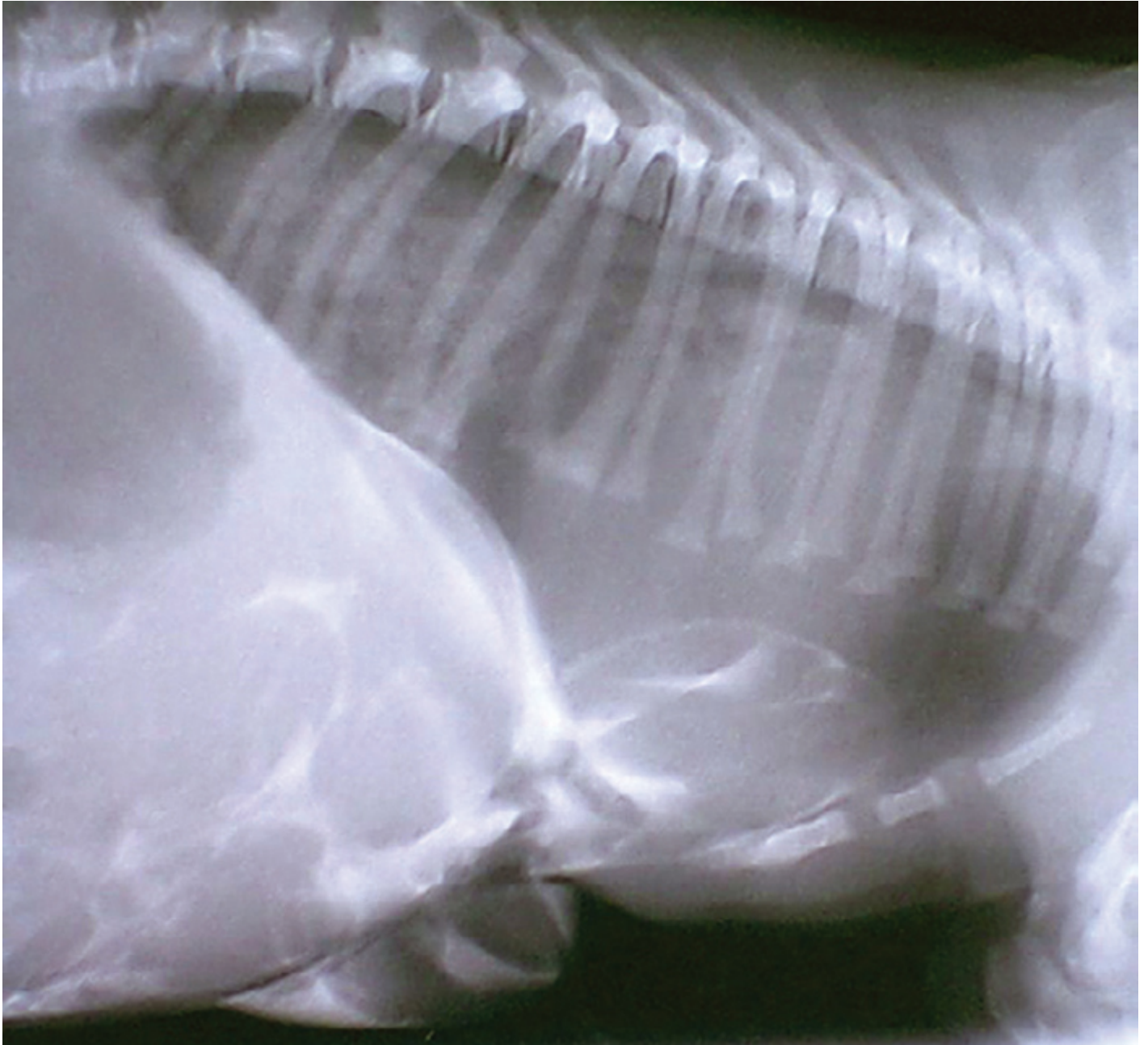


Figure 6. Positive contrast peritoneogram. This dog has a large cranial abdominal hernia and

PPDH.

