


Exploratory thoracotomy and rib osteosynthesis in a canine: Case report

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ABSTRACT

A thoracotomy is a surgical incision in the chest wall to access the thoracic cavity to correct various alterations, including fractures. In cases of rib fracture correction, osteosynthesis is usually performed. The aim of this study was to report the case of a thoracotomy followed by rib osteosynthesis in a canine. A one-year-old Shih-tzu female weighing 4 kg presented with respiratory difficulties and intense pain on chest palpation and movement, inappetence and a small circular lesion in the chest area, as well as depression of the affected area. The presumptive diagnosis was made by identifying the clinical signs, which were confirmed by exploratory thoracotomy. Pre-anesthetic medication was given with tramadol, anesthetic induction with propofol, followed by total intravenous anesthesia with propofol using a syringe infusion pump. Skin diuresis was performed at the level of the 4th intercostal space, identifying muscle tears and rib fractures. For fracture repair, the hemi-clamping technique using steel wire was recommended, as well as reduction of the intercostal muscles and myorrhaphy of the thoracic muscles, using a simple continuous suture pattern with size 2-0 polyglactin 910 thread. Reduction of dead space, in the subcutaneous region, in the Cushing pattern, with size 2-0 polyglactin 910 thread and dermorrhaphy in the Sultan pattern with 2-0 polypropylene thread. It can be concluded that steel wire osteosynthesis was effective in resolving the animal's thoracic trauma.

Keywords: Surgery, Rib fracture, Hemicerclage, Thoracic trauma.

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INTRODUCTION

Several anatomical regions can be covered during a surgical procedure, one of them is the region of the thoracic cavity, which can be delimited as being long laterally with a greater proportion in the ventral dorsal portion, having as structural constitution the pairs of ribs, as well as costal cartilages, vertebrae and sternabrae. Among these, it is delimited that the first and last sternabrae are called manubrium and xiphoid cartilage (RAMPAZZO; FRIOLANI; CAMARGOS, 2013).

The intercostal muscles of the inner and outer regions make up the wall of the thorax, and these are delimited by the region between the ribs. It is noteworthy that the thoracic region is also associated with the dorsal and ventral serratus muscles, scalene, external abdominal oblique, latissimus dorsi and pectoral. All blood flow in this region is carried out through the intercostal arteries (NUNES, 2009).

Thoracotomy is a surgical incision in the chest wall, with the purpose of accessing the thoracic cavity to perform fracture corrections, correct cardiovascular changes, remove foreign bodies, collect samples, evaluate the evolution of diseases and, in specific cases, can be used as a definitive diagnostic method (exploratory thoracotomy) (PEREIRA *et al.*, 2016). According to the target organ within the thoracic cavity, the most efficient method of approach can be chosen, which is through the intercostal, lateral or sternal region (sternotomy) (SOUZA *et al.*, 2014).

In cases of rib fracture repairs, osteosynthesis is usually performed. In it, orthopedic steel wires are commonly used as cerclage or hemicerclage wires. Where they are traditionally used in association with other orthopaedic implants in order to provide greater bone stability (FREITAS *et al.*, 2017).

The cerclage wire is so named when the steel wire is placed around the bone circumference, it is usually used in long oblique or spiral fractures, which require stabilization of a large number of segments, and is not indicated for stabilization of short or transverse oblique fractures (PIMENTEL *et al.*, 2021). While the hemicerclage wire can be said to be a steel wire that is passed through holes drilled in the bone, it can be used in smaller fractures, which have a simple continuity solution and in small dogs and cats (FOSSUM, 2019).

Due to the anatomy and physiology involved in the thoracic region, any and all procedures performed in the thoracic region require great care in order to avoid damage to vital structures, pain and physiological changes. It is worth mentioning that this region is surrounded by negative pressure, which ensures the functioning of respiratory functions (CURTOLO, 2021). This justifies the importance of studies that report procedures performed on the chest, in order to provide a broader knowledge of the various forms of intervention for the treatment of conditions in this region.

