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# Haemoabdomen. Part 1: Diagnosis and patient stabilisation

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ABSTRACT: Haemoabdomen (also known as haemoperitoneum) is defined as free haemorrhagic fluid in the abdominal cavity. There are a number of possible causes for this condition, which can be life-threatening in nature. This article will focus on the haemoabdomen in dogs and will review the pathophysiology, the presenting clinical signs, diagnosis and initial stabilisation of patients.

## Aetiology

Haemoabdomen may be classified as either traumatic or non-traumatic in origin, but it may also be iatrogenic, for example following ovariohysterectomy. Traumatic haemoabdomen usually develops after blunt-force trauma such as road traffic collisions, kicks or falls, although it can also occur due to penetrating trauma. The liver and spleen are most frequently involved, although bleeding can occur from any organ, the body wall or the abdominal vessels (Mongil, Drobatz & Hendricks, 1995). Non-traumatic or "spontaneous" haemoabdomen has a large number of possible causes (Brockman, Mongil, Aronson and Cimino Brown, 2000) including:

- neoplasia ,which may be either:
  - benign, for example haemangioma
  - malignant: the spleen, liver, kidney, prostate and adrenal gland are most commonly implicated (Prymak, McKee & Goldschmidt, 1988; Day, Lucke & Pearson, 1995; Spangler & Culbertson, 1992)
- coagulopathies, for example rodenticide toxicity, disseminated intravascular coagulopathy
- gastric dilatation and volvulus due to tearing of the short gastric vessels
- liver-lobe torsion
- splenic torsion

Once the patient has been stabilised, it is important that further investigations are performed to help determine the initial cause of the haemoabdomen so that the case can be managed appropriately.

## Handling the emergency phone call

The first contact with clients is usually by telephone. It is important to remain calm and obtain the information required to assess whether the clinical signs that the owner has observed mean that their pet should be seen by a veterinary surgeon as an emergency. Appropriate questions to ask the owner on the telephone include:

- owner's contact details in case you get disconnected
- pet's signalment (age, breed, sex)
- brief history, including any current medications
- any known trauma
- increased respiratory rate or effort
- mucous membrane colour
- level of consciousness, is their pet responding normally?
- is their pet ambulatory?

Based on the owner's responses, an emergency consultation should be offered. The most common clinical signs referred to by owners in the case of haemoabdomen include:

DOI: 10.1080/17415349.2016.1181448



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- sudden lethargy
- weakness or collapse
- pale mucous membranes
- "shallow" or fast breathing
- if there has been sufficient haemorrhage, they may appreciate a distended abdomen

Ensure accurate directions to the veterinary clinic are provided.

## Preparation prior to arrival

Until an assessment of the patient has been made it can be difficult to prepare fully for the required procedures; however, the more equipment that can be prepared in advance, the more efficient the initial triage and any immediate diagnostic investigations will be (**Box 1**; **Figures 1a and 1b**).

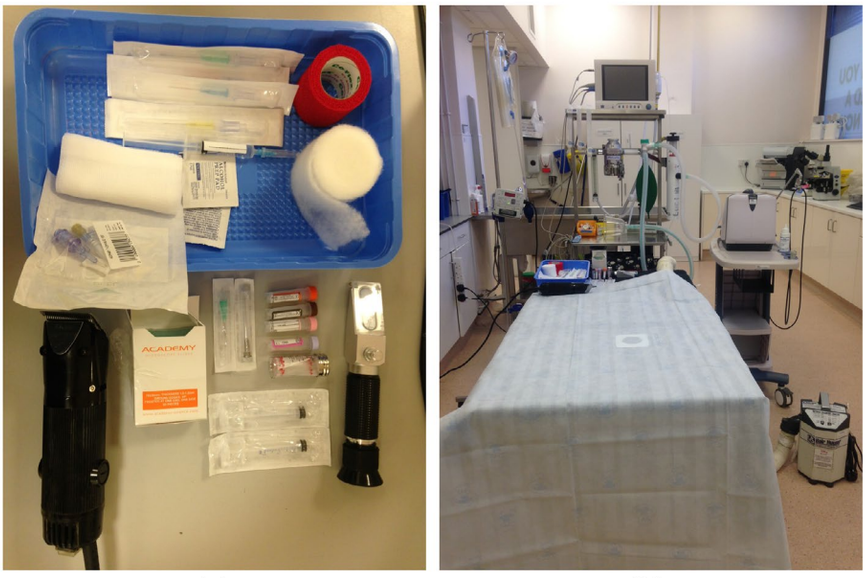
**Box 1.** Prepare for emergency treatment in advance