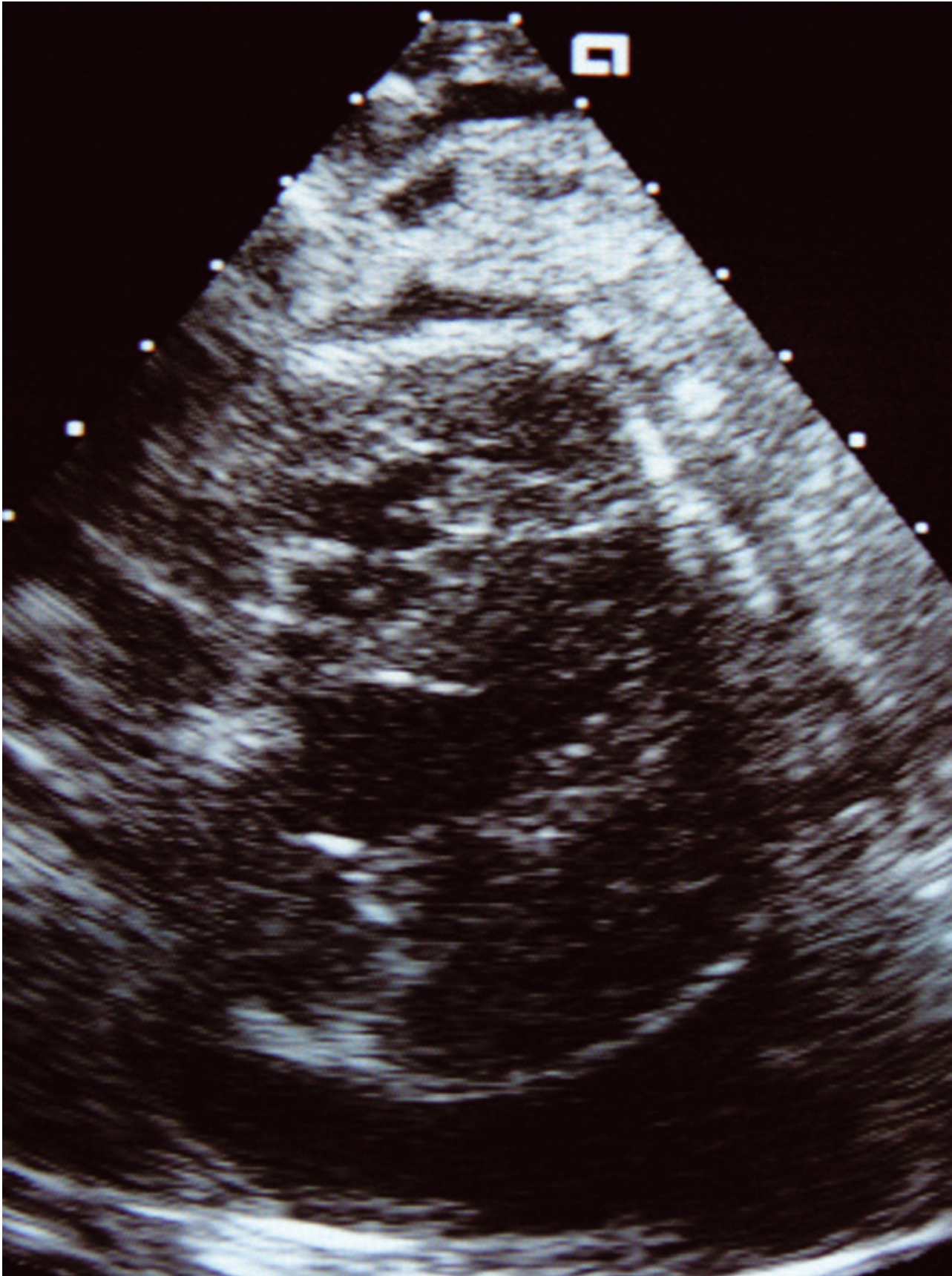


Figure 7 (left). In these ultrasound scans, there is a pericardial effusion and the caudal (top right) part of the pericardium is occupied by the omentum.