In this context, the objective of this study was to report the case of a canine patient with rib fracture, submitted to exploratory thoracotomy and rib osteosynthesis, treated at the University

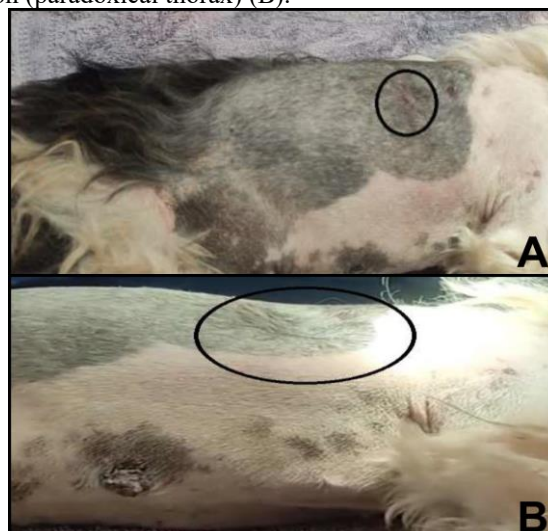
CASE REPORT

A one-year-old female Shih-tzu canine, weighing 4 kg, was treated at the HVU of UFPI/CPCE, located in the municipality of Bom Jesus – PI, on October 2, 2023, presenting respiratory difficulty. In the anamnesis, the owner reported that the dog had pain when moving, inappetence and suspected that someone had shot the animal with a pressure gun. It was also found that she did not have access to the street and only took walks accompanied. It is noteworthy that all vaccinations were up to date, as well as treatment for ectoparasites and endoparasites.

Then, the clinical and physical examination of the animal was performed. where the same presented Heart and respiratory rates of 148 bpm (beats per minute) and 36 mpm (movements per minute), respectively; rectal temperature of 37.7 °C; mucous membranes normocolored; capillary filling time (PCT) less than two seconds; degree of dehydration between 5 and 6 %; no noteworthy changes in the lymph nodes; and presence of a normokinetic pulse. Pulmonary auscultation revealed the presence of crackles on the side right, in the caudal pulmonary lobe, present mainly at the end of inspiration.

In addition, there was the presence of a circular lesion of approximately 0.5 cm in the middle third of the thorax, on the right side, with probable communication with the thoracic cavity (Figure 1-A). Palpation of the region revealed the presence of subcutaneous emphysema and pain. For a better visualization of the affected region, a broad trichotomy was performed. Thus, the presence of a bulging in the thoracic region was verified, which was more accentuated during inspiration, a clinical sign called paradoxical thorax (Figure 1-B).

Figure 1. Circular lesion in the cranial third of the thorax (circle) (A). Bulging (circle) in the thoracic region, which was more pronounced during inspiration (paradoxical thorax) (B).



Source: HVU, Bom Jesus – PI.



At the time, a blood count was requested for a better evaluation of the animal's general condition. The result of the complete blood count revealed normochromic macrocytic anemia, neutrophilia leukocytosis with deviation on the right, lymphopenia and thrombocytopenia, it should be noted that in the white series the presence of toxic neutrophils and Dohle corpuscles was observed. (Table 1).

Table 1. Values obtained from the preoperative blood count of a canine patient treated at the HVU – UFPI/CPCE presenting thoracic trauma.

