



# Pulmonary tractotomy for penetrating pulmonary injuries caused by bull horn: a case report

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**Abstract:** In our environment, the seriously wounded and injured in the context of the taurine injuries (by definition of high energy) justify an important problem of health. The potential complexity of the situations to be resolved obliges the prioritization in the action. So, to improve the prognosis of the penetrating pulmonary injuries it is absolutely necessary to both know the specificities of this type of injuries such as adapting the initial care protocols to these particularities traumatized serious. The present case reports a multiple and bilateral penetrating pulmonary injuries caused by bull-horn. It is not often that injuries of this magnitude reach the hospital alive, which is why the exceptionality of the case and the challenge that arises. We used endostapler for the management of penetrating pulmonary injuries to perform the tractotomy. After a complicated postoperative period by multiple thoracic and abdominal injuries, the patient could leave the hospital showing full recovery of thoracic wounds. Stapled pulmonary tractotomy allows a rapid, effective, and safe approach to the exposure of bleeding intraparenchymal pulmonary vessels and transected bronchi. This technique can be used without any bleeding from the staple line. We believe that tractotomy can play an important role in treating penetrating lung trauma, specially with multiple or bilateral injuries in the lung and avoid formal resection preserving lung volume and reduces the operative time and blood loss.

**Keywords:** Penetrating pulmonary injuries; tractotomy; bullfighting injuries; case report

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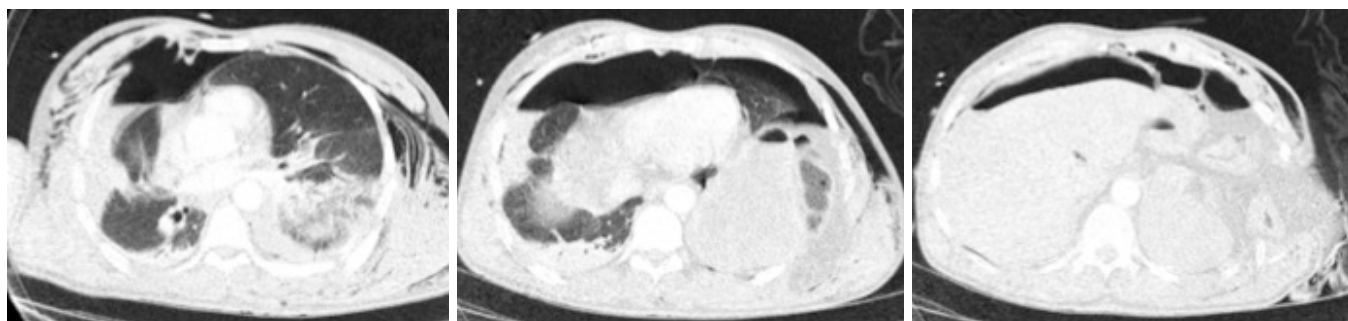
## Introduction

In our environment, the seriously wounded and injured in the context of the taurine injuries (by definition of high energy) justify an important problem of health. If to this the connotations of each type of show are added (distance to the nearest hospital, assistance and means according to the requirements legal...), the potential complexity of the situations to be resolved obliges the prioritization in the action. So, to improve the prognosis of the traumatized bullfighting it is absolutely necessary to both know the specificities of this type of injuries such as adapting the initial care protocols to these particularities traumatized serious. It is not often that patients with injuries of this magnitude reach the hospital alive, which is why the exceptionality of the case and the challenge that arises. The