- Intravenous (IV) catheter placement: IV catheters, adhesive tape, T-connector, flush (saline or heparinised saline), bandage material
- Blood sample consumables: needles, syringes, appropriate blood tubes, microhaematocrit tubes and putty, refractometer
- Abdominocentesis: 5 ml syringe, 22 G 1½″ needle, appropriate blood tubes, sterile surgical gloves, microscope slides, microhaematocrit tubes and putty, refractometer
- Ultrasound scanner and gel
- Clippers and equipment for aseptic preparation of the skin
- Fluid therapy: balanced electrolyte solution (BES) (e.g. Hartmann's), giving set, fluid pump, pressure infusion bag
- Patient monitoring equipment: ECG, $SpO_2$, thermometer, blood pressure monitoring equipment or multi-parameter monitor
- Equipment for provision of supplemental heating: forced warm air blanket, circulating warm water blanket, heat mat, veterinary bedding materials
- Equipment for delivery of supplemental oxygen: oxygen cylinder or piped gases, face masks, anaesthetic breathing systems, nasal oxygen prongs, etc.

## Initial examination and patient triage

On initial presentation, it is important that the patient is triaged immediately by a veterinary surgeon or a veterinary nurse.

The clinical signs of haemoabdomen can vary depending on the onset and severity of the disease. Animals that present with a haemoabdomen as an emergency are normally in shock and can show a variety of clinical signs (**Box 2**; **Figures 2** and **3**).




(a) (b)

**Figure 1.** It is useful to prepare (a) equipment and (b) the environment for the patient's arrival, to limit delays in initiating treatment
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**Figure 2.** Patients are frequently depressed and collapsed at presentation
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**Figure 3.** This patient with haemoabdomen shows signs of abdominal distention and umbilical skin discolouration (Cullen's sign)
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**Box 2.** Presenting signs of haemoabdomen

- pale/white mucous membranes
- slow/absent capillary refill time
- tachycardia/bradycardia
- tachypnoea
- hypothermia
- generalised weakness or collapse (**Figure 2**)
- obtunded mentation
- abdominal distension
- abdominal fluid thrill – a fluid volume of 40 ml/kg is needed to appreciate this (Crowe & Devey, 1994)
- abdominal pain
- palpable abdominal mass and umbilical/pre-testicular skin discolouration (Cullen's sign) (**Figure 3**)

## Resuscitation and stabilisation

When the clinical signs are severe, the patient is often in decompensated shock and it is important to resuscitate the patient with fluids prior to further diagnostic

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**Figure 4.** Intravenous fluids prepared for the arrival of a large-breed dog; note the infusion pump and the pressure infusion bags on the stand to allow rapid fluid administration
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testing. Decompensated shock occurs when the initial compensating mechanisms that are triggered in response to blood loss, such as peripheral vasoconstriction, fail and the tissues begin to respire anaerobically. This results in an increase in lactate levels and subsequent metabolic acidosis.

There are four main types of shock, namely hypovolaemic, distributive, cardiogenic and obstructive. Although it is not unusual for patients to have more than one type of shock, the blood loss associated with haemoabdomen tends to result initially in hypovolaemic shock.

During initial triage and stabilisation of a patient with haemoabdomen there are four main objectives (Herold, Devey, Kirby & Rudloff, 2008):

1. re-establish and maintain effective circulating volume
2. diagnose the haemoabdomen and any associated acid:base disturbances
3. maintain oxygen carrying capacity
4. stop ongoing haemorrhage

### Fluid resuscitation

There is controversy in both human and veterinary medicine with regard to the most appropriate fluids to use for resuscitation both during and following acute blood loss. Recently, the American Animal Hospital Association (AAHA) published guidelines for fluid therapy for dogs and cats (Davis, Jensen, Johnson, Knowles, Meyer, Rucinsky & Shafford, 2013), and what follows is based on those guidelines.

