Abomasal surgery: comparison of various techniques in cattle

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Left displacement of the abomasum (LDA) is a common production disease that primarily affects dairy cows.

Various corrective techniques have been described, but limited evidence-based accounts exist on their impact on subsequent patient recovery, survival and postoperative milk yields and fertility.

This article will review various corrective techniques – focusing on the advantages and disadvantages of each.

Aetiology
The exact aetiology of the condition is unknown, but the number of factors that can lead to displacement are classed in the following groups (van Winden and Kuiper, 2003):

- **Predisposition** – breed, age, production level, nutrition, metabolism, concurrent disease and environment.
- **Aetiological factors** – feed intake, negative energy balance and calcium.
- **Triggering causes** – abomasal gas production and abomasal hypomotility.

It is agreed that paying particular attention during the animal’s transition period can considerably reduce the condition in the subsequent lactation.

Based on the internal surgical audit of the author’s practice, it has been noted the prevalence of surgical corrections is significantly influenced by demand in milk and milk price. As can be seen from Figure 1, the number of monthly cases seen considerably dropped following the milk price collapse and reduced demand in milk (same herds compared in the two-year periods).

### Predicting factors

The ability to predict the condition on animal or herd level would be of great economic and welfare interest. No recognised methods exist to predict the disease, but some techniques have been considered. Although such laboratory tests would not be cowside and would be expensive, they may be a promising aid to our ability to predict the disease. Two laboratory tests have been examined:

- The revised quantitative insulin sensitivity check index is possibly the best predictor and incorporates the simultaneous collection and testing for insulin, glucose and non-esterified fatty acids (Holtenius and Holtenius, 2007; Stengärde et al, 2012).
- Measuring for insulin-like growth factor 1 (IGF1). Low concentrations of IGF1 in the peripartum period are an indication of the disease (Kobayashi et al, 2002; Lyons et al, 2014).

### Natural location of abomasum

Unlike the rumen, which lies static, the abomasum floats in the abdomen. There is an acceptable range of floating in normal circumstances, which, preceding displacement, increases dramatically and heralds the abomasal displacement.

To investigate the range of displacement in normal and pathological situations, a doughnut-shaped magnet was sutured to the pylorus of cows, and those that subsequently developed LDA, were found to have moved much more widely than healthy ones – especially to the left of the linea alba.
Displacement is also accompanied by a reduction in abomasal motility and its causes are two-fold – through decreased muscarinic and adrenergic receptors, as shown in vivo (Ontsouka et al, 2010), and through impaired excitatory cholinergic pathways, as shown in vitro (Geishhauser et al, 1998).

**Area of resonance**

![Figure 2](image_url). Right paralumbar fossa abomasopexy or omentopexy. The red line represents the approximate area for laparotomy.

The production of distinct sounds during examination of left intercostal and flank area, by auscultation and percussion, depends on the nature and volume of the abomasal contents (Braun et al, 2007). In terms of nature, this can be gaseous, liquid, or a mixture of both. When considering volume, this can be high or low.

The most distinct sign, the “ping”, arises when contents are mainly gaseous and of high volume. When contents are mostly liquid, the resulting sound becomes a “slosh”. In the case of mixed contents, the ensuing sound can be a blend of the two and is dependent on the gaseous to liquid phase ratio.

When the displaced abomasal part to the left is of very low volume, these marked sounds are difficult to detect. Therefore, an LDA can be missed if diagnosis of the condition relies exclusively on auscultation while omitting internal abdominal inspection.

**Technique comparison**

*Figures 2, 3 and 4* have been added to assist with the approximate location of the fixation area,
while bearing in mind all locations indicated are relative. **Table 1** considers the numerous groupings of the various corrective techniques.

![Table 1](image)

**Table 1.** Various corrective techniques for left displacement of the abomasum.

As the aim of this exercise is to compare surgical techniques, corrective considerations, such as rolling only, medicative management or no treatment, have been omitted as possible options. The left paramedian abomasopexy (Lee et al, 2002) has also been omitted, due to its lack of popularity.

When the duration of each technique is considered, the following sections are included:

- boots on at arrival
- examination of the patient
- surgical operation
- boots off on visit completion

Deflation of the abomasum is defined as passive when the inflated organ deflates without any aid from the surgeon. In active deflation, the surgeon massages the organ to assist its deflation.

Finally, the importance of postoperative complementary oral rehydration therapy cannot be stressed enough, with or without transfaunation (Mees, 2011; Rager et al, 2004).

Our “super league” of LDAs will put the following champion teams to the test:

- Hanover (right laparotomy)
- left and right laparotomy
- Utrecht (left laparotomy)
- paramedian
- endoscopy (Christiansen)
- toggle (Grymer-Sterner)
- roll and suture

**Hanover**
A description of the Hanover technique can be found in Weaver et al (2005). This is a laparotomic right paralumbar fossa omentopexy (or abomasopexy in some variations), where the abdominal access incision and abomasal fixation are co-located.