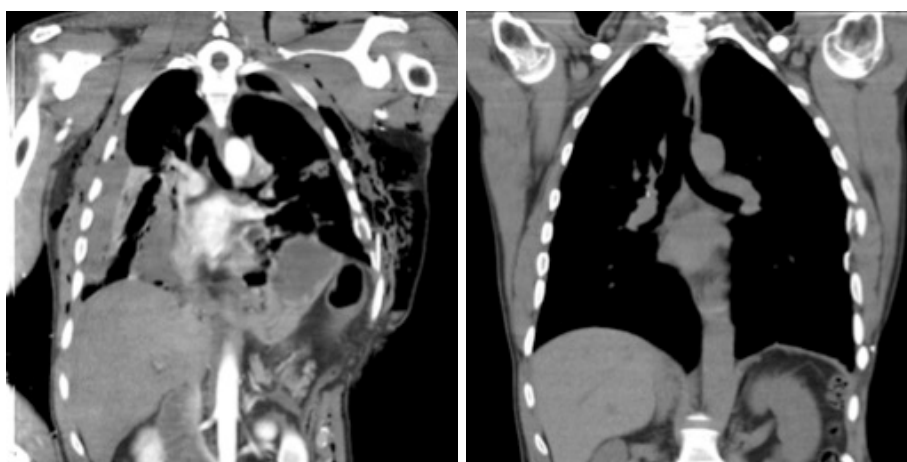
challenge of treatment is based on bilateral involvement, similar to what would occur in a patient with unilateral involvement and severe alteration of lung function (1). Pulmonary tractotomy was described by Wall *et al.* (2), we used endostapler for the management of penetrating pulmonary injuries to perform the tractotomy similar like it was described by Asensio *et al.* (3). We present the following case in accordance with the CARE guideline (1).

## Case presentation

A 45-year-old male patient was transferred from a nearby place where bullfighting is held. He was unconscious with a great open wound at the left thoracoabdominal junction and right subcutaneous emphysema with silence at pulmonary auscultation. The patient had no medical history



**Figure 1** Preoperative axial images.



**Figure 2** Preoperative and postoperative (8 months later) coronal images.

of interest for this pathology. A chest tube is placed in right hemithorax. Emergency CT was performed. The findings showed: right hemopneumothorax, mild left pneumothorax, bilateral apical lung contusion and in left lower lobe (LLL), intrathoracic stomach, multiple rib fractures, splenic rupture and pneumoperitoneum, free fluid and lateral left thoracoabdominal wall with continuity solution, multiple wounds in right inferior extremity without vascular involvement (*Figures 1,2*).

He was moved to the operating room, performing a midline laparotomy in which a bull horn wound is observed at the thoracoabdominal junction on the left side. At abdominal level presents a ruptured spleen, superficial lesion on the liver and stomach contusion. It was performed a splenectomy and conservative treatment of liver and stomach injuries. Despite splenectomy the patient was still hemodynamically unstable. There were two holes in the right hemidiaphragm and a disruption of the anterior face of the diaphragm on both sides. The wound was enlarged

with a middle sternotomy by the position of the patient. He had lung contusion in both lungs especially in right upper lobe (RUL) and multiple bilateral rib fractures with wall unfolding in the left side that depended on cartilaginous chest wall. In the right lung, which had vascular pleuropulmonary adhesions that were dissected, there were two lacerations in the right middle lobe (RML) that were sutured with linear Endo-GIA stapler following the technique of the tractotomy described by Asensio *et al.* and ceasing pulmonary bleeding. In the left hemithorax there were one laceration in lingula and four lacerations in the LLL which were sutured with the same technique, except a wedge resection that included two lacerations in LLL. A chest tube were placed in each one of hemithorax. The diaphragm is repaired without the placement of prostheses with non-absorbable thread.

The patient remained under mechanical ventilation for almost 2 months, the first 10 days with nitric oxide. Percutaneous tracheotomy was performed at 12th day.

