Temporary tracheotomy in a cow secondary to the inadvertent administration of an intratracheal magnet

CECILIA TOLASI[1]*

[1]Buiatra libero professionista, Studio Veterinario Armigio, Scarpizzolo di San Paolo, Brescia

SUMMARY

The need for diagnosis and surgical treatment of respiratory disease in cattle is uncommon. However, several disorders are well documented and are most expediently addressed with surgical therapy. Life-threatening situations are more frequently seen in referral centers following surgery of the upper airways, but in a field situation we can often still determine an accurate diagnosis through physical examinations, improving the success rate of the treatment. This case report describes the surgical treatment of an airflow obstruction due to the inadvertent administration of a magnet into a primiparous Holstein cow's trachea following an incorrect procedure during a routine administration of magnets as a preventive procedure against reticulum-peritonitis. The cow was presented with an increased heart and respiratory rate, but still alert and able to stand alone, signs that has led to perform a tracheotomy to remove the magnet and restore the normal airflow. As a field situation, without the possibility to perform an X-ray or an endoscopy to locate the magnet, palpation of the ventral neck area permitted to feel an enlarged trachea in its cervical portion.

With the animal in left lateral recumbency and the neck stretched to facilitate the surgery: a 10 cm vertical incision was made, centered at the junction of the proximal and middle thirds of the palpable trachea through skin to the muscles. As the trachea was exposed, the annular ligament between two tracheal rings was sharply incised, making sure not to cut more than 50% of the diameter of the trachea. After removal of the magnet the trachea was closed with a single knot tension suture and the surgery site in layers (muscle and skin independently).

Daily production as well as rumination time have been monitored for 30 days after the surgery, showing a constant improvement of the animal.

KEY WORDS

Tracheotomy, intratracheal magnet, cow.

Tracheotomy is a surgical procedure of the trachea when the airways above the surgical site are severely compromised. In some situations, tracheotomy is performed as an emergency procedure to save the animal's life. Life-threatening situations are more frequent in referral centers following surgery of the upper airways, but in a field situation, the inadvertent administration of an intratracheal bolus may result in the need for an emergency tracheotomy (1).

Pathologies involving the extra-thoracic trachea are uncommon. Instead intra-thoracic pathologies such as tracheal collapse, stenosis, and compression are the most frequent conditions encountered. However, even if such pathologies are uncommon, the trachea is a frequent site for surgery to relieve upper airway obstruction through a temporary or permanent tracheostomy (2).

Indications of airflow obstruction include nostril flaring, open mouthed breathing, lack of air flow through nostrils, audible respiratory noise and inability to eat and breathe at the same time. Roaring is a frequent clinical sign indicating the need for a tracheotomy. This abnormal sound is produced by the narrowing of the upper airway, which creates distortion of the normal airflow (increased impedance) (3).

Corresponding Author:
Cecilia Tolasi (tolasicecilia@gmail.com)

RELEVANT ANATOMY

The trachea is a semi-rigid tube that follows the larynx and ends in the mediastinum right after its bifurcation in the two major bronchi. We can identify a cervical and a thoracic portion of the trachea as the diameter narrows as we reach the entrance of the trachea in the thorax (4-5).

Rigidity of the trachea is maintained by a variable number of hyaline cartilage rings, that are united by longitudinal bands of fibroelastic tissue called annular ligaments. Its length differs greatly across species due to the length of the neck and body size: the bovine trachea is 60cm (5).

In its cervical portion the trachea is kept in place by the esophagus. In general, the esophagus is directly dorsal to the trachea at its origin in the upper neck, veers slightly to the left in the mid neck, and then returns to a more dorsal position in the thoracic cavity (3).

