Splenoptosis in a dairy cow and endoscopic correction of left displacement of abomasum

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FOOD/FARmed ANIMALS

SUMMARY

A third lactation Holstein dairy cow was presented with history of acute reduction in milk yield (‘milk drop’). On combined auscultation and percussion of the left costal area and paralumbar fossa, distinct sounds (‘ping’ or ‘slosh’) were identified ventrally. The case was investigated endoscopically, with two portals set-up either side of the 13th left rib. The abomasum was displaced and congested, and ecchymoses were found on its greater curvature. The spleen was not visible on the initial examination. The spleen became visible following abomasocentesis and deflation of the abomasum. Unlike the normal spleen that has a sharp caudal edge, this one's edge appeared swollen. The swelling was consistent with splenomegaly, due to the compromised blood circulation following the splenoptosis.

BACKGROUND

Splenoptosis is the displacement of part or the whole of the spleen from its normal location and can be primary or secondary in aetiology.1 Primary splenoptosis is often found at newborns and is therefore congenital, but it is not necessarily hereditary. Secondary splenoptosis is caused by the presence of concurrent disease and can occur anytime in life. Splenomegaly is the enlargement of the spleen and loss of its sharp edges, which become rounded.1 Ectopic spleen refers to disjointed splenic tissue found in the parenchyma of other organs where it is not normally found, such as the liver or the pancreas.1 Ectopic spleen is also referred to as wandering spleen. Splenopexy is the surgical fixation of the spleen.1 Endoscopy is a surgical procedure that involves visual examination of internal body structures, in which an instrument is inserted in a body cavity for exploratory or corrective purposes.1 Finally, laparoscopy is a surgical procedure that involves examination of the peritoneal cavity in order to explore or correct ailments.1

The spleen in the bovine is normally located on the left side of the cranial section of the dorsal sac of the rumen, occupying an oblique line from dorsocaudal to ventrocranial between the 8th and 13th rib.2

The spleen is held in place by the gastroplenic ligament between the rumen and the spleen.2 This ligament in polygastric species, such as the bovine, is formed by the visceral peritoneum as it surrounds the abaxial surface first, then covers the axial surface of the spleen and the two peritoneal folds meet along the axial sagittal axis of the spleen before they start surrounding the rumen. Finally, the splenic artery and splenic vein contribute towards holding the spleen in place. These blood vessels are forming a structure similar to a double Celtic cross on the abaxial surface of the spleen.3 As a result of the presence of these blood vessels, a spleen may partially, but not completely, displace without these blood vessels being ruptured first.

The normal location of the spleen is important, as during the left displacement of the abomasum (LDA), the grater curvature of the displaced stomach comes in contact with the abaxial surface of the spleen.

A case of splenoptosis as well as ectopic spleen was described in a 17-year-old European female with history of thalassaemia and recurrent attacks of abdominal pain.3 This case was described as peculiar because of the age of the patient and as it is unusual for the two splenic conditions to coexist. The ectopic spleen was believed to have taken place during embryonic development, and it was diagnosed in this case along with the splenoptosis by ultrasound and CT scan. The treatment of the splenoptosis took place by laparoscopic splenectomy.

A case of ectopic spleen was identified following CT scan in a 10-year-old miniature dachshund with intra-abdominal masses resembling hepatic tumour.4 What was thought as tumorous was removed by laparotomy and subsequently was diagnosed histopathologically as ectopic splenic tissue. These cases are thought to be secondary in aetiology, as a result of splenic rupture or splenectomy. The patient had a history of splenectomy.

Ectopic spleen was described in five cases of New Zealand White rabbits, found in the pancreatic parenchyma.5 These cases were thought to be of hereditary origin.

No documented previous reports of splenoptosis in cattle have been noted.

In the author’s opinion, in polygastric species such as the cow, splenoptosis is likely to be acquired later on in life, by an insult that erodes and destroys the gastroplenic ligament between the rumen and spleen. Splenomegaly and splenoptosis would compromise the function of the spleen and contribute in the deterioration of the patient.

The author believes therefore that peritonitis is the missing link in the pathogenesis of splenoptosis in cattle. D-dimer has been described as an accurate indicator of ischaemia of the digestive track and peritonitis in laboratory animals as well as humans.6–8 It has also been shown that D-dimer demonstrated superb accuracy in predicting the presence or absence of peritonitis in cattle.9 It was established that the peritoneal fluid of cattle with LDA or abomasal volvulus indicated distinctive
signs of ischaemia and inflammation, with the LDA group having elevated levels of D-dimer before surgery and further increased levels after surgery using a laparotomic correction technique as opposed to an endoscopic one. The author of this paper concludes that each LDA case is at risk of peritonitis, with this example showing extensive signs of abdominal catastrophe, such as widespread ecchymoses and inflammation.