| Cbc | Values obtained | Reference values |
|------------------|--|--|
| Erythrocytes | 3,3 | 5.5-8.5 x10 ⁶ / μ L |
| Hemoglobin | 8,8 | 12-18 g/dL |
| Haematocrit | 27 | 37-55 % |
| VCM | 81,8 | 60-77 fL |
| CHCM | 31,6 | 31-36 g/dL |
| Leukogram | Values obtained | Reference values |
| Total Leukocytes | 22.900 | 6,000-17,000 μ L |
| Rods | Relative (%): 3% Absoluta (μ L): 687 μ L | Relative (%): 0-3% Absoluta (μ L): 0-300 μ L |
| Targeted | Relative (%): 90% Absoluta (μ L): 20.610 μ L | Relative: 60-77% Absoluta: 3.000–1.500 μ L |
| Lymphocytes | Relative (%): 2% Absoluta (μ L): 458 μ L | Relative: 12-30% Absoluta: 1.000-4.800 μ L |
| Platelet | Values obtained | Reference values |
| Platelets | 102.000 | 200,000-500,000 μ L |

Source: HVU, Bom Jesus – PI. Reference values according to Weiss and Wardrop (2010).

After the evaluation of the exams and clinical signs presented by the animal, during the consultation, it was decided to perform an exploratory thoracotomy, in order to perform an evaluation of the possibly affected structures in the thoracic region, in addition to correcting them, if necessary. It is noteworthy that the radiographic examination was not performed due to the lack of availability of the radiographic examination in the region and in the HVU.

The animal was sent to the preoperative room, where the pre-anesthetic medication with tramadol was performed at a dose of 4 mg/kg intramuscularly (IM). In addition, venous access was established through catheter no. 22, and lactated ringer's fluid therapy was implemented at an infusion rate of 5 mL/kg/hour. It is noteworthy that a prophylactic antibiotic with enrofloxacin (5mg/kg) intravenous (IV) was used.

Subsequently, the patient was taken to the operating room, where anesthetic induction was performed with propofol, 4mg/kg, IV, followed by intubation with an orotracheal tube of n^o. 4,5 and subsequently, the animal was kept under stage three and anesthetic plane three by means of total intravenous anesthesia (TIVA) with propofol in a syringe infusion pump, at a dose of 0.3 mg/kg/minute.

In addition, ketamine 1.2 mg/kg/hour and lidocaine 3 mg/kg/hour were also infused in separate infusion pumps. After opening the thoracic cavity, the patient's oxygenation was maintained

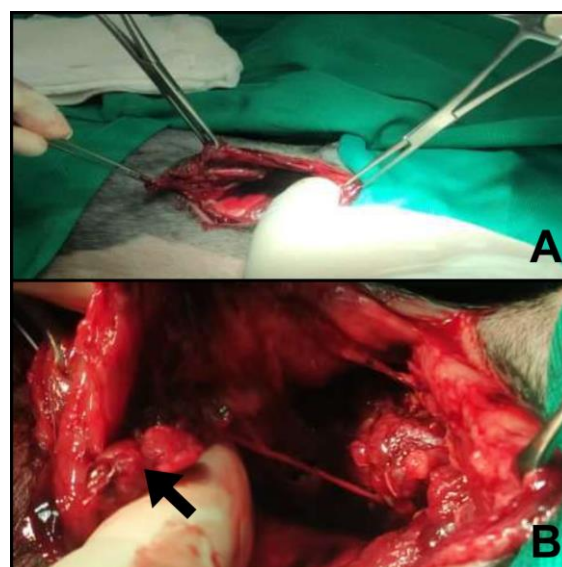
by means of manual ventilation (12 ventilations per minute), due to the unavailability of a mechanical ventilator. It was recommended to use intercostal blockade performed in the right lateral decubitus, following the margin of two intercostal spaces cranial and caudal to the lesion, and infiltrative block in the incision line, both were performed with lidocaine without vasoconstrictor at a dose of 5mg/kg.

Subsequently, the patient was placed in the left lateral decubitus position, thus performing prior and definitive antisepsis by means of degerming chlorhexidine the 2%. The field cloths were positioned and fixed with the aid of Backhaus tweezers. With the aid of a 23 scalpel blade, the skin was dieresis was performed, with approximately 10 centimeters at the level of the 4th intercostal space, after which the subcutaneous tissue was divulsed with the aid of Metzenbaum scissors with a blunt-fine tip to facilitate the visualization and exposure of the latissimus dorsi muscle. Skin and subcutaneous hemorrhages were contained by means of clamping and digital compression.