The operation lasts 60 to 90 minutes, depending on the surgeon's experience and case complications. The surgeon stands throughout the operation as this technique is not strenuous for the operator.

The surgeon is unable to visualise the displaced abomasum, but has got a perfect view of its fixation structures. The identification of the abomasum is carried out by internal palpation, aided by preoperative percussion and palpation of the approximate displacement area. Reduction of the displacement is done by applying gentle force on the displaced abomasum, until it is returned to the original position. Deflation of the organ is done passively once the abomasum is returned to the right or, in quite inflated cases, actively, where a 14-gauge needle paracentesis can be used.

There is minimal risk to the surrounding tissues of the areas where abomasal fixation takes place. Providing the patient is not suffering any concurrent disease, operational sterility is observed and postoperative cleanliness is good, laparotomic incision healing is usually without complications. A three to five-day postoperative antibiotic course is required to reduce the risk of peritonitis.

All instruments can be either cold sterilised or autoclaved. The cost of the surgical kit is approximately £500.

**Left and right laparotomy**

Left and right laparotomy is a variation of the Hanover technique, where a second laparotomic incision is applied on the left paralumbar fossa. This too is a laparotomic right paralumbar fossa omentopexy (or abomasopexy), where the abdominal access incision and abomasal fixation are also co-located.

Depending on the surgeon's experience, or case complications, the operation lasts 60 to 75 minutes. The presence of a second operator slightly reduces the operation's duration. Both surgeons will stand throughout the operation as it is not strenuous.

Both the displaced abomasum and fixation point can be fully visualised. Reduction of the displacement takes place by surgeon “B” gently handling the abomasum and passing it underneath the rumen to surgeon “A”. Identification of the displaced abomasum during the passing over phase (with or without sutures attached to the greater curvature) is done solely by palpation and can be made worse by the presence of adhesions or a friable, visceral wall. As with the previous technique, deflation takes place passively once reduced, or actively with a 14-gauge needle.
The same considerations apply to this method regarding damage to surrounding tissues around the fixation point and laparotomic incision healing. Postoperative antibiotic treatment is imperative in this method as two incisions are required and increased internal handling within the abdominal cavity takes place.

Instrument sterilisation and cost of the surgical kit is similar to the previous technique.

**Utrecht**

A description of the Utrecht technique can be found in Turner et al (1982). This is a laparotomic right paramedian abomasopexy, where the abdominal access incision – which lies in the left paralumbar fossa and the abomasal fixation – are not co-located.

The operation, depending on the surgeon’s experience and case complications, lasts 60 to 90 minutes. The surgeon stands for most of the time, except during abomasal reduction, where he or she must lean underneath the cow to view the area of abomasopexy. In complicated cases, this can be strenuous.

The Utrecht technique gives excellent visualisation of the displaced abomasum. Identification of the fixation point is done indirectly by internal palpation. While hiding a large curved needle in his or her palm, the surgeon moves his or her arm internally underneath the rumen until it reaches the fixation point. Once there, and while repetitively pressing the fixation point internally, the surgeon observes the area externally for signs of the advancing needle. Attention must be exercised not to include parts of the omentum or intestine as the needle is exteriorised. Reduction of the displacement is active and takes place with gentle and repetitive ballottement of the organ by the surgeon’s arm. In severely inflated cases, paracentesis with a 14-gauge needle can also be used.

The possibility of injury to the milk vein or its tributaries during abomasal fixation should be considered, and specific care to prevent such trauma should be taken. The same care must be
taken for laparotomic incision healing, as with the previous methods. Additionally, the fixation area lies ventrally and, as such, is likely to remain soiled postoperatively, but complications here are usually minimal (Fubini et al, 1992). A three-to-five-day postoperative antibiotic course is required to reduce the risk of peritonitis.

Instrument sterilisation and surgical kit cost is similar to the previous techniques.

**Paramedian**

A description of the paramedian technique can be read in Weaver et al (2005). This is a laparotomic right paramedian abomasopexy, where abdominal access incision and abomasal fixation are co-located.

The operation lasts 40 to 50 minutes, depending on the surgeon’s experience and case complications. The surgeon kneels down to access the ventral abdominal area of the patient placed in dorsal recumbency and, on occasions, this can be strenuous. Consideration should be given to secure the limbs of the recumbent patient, as these, if not fully safe, can strike the surgeon.

The surgeon has a perfect view of both the displaced abomasum as well as the fixation point. Reduction of the displacement is done by applying mild pressure on the abomasum by the surgeon until its return to the fixation area. Deflation of the organ takes place passively once it returns to its normal position, actively by manipulation or, in severely inflated cases, by paracentesis with a 14-gauge needle.