The author has encountered this condition a number of times in cattle. In these cases, it coincided with LDA. Each time, there was formation of adhesions of the left dorsocranial abdominal region, which may have led to adhesions forming between the displaced abomasum and the spleen. As the displaced abomasum changes the level of its displacement on the left, this in turn puts pressure on the gastrospenic attachment that may be already weakened by the peritonitis and the attachment ruptures.

Splenoptosis or wandering spleen has been described in monogastric species, such as humans, rabbits and dogs. The condition very often goes unnoticed and is a circumstantial finding of routine health examinations. In humans, the displaced spleen is found as an enlargement at various locations in the abdomen, during health examinations. In cattle, it coincided with LDA. Each time, there were formation of adhesions of the left dorsocranial abdominal region, which may have led to adhesions forming between the displaced abomasum and the spleen. As the displaced abomasum changes the level of its displacement on the left, this in turn puts pressure on the gastrospenic attachment that may be already weakened by the peritonitis and the attachment ruptures.

The spleen became visible following abomasocentesis and deflation of the abomasum. The colour of the organ was normal, and there were no documented widespread ecchymoses and inflammation. As opposed to an endoscopic one. The author of this paper concludes that each LDA case is at risk of peritonitis, with this example showing extensive signs of abdominal catastrophe, such as widespread ecchymoses and inflammation.

In the author’s opinion, cases of splenoptosis in the bovine are likely to go undetected and would add to the complications of the patient. Endoscopy, as it is of minimal intrusion, would allow us to assess the presence and severity of such conditions, hence offer a precise diagnosis and prognosis.

CASE PRESENTATION
A third lactation Holstein dairy cow was presented with history of acute reduction in milk yield (‘milk drop’). The animal had calved 15 days before the veterinary visit and had diminished appetite while eating mostly grass silage but not concentrates. The three-day mean daily milk yield was 12 kg. The rectal temperature was 37.4°C, respiration rate was 18 bpm and heart rate was 63 bpm. The conjunctivae were mildly congested bilaterally and light red in colour. Capillary refill time was 1 s as tested on the upper gingiva. The rumen contraction rate was one per minute. No subcutaneous emphysema was identified on the dorsal side of the animal. The sublumbar and superficial cervical lymph nodes were normal in size on both sides. The rectal contents were loose. The demeanour of the cow was lightly depressed. Her body condition was assessed at score two, her rumen fill at score three and her mobility was observed at score one, according to the respective Agriculture and Horticulture Development Board scoring methods.

On combined auscultation and percussion of the left costal area and paralumbar fossa, distinct sounds (‘ping’ or ‘slosh’) were identified ventrally. ‘Ping’ or ‘slosh’ was not returned when combined auscultation and percussion of the transverse processes located above the left paralumbar fossa took place. Finally, there were no distinct sounds during simultaneous auscultation and percussion of the costal area, paralumbar fossa and transverse processes of the right side of the patient. The animal did not appear to be in pain or dehydrated.

The most remarkable findings of the endoscopic abdominal examination were located dorsocranially on the left side. The abomasum was displaced and congested, and ecchymoses were found on its greater curvature. The diaphragm also appeared congested, with a wide haematoma on its sagittal axis. The spleen was not visible on the initial examination. There were fibrin deposits, consistent with localised peritonitis.

The spleen became visible following abomasocentesis and deflation of the abomasum. The colour of the organ was normal, but the dorsal quarter of the spleen was folded abaxially with its sharp caudal edge, the edge of this one appeared swollen. The rumen contraction rate was one per minute. No subcutaneous emphysema was identified on the dorsal side of the animal. The sublumbar and superficial cervical lymph nodes were normal in size on both sides. The rectal contents were loose. The demeanour of the cow was lightly depressed. Her body condition was assessed at score two, her rumen fill at score three and her mobility was observed at score one, according to the respective Agriculture and Horticulture Development Board scoring methods.

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INVESTIGATIONS
A blood sample from the coccycgeal vein was collected for the diagnosis of ketosis by measuring beta-hydroxybutyrate level (BHB) (FreeStyle, MediSence, Abbott UK). The result of this sample was 0.9 mmol/l, which indicated absence of ketosis. It has been demonstrated that for every 0.1 mmol/l increase in blood BHB concentration, the risk of LDA increased too by a factor of 1.1.

DIFFERENTIAL DIAGNOSIS
Conditions included in the differential diagnosis are left displacement of abomasum, primary and secondary ruminal tympany, as well as pneumoperitoneum.