In intensive care follow-up (*Figure 3*), there was a need

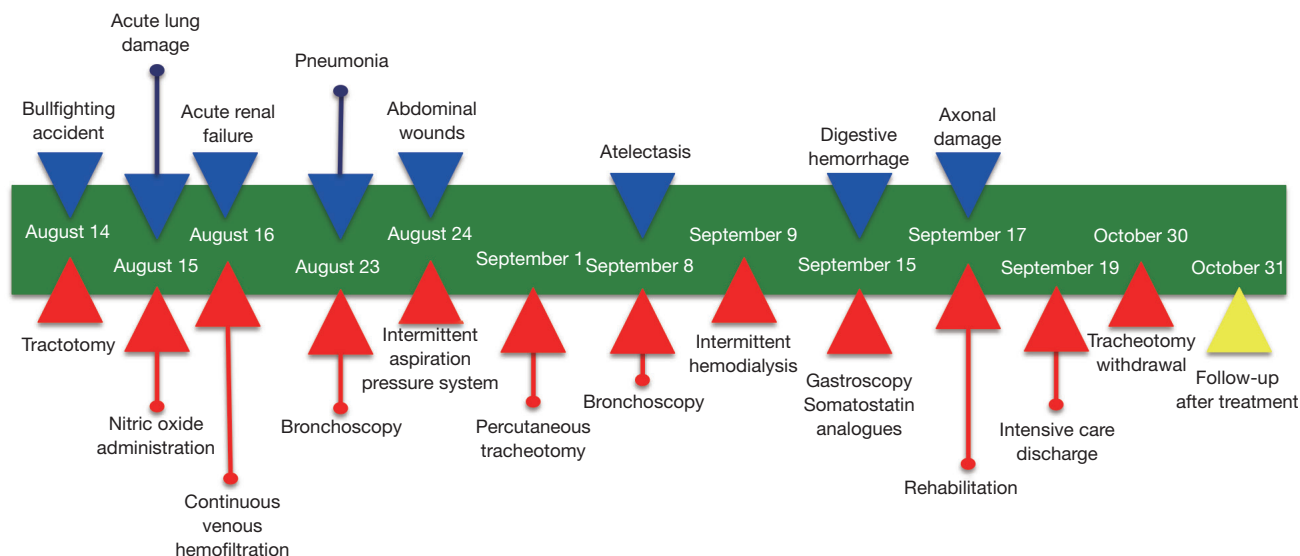


Figure 3 Timeline pulmonary tractotomy.



Figure 4 Postoperative axial images (8 months later).

for input inotropics, pneumonia associated with mechanical ventilation that required antibiotic treatment and several aspiration bronchoscopies, acute renal failure due to polytransfusion and signs of axonal damage of the right brachial plexus. He also presented digestive hemorrhage in the area of the gastric plication treated with somatostatin analogues. Abdominal wounds were treated with antibiotics and intermittent aspiration pressure system until resolved, and the patient could leave the hospital at two and a half months. In subsequent reviews, the thoracic wounds show full recovery (Figures 2,4).

### Discussion

Surgical treatment for penetrating chest trauma is very challenging and can have high mortality and morbidity

rates. In emergent situations, the successful treatment of open traumatic lung injuries requires rapid intraoperative evaluation, precise control of the injury with rapid bleeding control and a short as possible operative time (4).

The penetrating injuries to the chest rarely need operative repair. The majority of these injuries can be managed non-operatively. Wounds caused by large animals are usually mostly closed, although in some cases, specially horned animals could cause open wounds. In these cases, the knowledge of kinematics that is the set of forces, movements and energy involved in trauma, must be taken into account for problem solving. In the case of surgery performed in bullfights, surgeons are watching the situation and this allows them to anticipate the potential injuries that may develop. In this case it is a popular celebration similar to those carried out in Pamplona that are much better

known and although depending on the size of the bull there is an obligation of presence of at least one surgeon, they do not cover their entire route. The kinematics of the horn injury presents several phases in which different muscle groups of the animal are involved, producing different types of lesions. In addition to the trajectory of the horn, two other components are distinguished: the area of reach (trajectory in the longitudinal direction) and the volume of scanning (in the three dimensions of space) (5).