As a result, muscle lacerations and rib fractures were identified. Finally, in order to gain access to the cavity, the external and internal intercostal muscles were incited, widening the incision line with the aid of Metzenbaum scissors with a fine-blunt tip. At this point, the anesthesiologist was informed about the institution of positive pressure for the thoracic cavity, so that manual ventilation could be initiated.

With the aid of two Allis forceps, the intercostal muscle was clamped on both edges, and then the forceps were lightly tractioned to improve the visualization of the cavity (Figure 2a). After inspection of the region, it was found that the lung had not been affected, but three ribs were fractured (Figure 2b).

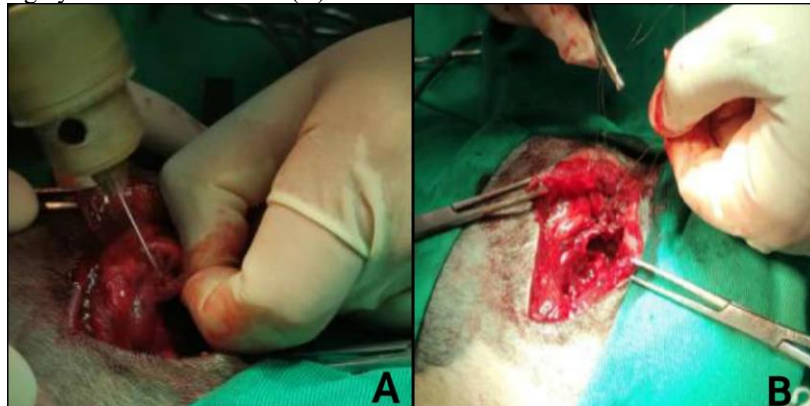
Figure 2. Clamping of the intercostal muscle for visualization of the thoracic cavity (A). Exposure of one of the fractured rib segments (arrow) (B).



Source: HVU, Bom Jesus – PI.

The fracture found in the ribs was of the simple, transverse, diaphyseal and closed complete type. For the correction of the fracture, the technique of hemicerclage by means of steel wire was recommended. Thus, the end of each segment of the fractured rib was drilled with the aid of an orthopedic drill, accompanied by a smooth 1.0 mm steel pin. The holes were used to pass through a 0.6 mm steel wire (Figure 3a) and be able to anchor all segments, in addition to bringing them closer together (Figure 3b), and the same procedure was performed in the three segments.

Figure 3. Perforation of one of the fractured segments of the rib to fix the steel wire (A). Hemicerclage made in the rib segments, after anchoring by means of steel wire (B).



Source: HVU, Bom Jesus – PI.

Subsequently, after stabilization of the fractured ribs, myorrhaphy of the intercostal and thoracic muscles was performed by means of the simple continuous suture pattern, in both cases the use of polyglactin 910 thread size 2-0 was recommended (Figure 3a). Dead space was reduced in the subcutaneous region in a Cushing pattern with 910 polyglactin thread size 2-0 (Figure 3b). Finally, 2-0 polypropylene thread was used for the dermorphaphy, which was done in the Sultan pattern (Figure 3-C).

Figure 3. Reduction of the intercostal space and myorrhaphy of the thoracic muscles (A). Reduction of dead space in the subcutaneous region (B). Sultan pattern dermorphaphy with polypropylene thread (C).



Source: HVU, Bom Jesus – PI.



After the procedure is over, ReinstatedThe negative pressure of the thoracic cavity was measured with the aid of a 10 mL syringe coupled to a three-way stopcock and a 23G scalp. Finally, the affected region was wrapped with a bandage with medium compression.