Primary tympany occurs when the gases that are normally produced by microbial fermentation are trapped in the rumen as a stable foam. These confined gases cannot be disposed of by eructation. The stable foam is caused by saponins found in the leaves of edible plants. This may be caused by oesophageal obstruction, such as potatoes or apples stuck in the oesophagus, oesophageal stenosis, external oesophageal blockage, such as a neoplasia or an abscess, vagal nerve damage, which controls the function of the oesophageal groove, hernia in the oesophageal region of the diaphragm, tetanus and hypocalcaemia.

The lack of ‘ping’ or ‘slosh’ during combined auscultation and percussion of the left transverse processes would point against tympany in this case. Were to be the rumen tympanic, the sound generated from such percussion would resonate through the transverse process of the left, due to the rumen’s attachment and...
proximity to the spinal column. The left displaced abomasum on the other hand, does not attach to the abdominal roof and therefore sound is unlikely to resonate through the transverse processes.

Pneumoperitoneum, as a consequence of peritonitis, is likely to return ‘pings’ or ‘sloshes’ during auscultation and percussion of both right and left costal and paralumbar fossa areas, as the offending gases that accumulate in the abdomen are likely to expand freely on both sides of the cavity.

**TREATMENT**
The case was investigated endoscopically, and the surgical kit used was from Mendip Veterinary Services Limited for the trocars, cannulas, light source, cordlock forceps and camera attachment for endoscope. Dr-Fritz GmbH for the optic fibre rigid endoscope, 0°, 40 cm working length and 8 mm diameter. Panasonic DMC-G3 Lumix for the camera attached to the endoscope for the internal recording of the operation.

Two portals set-up either side of the 13th rib at approximately a distance of a hand and a half from the transverse processes. The optical portal on the paralumbar fossa was 1.0 cm long, and the working portal in the intercostal space was 1.5 cm long. These portals were set-up by a stabbing motion of just the skin layer with a scalpel while avoiding incising the underlying muscle layers. The scalpel blade used was number 21. Each skin incision is elongated as necessary in order to achieve the desired length.

The 10 mm magnetic trocar and cannula is used to complete the optical portal. It is first inserted through the incised skin site at the paralumbar fossa and then advancing through the remaining abdominal wall with a short-sharp stabbing motion, while the direction of insertion is aimed medially and craniodorsally. Once in situ, the trocar is promptly removed.

The 13 mm magnetic trocar and cannula is used to complete the working portal. It is inserted through the incised skin site at the intercostal space, but its advancement through the remaining abdominal wall is strictly under observation with the endoscope in order to avoid inadvertent visceral trauma of the surrounding organs. Again, once this instrument is in situ, the trocar is promptly removed.

The repositioning of the LDA took place according to the one-step endoscopic technique. While observing with the endoscope, the following sequence of steps takes place through the working portal: abomasal paracentesis, abomasal toggle insertion, deflation of the abomasum, passive repositioning of the abomasum caudolaterally to the xiphoid process on the right hand side.

Once the LDA was corrected, the displaced spleen was restored in its correct position with the aid of the endoscopic cordlock forceps. These forceps were inserted through the working portal, and while observing with the endoscope, the caudal edge of the collapsed section of the displaced spleen was clamped and unfolded in a medio-dorsal motion back to its correct position.

Procaine hydrochloride (50 mg/ml) with epinephrine (0.02 mg/ml) (Adrenacaine Solution for Injection for Cattle, Norbrook Laboratories Ltd) was used for the local anaesthesia of the portals, at a dose of 1 mg/kg per site, as subcutaneous infiltration injected dorsocranially to the portal site. Xylazine (20 mg/ml) (Sedaxylan 20 ml/ml Solution for Injection for Dogs, Cats, Horses and Cattle, Dechra Veterinary Products) was used as a tranquilliser at a dose of 0.013 mg/kg, as an intravenous injection, in order to achieve a mild sedative effect.

Unlike uncomplicated left displacement of abomasum cases that do not require antibiosis, antibiosis as well as a non-steroidal anti-inflammatory preparation was recommended in this case due to the concurrent disease. Procaine penicillin (200 mg/ml) and dihydrostreptomycin sulphate (250 mg/ml) (Pen & Strep Suspension for Injection, Norbrook Laboratories Ltd) was used as the antibiotic course, at a dose rate of 8 mg/kg for procaine penicillin and 10 mg/kg for dihydrostreptomycin sulphate. The product was injected intramuscularly daily for three consecutive days. Meloxicam (20 mg/ml) (Loxicom 20 mg/ml Solution for Injection for Cattle, Pigs and Horses, Norbrook Laboratories Ltd) was used as an anti-inflammatory, at a dose rate of 0.5 mg/kg, as subcutaneous injection daily for three consecutive days. Finally, 40lt of oral rehydration formula (Selekt Off Feed 785 g, Nimrod Veterinary Products Ltd) diluted in water was administered with an oesophageal stomach tube and pump following the operation.