On the other hand, the horn injuries are contuse wounds that have their own characteristics: (I) they can have only one entrance or several entrance and exit holes, there may be a small entrance hole but with great tissue damage inside; (II) the mechanism that explains the injuries is there may be several paths included in a cone in which the vertex is the entrance hole, the different paths are caused by the victim and the movements of the animal trying to separate; (III) they are contaminated wounds, with multiple microorganisms or foreign bodies; (IV) they can associate wounds of different sizes, both directly and caused by kickback. In our case the wounds caused by the horn fulfilled all the characteristics. (I) The entrance hole was large, with loss of substance in the abdominal wall, it presented lesions that reached the entire upper portion of the abdominal cavity (spleen, stomach and liver) and both hemithorax with involvement of both hemithorax. The horn had caused a disruption of the anterior face of the diaphragm to the thoracic wall and partially on both sides of the pericardium reaching the RML and the left lung (lingula and LLL). However a small entrance hole could also cause multiple injuries. (II) The mechanism of the cone with the vertex in the entry hole justifies all injuries. (III) The abdominal wound presented bacterial contamination and needed antibiotic treatment and intermittent negative aspiration system for healing. (IV) Backlash injuries appeared as occurs in the contusion of RUL.

In the presence of severe bleeding, usually from a large lung vessel, a thoracic surgical approach is necessary. Due to the low-pressure vascular system and the rich concentration of tissue thromboplastin in the lungs, any bleeding is usually self-controlled (6). In this case, the general surgeons began with a middle laparotomy, since the entrance hole was abdominal and the spleen was compromised. Active bleeding had been observed in the spleen, when performing laparotomy the presence of multiple thoracic lesions were noted. Once the abdominal bleeding was resolved, the presence of bleeding from the thoracic cavity and the severity and bilaterality of the wounds, the incision to the

thorax is enlarged through a middle sternotomy.

Penetrating lung injuries rarely need operative repair. However, in some cases with extensive parenchymal damage or hilar injuries, a lobectomy even may be necessary. Some authors propose in this situation stapled pneumonectomy better over an anatomical lobectomy with isolation of the hilar structures, because it is easier, faster, and associated with less blood loss (6). But *in situations* with significant bleeding or major air leak from a missile or knife tract lung-sparing techniques with the use of staplers, like wedge resection and tractotomy with direct control of the vascular or bronchial injury, have allowed easier, faster, and effective control of bleeding without sacrificing unnecessarily normal pulmonary parenchyma (7).

Pulmonary tractotomy with selective vascular ligation was described by Wall *et al.* (2) for the management of penetrating injuries to the lung. Stapled pulmonary tractotomy allows the management of deep through-and-through pulmonary parenchymatous injuries. The use of the staplers can lead to rapid exposure of bleeding pulmonary vessels for selective vascular ligation. It can also expose transected segmental bronchi, which require ligation to control air leaks (3). In our case with a bilateral affectation it was necessary to preserve the greatest possible parenchyma as well as to control the bleeding of the multiple wounds present. In this case the orifices of entrance and exit were located and Duval lung clamps were placed in parallel with the tract. We used GIA 80 because of the size of the injuries, the availability of the device and it was an open surgery. On other occasions endostaplers of other sizes could be used like in video-assisted thoracoscopic surgery (VATS). The clamps allowed to separate the tissues in order to expose vascular lesions in greater depth that were sutured with 3-0 absorbable sutures like the technique described by Asensio *et al.* (3).

This procedure, like these authors recommend, exposed the bleeding and air leakage site providing a direct access to the lesions. This great exposure of the lesion allows quickly suture for hemostasis and airway control. What is more it prevents the resection of unnecessary lung parenchyma while preserving as much as possible lung function. Therefore, several authors recommend trying first the tractotomy before planning a regular pulmonary resection in these situations, particularly in patients with poor lung function (4). On the other hand, the performance of major regulated resections such as lobectomy or pneumonectomy associated with a higher mortality (8). Like in the present

case, the tractotomy was successfully performed in both ventilating lung with intermittent apnea, this saves time over preparing for 1-lung ventilation in unstable patients with penetrating thoracic injuries that need emergent surgery (4,9).