Haemorrhage results in a depleted vascular fluid volume, which causes reduced tissue perfusion and anaerobic respiration. It is therefore important to gain IV access as soon as possible, placing at least one large-gauge catheter to facilitate fluid resuscitation. A BES, such as Hartmann's, is a good initial fluid choice. However, if using crystalloids alone, large volumes of fluid are required. Typical values would be fluid rates of 80–90 ml/kg in dogs and 50–55 ml/kg in cats, delivered as fluid boluses of 25% of the total calculated volume, administered over 10–15 min sequentially to effect. For example, a 20-kg dog would require up to 90 ml × 20 kg, or 1800 ml of fluid delivered in four 450-ml boluses.

If haemorrhage is severe and/or ongoing, it can be difficult to administer the required volume of fluid at an appropriate rate, and this is especially true in larger patients. Using two IV lines and infusion pumps may help, but in some cases the use of pressure infusion cuffs may be required (**Figure 4**). However, because BESs are rapidly redistributed from the intravascular space, they will not maintain adequate vascular volumes in the medium term. Indeed, it has been shown that if the patient has lost more than 15 ml/kg blood from its intravascular space, crystalloid fluid rates as high as 75 ml/kg would be insufficient to replenish the intravascular blood volume, due to the rapid redistribution of the fluid from the vascular space to the extravascular space (Iijima, 2009). Therefore, the AAHA guidelines suggest that a combination of isotonic crystalloids and hypertonic saline (HS) can be considered.

The HS acts to relocate fluid from the interstitium back into the intravascular space, and provides a fast-acting, low-volume resuscitation technique. The recommended dose rate of HS is 4–5 ml/kg for dogs and 2–4 ml/kg in cats, administered as a bolus over 20 min. Balanced electrolyte solutions should be administered at the same time as the HS using fluid rates of 40–45 ml/kg in dogs and 25–27 ml/kg in cats, to replace the fluid that will be removed from the interstitium by the HS. Both fluids may be given through the same IV catheter using a Y-connector or through separate IV catheters if preferred.

Alternatively, colloids can be used at a fluid rate of 5–10 ml/kg in dogs and as a 1–5 ml/kg bolus in cats, in conjunction with crystalloids, at a rate of 40–45 ml/kg in dogs and 25–27 ml/kg in cats.

Regardless of which technique is used, the patient should be monitored continually and the fluid rate and type reassessed frequently based on the change in the patient's clinical parameters in response to the fluids already administered. Continuous monitoring of patients with haemoabdomen is required during the initial fluid resuscitation. With appropriate resuscitation we would expect an improvement in the patient's mentation, respiratory rate, peripheral pulse quality, mucous membrane colour and capillary refill time. Improvements in blood pressure are expected following fluid resuscitation. In general, the aim is to return the blood pressure to low normal levels, i.e. asystolic blood pressure of 90 mmHg or mean arterial blood pressure of 60 mmHg, to reduce the risk of promoting haemorrhage by dislodging fragile blood clots with high pressures (Mathews, 2006).

## Diagnosis and further investigations

The initial diagnostic tests will vary, based on the clinical condition of the patient. It is always beneficial, when placing an IV line, to get blood from the peripheral vein for a packed cell volume (PCV) measurement and estimation of total solids (TS) – this may provide an indication of the extent of the anaemia associated with the blood loss. However, this result should be interpreted with caution, because, following acute haemorrhage, the PCV may remain within the normal reference range for a period of time because there has been a loss of whole blood. The true extent of the anaemia may not be apparent until there is redistribution of the fluid within the extravascular fluid space and/or following fluid resuscitation of the vascular space.