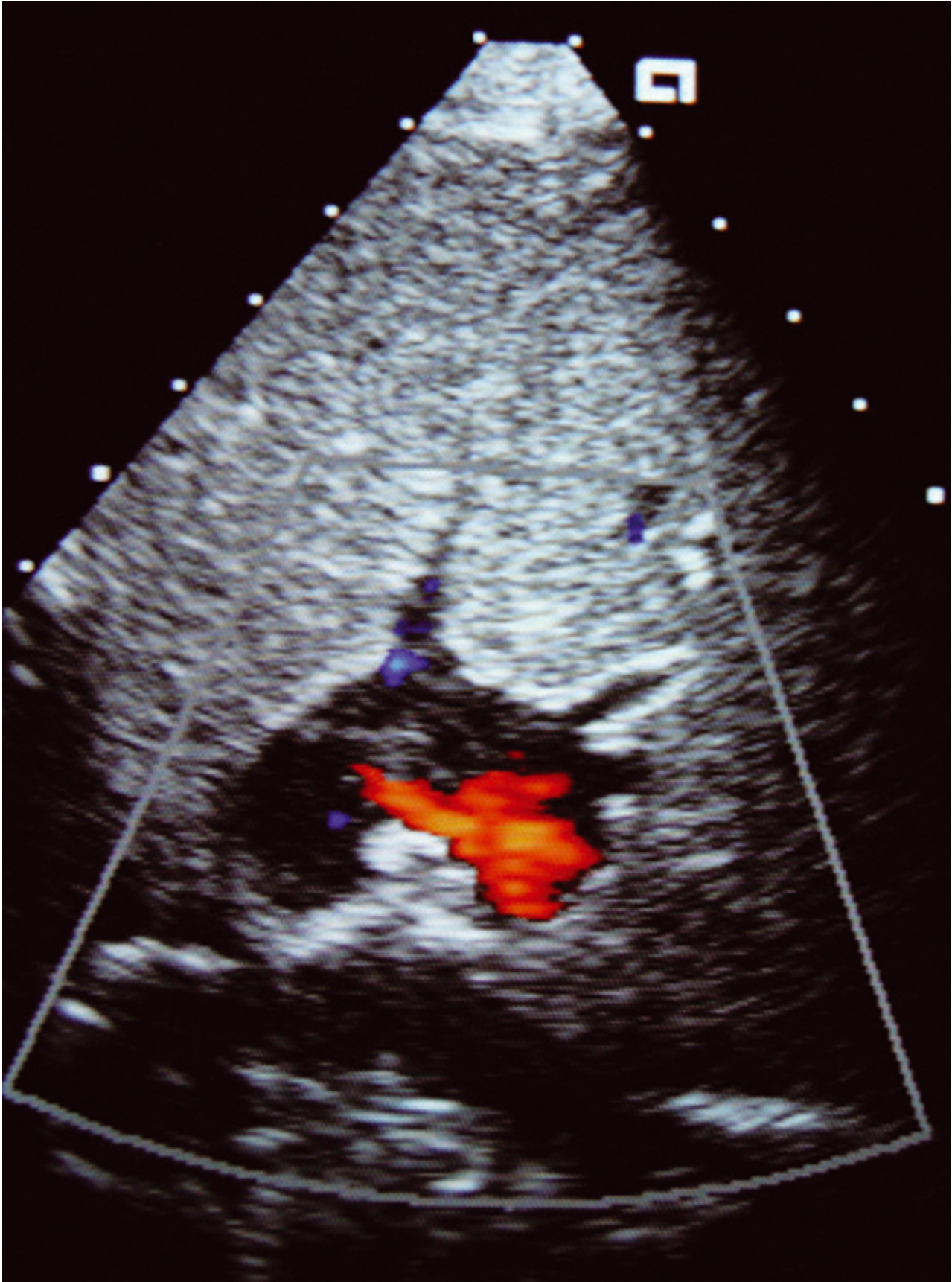


Figure 8. Entrapment of the liver and vascular compromise leads to blood stasis and thrombosis in the major hepatic veins. This dog is likely to experience a surge of vasoactive agents into its systemic circulation as the viscera are released from the pericardium.