An important aspect after performing the tractotomy is to demonstrate that the divided margin could become ischemic due a vascular interruption (10). This inspection is crucial in order to avoid ischemic or atelectasis tissue that leads to another surgery (8). However, the risk of ischemia is low due to the double circulation, systematic and pulmonary (2).

In another order of things, the patient presented a diaphragmatic rupture that occurs in between 10% and 15% of open thoracic trauma. Due to our idiosyncrasy, in the Spanish series, diaphragmatic tears due to a horn and bull injury reach 2.3% (11). In this case it was necessary to repair the diaphragmatic lesion and the left flail chest with stitches avoiding the use of prosthetic material that would have increased the risk of infection.

The main limitation is that it is a very rare case but it can be applied in cases with unilateral involvement and severe limitation of respiratory function.

## Conclusions

Stapled pulmonary tractotomy allows a rapid, effective, and safe approach to the exposure of bleeding intraparenchymal pulmonary vessels and transected bronchi. This technique can be used without any bleeding from the staple line. We believe that tractotomy can play an important role in treating penetrating lung trauma, specially with multiple or bilateral injuries in the lung and avoid formal resection preserving lung volume and reduces the operative time and blood loss.

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## Footnote

*Conflicts of Interest:* Both authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/ccts.2019.11.05>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are

appropriately investigated and resolved. Informed consent for the study was waived because the patients remained anonymous. All efforts to remove patient health information and maintain anonymity were made.

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## References

- Riley DS, Barber MS, Kienle GS, et al. CARE guidelines for case reports: explanation and elaboration document. *J Clin Epidemiol* 2017;89:218-35.
- Wall MJ Jr, Hirshberg A, Mattox KL. Pulmonary tractotomy with selective vascular ligation for penetrating injuries to the lung. *Am J Surg* 1994;168:665-9.
- Asensio JA, Demetriades D, Berne JD, et al. Stapled pulmonary tractotomy: a rapid way to control hemorrhage in penetrating pulmonary injuries. *J Am Coll Surg* 1997;185:486-7.
- Kang DH, Park HO, Moon SH, et al. Successful Tractotomy Technique for a Penetrating Lung Injury in a Patient with One Lung. *Korean J Thorac Cardiovasc Surg* 2017;50:399-402.
- Montejo B. Cirugía taurina: ¿Dónde estamos? ¿Hacia dónde nos dirigimos? ¿Qué podemos hacer para mejorar? *Rev Acircul* 2015;2:5.
- Velmahos GC, Baker C, Demetriades D, et al. Lung-sparing surgery after penetrating trauma using tractotomy, partial lobectomy, and pneumonorrhaphy. *Arch Surg* 1999;134:186-9.
- Demetriades D, Velmahos GC. Penetrating injuries of the chest: indications for operation. *Scand J Surg* 2002;91:41-5.
- Asensio JA, Ogun OA, Mazzini FN, et al. Predictors of outcome in 101 patients requiring emergent thoracotomy for penetrating pulmonary injuries. *Eur J Trauma Emerg Surg* 2018;44:55-61.
- Petrone P, Asensio JA. Surgical management of penetrating pulmonary injuries. *Scand J Trauma Resusc Emerg Med* 2009;17:8.

10. Gasparri M, Karmy-Jones R, Kralovich KA, et al. Pulmonary tractotomy versus lung resection: viable options in penetrating lung injury. *J Trauma* 2001;51:1092-5; discussion 1096-7.
11. Cerón Navarro J, Peñalver Cuesta JC, Padilla Alarcón J, et al. Traumatic rupture of the diaphragm. *Arch Bronconeumol* 2008;44:197-203.

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