### Blood tests and urinalysis

- PCV and TS
- haematology, including blood smear evaluation
- biochemistry, including electrolytes and lactate
- blood gas analysis
- prothrombin time and activated partial thromboplastin time will help in the diagnosis of coagulopathies
- urinalysis

### Abdominocentesis

Ultrasonography has improved sensitivity and specificity with regards to diagnosis of abdominal effusions when compared with radiography (Lisciandro, 2011) (**Figure 5**). Abdominocentesis is now usually guided by abdominal ultrasound. This may be


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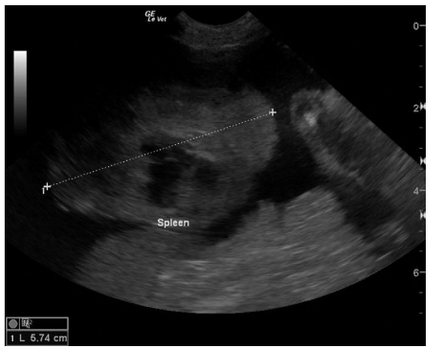


**Figure 5.** Abdominal ultrasound image showing the presence of free fluid and a heterogeneous mass associated with the spleen
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either abdominal-focused assessment with sonography for trauma (A-FAST) or a full abdominal ultrasound scan (**Box 3**). A-FAST is frequently performed during the initial stabilisation of the patient.

**Box 3.** Using ultrasound in the diagnosis of haemoabdomen

A focused assessment with sonography for trauma (FAST) scan is an ultrasound technique that was first described in human patients for evaluation of injuries associated with abdominal trauma and has been adapted for use in veterinary medicine. It is now often referred to as an A-FAST. It involves examining four intra-abdominal quadrants (Boysen et al., 2004):

- caudal to the xiphoid process
- caudal ventral midline in the region of the bladder
- right flank in the region of the kidney
- left flank in the region of the kidney

This ultrasound scan may not identify the location of the haemorrhage, but will help assess for any intra-abdominal masses and evaluate organ parenchyma (Herold et al., 2008). Taking serial FAST scans is a useful way of monitoring these critical patients to monitor whether the haemorrhage is ongoing or whether it is resolving.

Ultrasound-guided abdominocentesis is preferred, as it allows the aspiration of smaller volumes of fluid and reduces the risk of organ laceration (Herold et al., 2008). However, if ultrasound is not available but free abdominal fluid is suspected, abdominocentesis can be performed blind, using either the four-quadrants technique or by sampling from a single site 2–4 cm caudal to the umbilicus and to the right side of the body, with the patient lying in left lateral recumbency to avoid the falciform fat and reduce the risk of splenic laceration (Walters, 2003). The latter technique works well where there is a large effusion but there is a risk of false-negative results if the volume of the abdominal effusion is less than 6 ml/kg. The penetration of an organ such as the liver or spleen can result in false-positive results.

In cases of haemoabdomen, gross examination of the sample usually reveals non-clotting whole blood from within the peritoneal space (Brockman et al., 2000; Connally, 2003). It is very unusual in cases of haemoabdomen for blood from the peritoneal cavity to clot unless there is significant ongoing bleeding. Consequently, if clotting of the blood occurs it is possible that there has been penetration of an organ such as the liver or spleen, rather than sampling of abdominal fluid.

Once the sample has been collected it is important to perform some diagnostic tests on it. The PCV and TS of the abdominal fluid should be compared to the PCV and TS of the peripheral blood: it may be similar, higher or lower than that of the peripheral blood, depending on the length of time the patient has been bleeding. The normal ranges for the PCV and TS of peripheral blood in dogs are 37–55% and 54–71 g/l, respectively. If the PCV and TS values of the peripheral blood and abdominal fluid are very similar, it is likely that there has been a recent acute haemorrhage and there has not been adequate time for fluid redistribution. Where the PCV in the abdominal fluid is higher than that of the peripheral circulation, it is indicative of active haemorrhage.

Serial peripheral and abdominal PCV and TS tests taken over a period of time are very useful to assess whether the haemorrhage is ongoing. If the PCV of the abdominal fluid continues to rise in relation to the peripheral circulation then it suggests an ongoing bleed and indicates that an exploratory laparotomy may be required.