After the end of the surgery, the animal was sent to the anesthetic recovery room, where the physiological parameters were monitored until the patient was discharged. In the immediate postoperative period, dipyrone (25 mg/kg) was administered intramuscularly (IM) and meloxicam (0.1 mg/kg) were administered subcutaneously (SC). After the reestablishment Of all physiological parameters, considering the normal values for the species, the animal was discharged surgically, with a return after three days for removal of the bandage and reevaluation. It was recommended that the animal be hospitalized for constant monitoring during the first 24 hours.

For the immediate postoperative treatment, the following were prescribed: carprofen, 2.2mg/kg orally (PO), twice a day (BID), for four days; dipyrone, 25mg/kg, PO three times a day (TID), for seven days; tramadol 5 mg/kg, PO, TID, for five days; amoxicillin + potassium clavulanate, 25 mg/kg, PO, BID, for 12 days; and antibacterial ointment based on gentamicin, sulfanilamide, sulfadiazine, urea, and vitamin A palmitate, until total healing. In addition, it was recommended to wear surgical clothing 24 hours a day and to rest completely until the stitches were removed after 10 days.

According to the recommendation, after three days the animal returned for removal of the bandages and a new evaluation. The respiratory pattern was reestablished and without alterations, even after the removal of the bandages, all physiological parameters were evaluated and when pulmonary auscultation performed, the persistence of the crackle on the right side in the caudal pulmonary lobe at the end of expiration, and no other changes were found. The tutor reported the return of food intake and a higher level of activity by the patient. In view of the current inflammatory condition, prednisolone, 1 mg/kg, PO, BID, for ten days, and a nutritional supplement based on blood plasma, mannan oligosaccharide and beta-glucan, 3 g/day/once a day (SID) for thirty days, and a new evaluation was scheduled after ten days.

The patient returned for reassessment, in which no changes in physiological parameters were observed and pulmonary auscultation was unclear. The animal did not present pain on palpation of the thoracic region, and the thoracoabdominal breathing pattern was normal. The surgical wound was completely healed, so it was decided to remove the stitches.

DISCUSSION

An unstable chest, also known as a paradoxical chest, is seen when, now of inspiration, the fracture site becomes depressed, and at the moment of expiration, an expansion occurs. This fact was



observed in the animal treated during the physical examination, where the depression in the fracture region was accentuated on inspiration (CUNHA *et al.*, 2009).

Animals with chest trauma usually have difficulty breathing, requiring emergency stabilization, which may include oxygen delivery, thoracocentesis, and/or stabilization of the costal segments. In this case, the patient was stable (urgency) and it was not necessary to perform emergency stabilization as described (FOSSUM, 2019).

Inspiratory crepitus detected on pulmonary auscultation is correlated with detachment of the walls of small airways filled with fluid or mucus, and is associated with pulmonary edema (JASSNIKER *et al.*, 2023). Therefore, it can be said that the crepitus found in the pulmonary auscultation at the end of the animal's inspiration converges with what has been described in the literature.

Chest injuries can be associated with fights, car accidents, firearms, and falls. Cases arising from fights are common in the clinical routine and may present circular perforation points due to penetration of the canine tooth (CUNHA *et al.*, 2009). In this case, there was also the presence of a perforation in the chest detected on physical examination, which presented characteristics of biting and not of being shot by a pressure gun, as reported by the tutor.

It is observed that leukocytosis due to neutrophilia with a right shift, described in this case, may correspond to an excess of cortisol (chronic stress), since cortisol has an anti-inflammatory effect preventing the exit of leukocytes from the vessel, providing a hypersegmentation of neutrophils, consistent with what was described by Portas *et al.* (2022).

Trettene *et al.* (2020), reports that opioids are widely used as pre-anesthetic medication because they provide efficient analgesia. In this case, the use of tramadol for pre-anesthetic medication provided a reduction in discomfort and moderate analgesia for the surgical procedure.

Müller *et al.* (2014) describes that intercostal nerve blockade when performed in two cranial and caudal intercostal spaces of the incision site has high analgesic efficiency in the transoperative and postoperative periods. Consistent with the recommended blockade for this case.