Particular care has to be applied to avoid injury of the milk vein or any of its tributaries. Identifying the least complicated site for laparotomy is exacerbated by the animal lying in dorsal recumbency, while veins are not pronounced as in the normal stance. Ideally, ventral blood vessels need to be identified beforehand to avoid damage. Although the incision is located in a dirty area of the body, postoperative complications are not common (Fubini et al, 1992) and are usually related to delayed healing due to the proximity of the incision to the aponeurosis.

As with other laparotomic methods, a three-to-five-day postoperative antibiotic course is required to reduce the risk of peritonitis.

Instrument sterilisation and surgical kit cost is similar to the previous techniques.

**Endoscopy**
Endoscopy is a modified technique (Christiansen, 2004) as adapted from the original two-step method (Janowitz, 1998). It is classed as a right paramedian abomasopexy, where the abdominal access and fixation points are not co-located. For abdominal access, two portals are used either side of the left last rib (paralumbar fossa and intercostal space).

The operation lasts 40 to 45 minutes, depending on the surgeon’s experience and case complications. The surgeon stands throughout and momentarily leans underneath the cow to view the area of abomasopexy. In complicated cases this can be strenuous.
Through an 8mm fibre optic magnifying lens, we have excellent visualisation of the displaced organ. Identification of the fixation point is done indirectly by tracking the position of a Christiansen spieker. This is a 11mm cannula, inserted in one of the portals (the working one) and repositioned internally to the fixation point. While ensuring no viscera are trapped between the spieker and the abdominal wall, a hidden needle, which lies inside the spieker lumen, is exteriorised at the fixation point and completes the abomasopexy. The abomasum is not handled at all by the surgeon and its repositioning is done entirely passively once deflated.

Deflation of the displaced abomasum is done passively too through abomasocentesis via a 5mm trocar. During the abomasocentesis, its gas and liquid content escapes through a cannula outside the body. The lack of abomasal handling reduces the chance of partial ischaemic necrosis. Possible leakage of content into the peritoneal cavity is aseptic – comparable to other corrective techniques (Wittek et al, 2012).

The possibility of injury to the milk vein or its tributaries during visceral fixation should be considered and spieker adjustment must be carried out to avoid this. Due to their small size, the portals (biggest one is 15mm) heal very quickly, without suturing at the end of the operation. The ventral fixation point hardly ever produces complications (Fubini et al, 1992). Unless the patient is compromised, postoperative antibiotics are not required.

Most items can be either cold sterilised or autoclaved, provided the latter is long enough. The only item that cannot be autoclaved is the endoscope, which also requires specific disinfectants not harmful to its optic fibre. The cost of investment for the instruments is approximately £6,000.

**Toggle**

The toggle technique has been described by Grymer and Sterner (2002). This is a right paramedian abomasopexy without an abdominal access incision.

The operation lasts 20 to 30 minutes, depending on the surgeon’s experience and case complications. The surgeon kneels down to access the ventral abdominal area of the patient placed in dorsal recumbency and, on occasions, this can be strenuous. As with the paramedian technique, the same considerations of the limbs should take place.

The surgeon cannot view the displaced abomasum, thus identification of the fixation point is done by simultaneous auscultation and percussion, while receiving the distinct sounds of the displaced abomasum. Reposition of the displacement takes place passively, while the cow is being rolled and under the surgeon’s monitoring of the abomasal track.

Abomasal deflation takes place with paracentesis by inserting two toggles into the viscera perceived to be the target organ. It is not possible with this technique to distinguish the abomasum to other viscera that may also be inflated.
The same considerations should take place as with other corrective approaches on milk vein injury. As this method is bloodless, incision healing is not a concern. As with other abomasopexy techniques, the same considerations with the fixation point should take place. No antibiotic treatments are required.

Instruments can be either cold sterilised or autoclaved. Tool costs are approximately £150.

**Roll and suture**

The roll and suture technique was anecdotally described to the author by retired colleagues and is a precursor to the Grymer-Sterner method. It is a right paramedian abomasopexy without abdominal access incision.

Duration, surgeon’s position, inability to visualise the displacement, identification of the fixation point, visceral handling, deflation method, milk vein injury, access incision and fixation point healing, need for antibiotic treatments, and instrument sterilisation are identical with the Grymer-Sterner method.

Roll and suture is different to the previous method in that instead of specialised toggles, a large curved needle is used to fix the abomasum at the appropriate area. Also, the cost of the equipment is approximately £100.

**Conclusion**

Numerous corrective techniques exist for common management of LDA in dairy cows. It has been agreed our efforts should be focused more on preventing the disease with appropriate pre-parturition management and less on “fire brigade” emergency corrections. However, all the techniques provide relatively good results and, moreover, each one has a loyal following.

LDA corrective techniques in the veterinary world are like religion; promoting new techniques should not be seen as proselytising, but as an opportunity to offer evidence-base results on how each method works on a set of given criteria.

Finally, it is important surgeons are versatile with more than one technique and build their surgical repertoire early on in their working lives.

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