Cytology of the fluid is also useful, as it may show the presence of neoplastic cells (**Figure 6**), erythrophagocytosis (consumption of red blood cells by macrophages) or the presence of haematoidin, a yellow–orange pigment released when haemoglobin is broken down, both of which indicate that haemorrhage has been ongoing for some time. Usually the sample will be devoid of platelets. The presence of intracellular bacteria on cytology is highly significant as it indicates a septic process and will significantly alter the patient's prognosis.

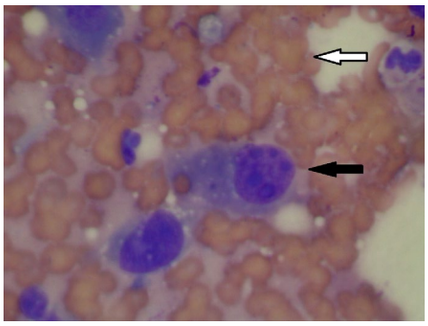

**Figure 6.** Cytology of haemorrhagic abdominal fluid stained with Diff-Quik™: against a background of red blood cells (white arrow), a malignant cell with a large nucleus and multiple nucleoli can be seen (black arrow), raising concern that haemoabdomen has developed secondary to rupture of a neoplastic mass
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### Radiography

Abdominal radiographs are usually non-specific, simply showing changes such as a loss of serosal detail associated with peritoneal effusion (Mahaffey & Barber, 1998). It is sometimes possible to appreciate a soft tissue mass or organomegaly (**Figure 7**), which may be suggestive of neoplasia; however, this cannot be confirmed by radiographs in isolation. When the patient is known to have been involved in trauma, abdominal radiographs can help diagnose pneumoperitoneum, which may suggest rupture of a hollow viscus (Brockman et al., 2000).

Thoracic radiography is indicated when a diagnosis of haemoabdomen has been reached, as it will detect thoracic trauma or haemorrhage if the incident is traumatic or will assess for evidence of metastasis if related to a neoplastic process.

### Computed tomography (CT)

CT is the gold-standard technique for diagnosis of haemoabdomen in human medicine, as it provides more detailed evaluation of the abdominal organs and allows a more accurate estimation of the volume of fluid within the peritoneum. CT could also prove a useful tool in veterinary medicine with an increasing number of larger practices having access to scanners on site.

## Maintain oxygen carrying capacity

When a patient is haemorrhaging they lose red blood cells from the vascular space

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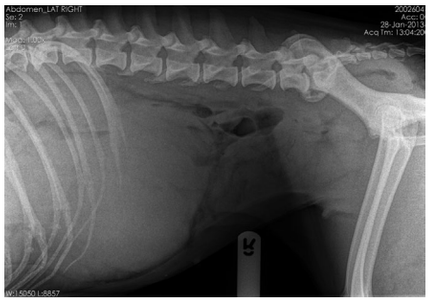

**Figure 7.** This abdominal X-ray shows a loss of serosal detail consistent with abdominal effusion as well as the presence of a large soft tissue mass displacing the intestines – this mass was associated with the spleen.
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and, consequently, haemoglobin, which is important for transporting oxygen to the tissues. This can lead to tissue hypoxia and anaerobic respiration. In this situation, supplemental oxygen can be beneficial as it increases the fraction of inspired oxygen ($FiO_2$) above that available in room air, i.e. 20.9% oxygen or an $FiO_2$ of 0.209.

However, because only a minimal amount of oxygen is dissolved directly in the plasma, compared with the majority that is transported by binding to haemoglobin, the volume of red blood cells and the haemoglobin concentration in the vascular space remain the critical factors in maintaining oxygen transport to the tissues. In many patients the severity of the blood loss means that transfusion of packed red blood cells or whole blood is required to increase the oxygen carrying capacity. This will be discussed further in the next article.

## Stop ongoing haemorrhage

When the haemoabdomen is caused by ongoing haemorrhage, it may not be possible to prevent ongoing losses without surgical intervention. If it is due to a coagulopathy then plasma or fresh whole blood can be administered to help correct this. In addition, vitamin K1 can be administered if exposure to an anticoagulant rodenticide or hepatic dysfunction is suspected (Herold et al., 2008).