As described by Nelson and Couto (2015), the definitive diagnosis of a rib fracture is commonly made through radiographic examination, which allows the precise visualization of bone structures, however, in the absence of it, exploratory thoracotomy can be used as a diagnostic method, despite being highly invasive, it proved to be efficient for the diagnosis of this case.

Cases of exploratory thoracotomy with an intercostal surgical approach are efficient if the affected area is limited to only the left or right side (FOSSUM, 2019). In this case, the right lateral intercostal surgical approach provided adequate exposure of the three fractures present, thus allowing adequate correction and stabilization of the segments by means of the steel wire.



Thoracotomy with rib resection generates greater exposure when compared to intercostal thoracotomy, making it more difficult to obtain a safe closure of the region and longer postoperative recovery time, and is not recommended in cases with pre-existing rib fractures because it provides greater surgical stimulation (FOSSUM, 2019). According to the report, it is verified that the surgical approach chosen is consistent with that recommended by the literature.

According to Flores *et al.* (2022), depending on the exposure required and the pathological process established, intercostal thoracotomy with lateral access can be said to be a standard approach for the thoracic cavity in most cases in small animals. This proved to be efficient for the present case, providing adequate exposure for the visualization of fractures.

According to Minto and Dias (2022), the use of hemicerclage may be convenient in cases where the fracture has a simple solution of continuity, has a transverse direction, and the animal is small. Therefore, in this case, the surgical approach is consistent with what has been described in the literature, since the characteristics of the fracture were consistent with the use of the stabilization technique by means of hemicerclage.

According to Maritato, Colón and Kergosien (2009), after the opening of the thoracic cavity, the negative pressure is lost and, as a result, there is a loss of autonomic respiratory function due to the intake of air. Therefore, the negative pressure was restored at the end of the surgery, using a syringe coupled to a three-way stopcock and a scalp for complete removal of air in the thoracic cavity.

The use of compressive bandage with medium compression in the postoperative period of thoracic surgeries is essential for an adequate recovery of the patient, limiting respiratory movements in the first weeks, promoting better healing and ossification (FARO, 2008). In the present report, the use of compressive bandages proved to be efficient for the containment of the dead space, ensuring greater stability of the affected site, consistent with what has been described.

Bif (2022) mentions that the continuous infusion of lidocaine and ketamine acts crucially in analgesia, in addition, ketamine acts by reducing pain and the requirement of opioids in the postoperative period, so the clinical and therapeutic approaches adopted were efficient to ensure efficient analgesia to the patient.

The immediate postoperative period for surgeries with thoracic approaches requires the use of analgesics and anti-inflammatories, due to the exacerbated stimuli caused during surgery (FRAGATA, 2008). Thus, the use of tramadol for moderate pain control and carprofen as a non-steroidal anti-inflammatory drug for the control of the inflammatory process and as an adjuvant for pain control were recommended.

Ribeiro (2019) describes that amoxicillin associated with potassium clavulanate is an important broad-spectrum antibiotic used in clinical routine in cases of infections by gram-negative



and positive bacteria, being the drug of choice in less severe cases. Therefore, in cases of opportunistic infections, as observed in this report, amoxicillin proved to be efficient in containing and eliminating the infection.

Prednisolone is a steroidal anti-inflammatory drug that has an anti-inflammatory and immunosuppressive effect, it inhibits the initial and late manifestations of inflammation, but delays healing, so it should be used with caution in cases of wounds (GORENSTEIN *et al.*, 2019). In this case, its use proved to be necessary due to the persistence of the inflammatory process in the pulmonary region detected in the surgical follow-up by means of pulmonary auscultation with the presence of crackles, showing that the carprofen prescribed for the immediate postoperative period was not efficient in controlling the inflammatory process triggered.

CONCLUSION

It can be concluded that the surgical technique used was efficient for the resolution of the animal's thoracic trauma, providing adequate postoperative recovery.



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