Together with the esophagus, muscles of the neck contribute to keep the trachea in place : the longus colli muscle relates dorsally to the remainder of the cervical trachea, in the cranial cervical region the trachea is covered ventrally by the paired sternohyoid muscles, whereas caudally it is related to the ster-

nocephalic and sternothyrohyoid muscles (4). On both sides of the trachea flow nerves bundles of the vagosympathetic nerve trunk, common carotid artery and jugular veins. (Fig. 1)

CASE HISTORY

On a 600milking dairy farm in Soresina, Northen Italy, primiparous cows are routinely given magnets as a preventive procedure against foreign bodies and subsequent reticulum-peritonitis.
As a consequence of an incorrect procedure during one of these routine operations, a magnet was incorrectly administered into the trachea of a 550kg primiparous Holstein cow.
On clinical examination the cow appeared in severe respiratory distress: 30 rpm respiratory rate and 95 bpm heart rate. Nostril flaring and open-mouthed breathing were visible and a roaring sound was audible on exhalation.
The diagnosis of trachea involvement should be based on visual inspection of the trachea by endoscopy or by the use of radiography (6), but in this field situation the only possible option was to palpate the ventral neck to locate the magnet. Ultrasound scanning was attempted but due to the cartilaginous composition of the trachea it was inconsistent.
A mass was located by palpation in the second third of the palpable trachea that corresponded with the framed magnet.
As the animal was still alert and able to stand up and move, it was decided to perform a tracheotomy to try to remove the magnet following consultation with the farmer.
Accurate preoperative evaluation and resultant support measures are essential to the successful correction of tracheal disorders and surgical management must be directed at main-