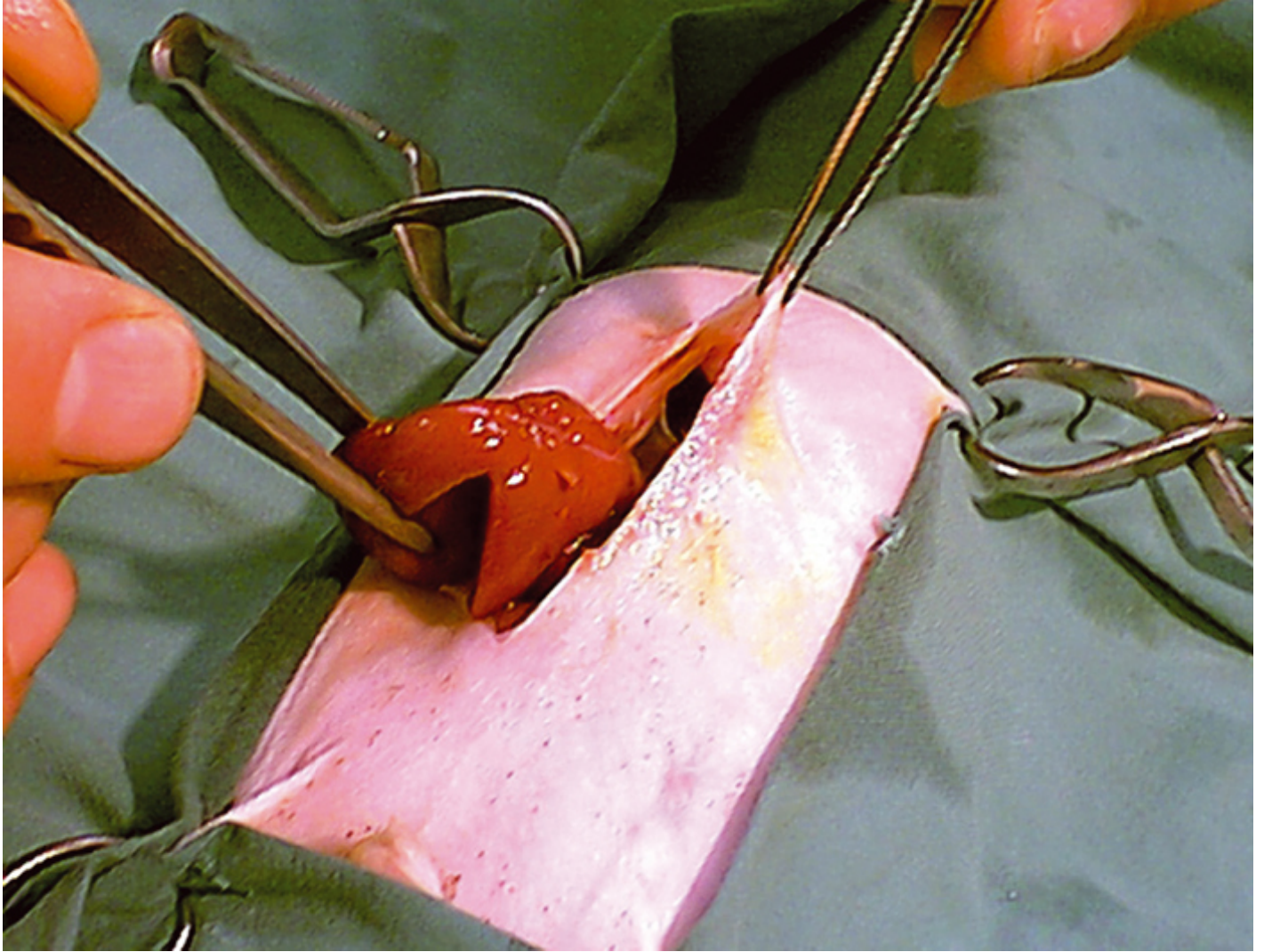


Figure 9 (far left). Surgical correction of PPDH in a Lhasa apso pup. At this age the flexibility of the ribcage and soft tissues, and the lack of adhesions, make correction much easier.