Regardless of the cause of the haemoabdomen, abdominal counter-pressure can be applied to help reduce further intra-abdominal haemorrhage and increase systolic blood pressure. This can be useful as, according to Poiseuille's law, a reduction in a vessel's radius will reduce the blood flow by a power of four (Guyton & Hall, 2000). Abdominal counter-pressure can also create a "tamponade effect", which means that the increased pressure of the fluid within the peritoneum following abdominal counter-pressure acts to limit further bleeding. **Box 4** explains the technique for applying counter-pressure.

**Box 4.** Abdominal counter-pressure

**Consumables**

- soft padding material, for example Soffban™ or cotton wool and
- binding material, for example Vetrap™, or adhesive tape, such as Elastoplast

**Technique**

For efficient application of counter-pressure, it is important to incorporate both the abdomen and the hind limbs into the wrap, starting at the toes and working proximally. This prevents a reduction in venous return to the heart and a subsequent decrease in cardiac output, when compared to wrapping the abdomen in isolation.

The first layer should be soft padding material to allow even distribution of pressure and to aid removal of the bandage. Start by individually wrapping each limb in soft padding before covering the padding with an adhesive bandage. Repeat this technique wrapping the pelvis and caudal abdomen up to the 13th rib; do not incorporate any ribs as this compromises respiration.

This technique has been shown experimentally to improve survival in dogs (McAnulty & Smith, 1986). However, it is important not to use it if the patient shows signs of thoracic disease or intracranial trauma, as it can cause increases in central venous pressure, intracranial pressure and intrathoracic pressure (Herold et al., 2008).

The duration of counter-pressure should be as short as possible to achieve the desired result and, when the pressure is released, this should be done gradually to prevent sudden hypotension. This is achieved by cutting the bandage incrementally every few minutes, starting caudally and moving cranially. There are practical limitations to abdominal counter-pressure due to the body shape of some breeds of dog, resulting in bandage slippage.

## Conclusion

It is important to act efficiently and promptly when evaluating, diagnosing and stabilising patients with suspected or confirmed haemoabdomen. Preparation prior to the patient's arrival, based on the history from the emergency phone call, can improve efficiency on admission and allows the patient to be stabilised as soon as possible. Initially, it is important to place an IV line to facilitate fluid resuscitation, followed by an initial assessment of the abdominal fluid. Once stabilised the patient can then proceed to surgery if this is indicated – this will be discussed in the next article.

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# Multiple Choice Questions

1. **Why are traditional crystalloids sometimes insufficient to maintain vascular volumes?**

(a) They are quickly redistributed in the body

(b) If a large volume of blood has been lost they simply cannot fill the loss

(c) Only hypertonic saline can help maintain vascular volumes

(d) A and B

(e) A and C

2. **What is Cullen's sign?**

(a) Pale mucous membranes

(b) Abdominal mass

(c) Lethargy and depression

(d) Discolouration of the umbilicus

3. **What is NOT the aim of fluid resuscitation using hypertonic saline?**

(a) To help replenish sodium and chloride

(b) To help quickly restore vascular volume

(c) To move fluid back into the vessels from the tissues

(d) To provide a low-volume alternative to increasing the crystalloid fluid rate

4. **Select the TRUE disadvantage to blind abdominocentesis?**

(a) Laceration of the spleen or other organ can produce false negative results

(b) False negative results if the effusion is low-volume

(c) False positive results can occur in large effusions

(d) It is cost effective but risky

5. **What does abdominal-focused assessment with sonography for trauma A-FAST permit?**

(a) Guided abdominocentesis

(b) A quick view into the abdomen at initial assessment

(c) Determination of the origin of the problem

(d) A and B

6. **Which is FALSE? Abdominal counter-pressure bandages:**

(a) Have been shown experimentally to improve survival

(b) Do not suit all dogs due to conformation

(c) Must be applied in full consideration of other injuries, as they are contraindicated if there are thoracic or intracranial injuries

(d) Must be removed slowly, cranially to caudally

**For the answers to the MCQs, please go to: http://www.bvna.org.uk/publications/veterinary-nursing-journal**

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