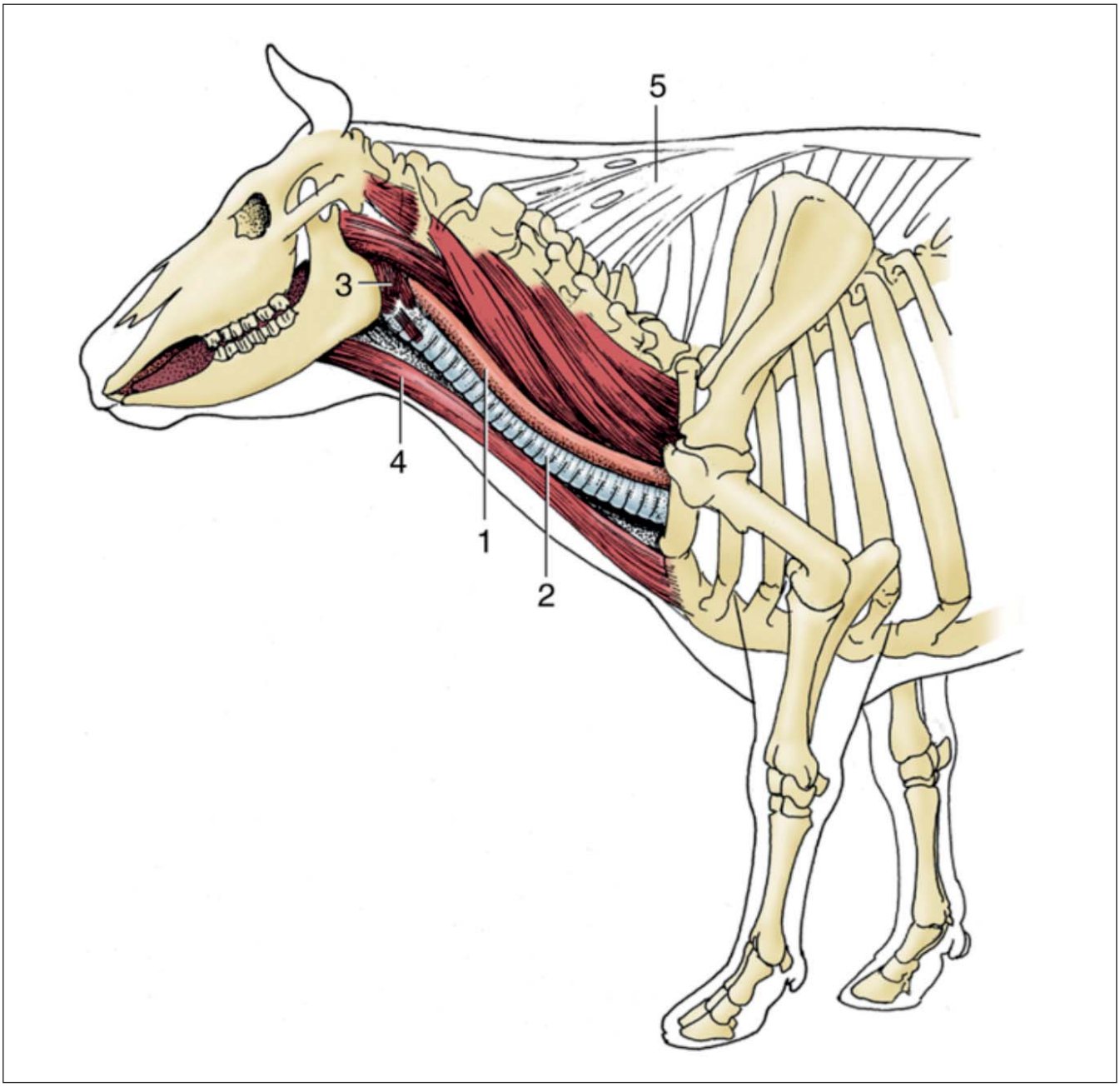

Figure 1 - Lateral view of the bovine neck.
In the midneck the esophagus lies on the left dorsolateral aspect of the trachea. 1, Esophagus; 2, trachea; 3, pharyngeal *musculature; 4, sternocephalicus muscle; 5, nuchal ligament. TVA*

Figure 2 - Incision through the muscles.

taining tracheal function, thereby preventing impairment of gas exchange or interruption of the mucociliary escalatory system (7).

Premedication was obtained with Xylazine (0,05mg/kg BW IV) and local anesthesia with 15ml of Procaine Chlorhydrate 2%. The preoperative preparation was done with the head in a normal anatomic position. At the time of surgery, the head was stretched up using two halters (one on each side) to mobilize the head up. This position, however, can aggravate the respiratory distress of the animal (1,6,7). The animal was placed in this position just before the surgery to minimize respiratory distress.

This type of procedure has been previously performed with the animal in left lateral recumbency, however the literature suggests to do it with the animal standing because of veterinarian safety and as it is easier to contain the animal.

With one hand, the trachea was immobilized while a 10 cm vertical incision was made, centered at the junction of the proximal and middle thirds of the palpable trachea through skin to the muscles (fig.2). A shorter incision can make the manipulation of the trachea more difficult and increases the trauma done to the surrounding tissue (1).

The location of the surgery site is important: if done too low on the neck, more dissection is needed because the trachea is located deeper beneath the skin. This increases the dead space and the chance of infection. If done too high on the neck, it may preclude doing a trachea-laryngotomy after a treatment failure. It is also possible to damage important structures such as thyroid glands located proximally to the larynx (1).

As the neck strap muscles cover the surface of the trachea but do not cross midline, the incision was centered in order to separate the muscle bellies and avoid cutting any muscle (3). After muscle dissection the trachea was easily visible and palpable.

The tracheal rings are cartilaginous, and if cut, they tend to form chondromas. Chondromas can obstruct airflow, so it is important to cut between the rings, not through them, paying attention to the closest important structure that is the esophagus (3, 8).