**OUTCOME AND FOLLOW-UP**
The farmer was contacted over the telephone 48 hours following the operation. According to the owner, the patient’s clinical symptoms and milk yield were not improved. The owner decided to destroy the animal the following day.

**DISCUSSION**
Cases of splenoptosis have been extensively described in human medicine. In veterinary literature, there is a limited number of references for such splenic anomalies, with ectopic spleen described in dogs and rabbits, but no cases found of acquired partial splenoptosis in cattle.

Although blood calcium and potassium levels were not measured in this case, it was remarkable that the blood BHB level was found to be normal. There is a view that normal blood BHB level is a poor prognostic indicator for LDA cases. In this study, milk yields were not available for all enrolled cases, and the effect of milk production was not fully accounted in the statistical model. On a separate study, it has been proven that hypokalaemia predisposes to LDA by reducing the contractions of the abomasal smooth muscles. Also, an exclusive blood BHB increase or exclusive hypocalcaemia were found not to reduce abomasal contractions and therefore increase the risk of LDA. This conclusion is consistent with this case. It is suspected that the combined and prolonged hypocalcaemia and high BHB affect abomasal motility.

The author believes that splenoptosis in cattle is an infrequent pathological condition in the field. The author had identified an instance of splenoptosis previously and one following this case that both coincided with left displacement of abomasum and localised peritonitis. In these cases, milk productivity was also reduced due to the LDA, the peritonitis and the possible acetonaemia. While the effect of splenoptosis on milk production is difficult to estimate and compare against the influence of other concurrent conditions, the author believes that its presence is more likely to lead to a poor recovery.

Although splenoptosis in cattle is uncommon, it is also the author’s view that there are limited diagnostic means in farm practice that can identify this condition or offer a precise prognosis. Abdominal exploration using laparoscopy offers advantages over laparotomy, particularly minimal intrusion to the patient, satisfactory visualisation of the operating field, speed of completion, short hospitalisation and lower requirement for postoperative antibiosis. The disadvantage of endoscopy in farm practice is that the procedure is not commonplace yet and not every cattle veterinary surgeon has knowledge in its
use. An alternative diagnostic technique is the transabdominal ultrasound scanning, and the author uses it regularly to diagnose cattle ailments. Examining cases of splenoptosis by ultrasound, although not impossible, would be difficult to identify as the space between the abdominal wall, and the spleen is occupied by the displaced abomasum. Finally, CT scan is a diagnostic technique that is not intrusive and very accurate, but its disadvantage is cost and availability. The author believes that in the absence of any diagnostic means to identify splenoptosis, we should add the condition to the list of reasons for cases of LDA not recovering as expected.

Endoscopic LDA corrections exhibit quicker postoperative recovery compared with laparotomic ones, as well as significantly higher daily milk yield during the first six weeks postoperatively.23

In other species, the documented treatment of splenoptosis is laparoscopic spleenectomy. In this case, after the correction of splenoptosis, it was decided not to remove the spleen. The author’s opinion was there were two-thirds of the spleen that appeared normal and likely to be functioning properly. Additionally, the author was concerned that the presence of peritonitis would impede the bonding process that follows fixation, and therefore, no splenopexy took place. Splenopexy would have been carried out by suturing the dorsal tip of the spleen to the adjacent rumen. In the author’s opinion, this was best done once the splenomegaly and peritonitis had subsided. In the short term, the reduced spleen is kept in place by the correction of the LDA, as well as the restoration of negative atmospheric pressure in the peritoneum. This keeps the reduced spleen sandwiched between the abdominal wall and the rumen.

In the author’s opinion, the gastrospenic ligament between the spleen and the rumen was damaged due to the localised peritonitis, which in turn allowed the spleen to displace. Despite the success of the operation and due to the complications arising from the concurrent peritonitis, it was decided that the animal should be dispatched on humane and economic grounds 72 hours following the operation.

Learning points

► In the absence of any diagnostic means to identify splenoptosis, we should add the condition to the list of reasons for cases of left displacement of the abomasum (LDA) not recovering as expected.
► Target organs can be fully visualised through 1–1.5 cm incisions.
► Unless the case warrants, no antibiosis is required for endoscopic corrections.
► There is evidence that endoscopically corrected LDAs result in quicker clinical recovery.
► There is strong evidence that laparoscopically corrected LDAs produce more milk than laparotomically done within the first six weeks postoperatively.

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