As the trachea was exposed and grabbed, the annular ligament between two tracheal rings was sharply incised, making sure not to cut more than 50% of the diameter of the trachea. The

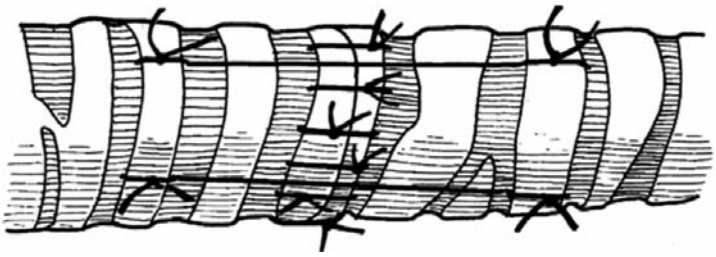

Figure 3 - Tension suture of the trachea.

magnet was directly beneath the incision.
As the magnet was too big to be removed from the incision it was decided to push it up toward the larynx, to make it possible to remove it through the epiglottis.
Stricture is a major complication of tracheal healing and is usually due to excessive tension on the suture line or extensive loss of tissue involving the tracheal wall. Moreover, lesions greater than 2cm require the placement of tension sutures to reduce stress at the anastomotic site (8).
The split connective tissue was approached and four single knot tension relieving sutures were placed around the cartilages adjacent to the anastomosis with a polyfilament absorbable filament. The tension suture enveloped the connective tissue of the previous and subsequent ring from the incision: stitches were placed through the annular ligaments encircling adjacent cartilages.
The surgery site was closed in two layers (muscle and skin independently), with a continuous suture.
Immediately after the surgery the animal got up with no more signs of respiratory failure: both heart rate and respiratory rate returned to normal.
The surgical wound was medicated twice a day with diluted iodine solution in order to remove blood clots or tissue debris and monitor possible subcutaneous emphysema caused by an incomplete scarification of the trachea.
Systemic antibiotic and anti-inflammatory therapies were started with Cloxalene Plus® (10ml/100kg BW, IM) and Alivios® (2ml/45kgBW, IM) and were continued on the following 3 days.
Complications associated with this type of procedure are cellulitis, tracheitis, bronchopneumonia, asphyxia, and death. It is important to monitor the surgery site for excessive swelling and foul discharge (7). A month after the surgery no signs of subcutaneous emphysema were visible, the surgery site filled rapidly with granulation tissue and it left minimal scaring not easily detected on palpation without knowing the past history of the animal.
The cow was previously equipped with a collar as a monitoring system of health and production performance that has been

Table 1 - Cow's production post-surgery.

Days	Data	Milk Production
0	06/05/23	-
1	07/05/23	-
2	08/05/23	-
3	09/05/23	-
4	10/05/23	-
5	11/05/23	-
6	12/05/23	-
7	13/05/23	-
8	14/05/23	15.0
9	15/05/23	35.3
10	16/05/23	34.7
11	17/05/23	32.6
12	18/05/23	34.9
13	19/05/23	36.4
14	20/05/23	38.9
15	21/05/23	35.4
16	22/05/23	37.7
17	23/05/23	35.0
18	24/05/23	40.1
19	25/05/23	38.9
20	26/05/23	42.7
21	27/05/23	38.4
22	28/05/23	35.4
23	29/05/23	29.6
24	30/05/23	36.1
25	31/05/23	31.7
26	01/06/23	34.7
27	02/06/23	36.1
28	03/06/23	32.7
29	04/06/23	36.5
30	05/06/23	34.5
31	06/06/23	41.6
32	07/06/23	40.5

removed after the surgery in order to allow the wound to heal. Seven days after the surgery the collar was replaced around the cow's neck and that has allowed the farmer to monitor the production and the rumination time that showed a complete recovery: after nine days the animal was producing 35kg/day of milk and was spending 10 hours/day ruminating.
Daily production has been monitored for 30 days after the surgery, showing a constant improvement of the animal (tab.1). Rumination time has been monitored as well as the milk production it rapidly increased: after a month the cow spent 400min/day ruminating.

CONCLUSION

Proper position of the head, adequate location of the incision, and careful dissection of the soft tissue over the trachea are key points to follow to perform a successful tracheotomy.
Either as an emergency treatment or as part of therapy, being able to perform a tracheotomy can be very useful for the bovine practitioner.

Conflict of interests

The author declares that there were no conflicts of interest.

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