

# Endovascular Treatment of Blunt Aortic Trauma: First Colombian Case Series

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**Background:** Endovascular repair of the aorta has been established as the treatment of choice for patients with closed traumatic aortic injury, and its implementation has resulted in better clinical outcomes for patients. Our objective was to describe a case series of patients with closed traumatic aortic injury who received endovascular management.

**Methods:** We carried out a retrospective review of the experience accumulated over 5 years in a level IV center in Colombia of the management of closed traumatic aortic injury with endovascular treatment. We found four patients with different aortic injuries described as grade II or III. Endovascular management was performed during the first 48 hours after admission to the emergency room; hospital survival was 100%, and there was no record of complications after the procedure.

**Conclusions:** Endovascular repair is the treatment of choice for closed traumatic aortic injury, including scenarios of hemodynamic instability. This is the first case series published from Colombia.

**Keywords:** *Aortic Diseases; Aortic Rupture; Endovascular Aortic Repair*

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## INTRODUCTION

Trauma and consequent closed aortic injury occur most frequently secondary to sudden deceleration mechanisms, usually in a motor vehicle accident [1]. It also happens in motorcycle, aircraft, automobile, and pedestrian collisions, in addition to crush injuries.

The diagnosis and comprehensive approach to this entity is of vital importance in clinical practice since it involves a high mortality rate. Some injuries are even

fatal in the out-of-hospital setting, which highlights the priority of addressing these patients early.

The diagnosis is made with extension studies such as computed tomography angiography, which also allows us to classify the severity. In this regard, the Society for Vascular Surgery (SVS) and European Society for Vascular Surgery (ESVS) have classified aortic traumatic injury as follows [2,3]:

- Grade I of ESVS or grade I and II of SVS: Injury confined to the intima or vessel wall with normal external wall contour
- Grade II of ESVS or grade III of SVS: abnormal external wall contour or external wall disruption with contained hemorrhage (e.g., pseudoaneurysm)
- Grade III of ESVS or grade IV of SVS: complete wall transection with free rupture.

The possible treatment methods are as follows. Conservative treatment is intended for patients with grade I injuries of ESVS or grade I injuries and some stable grade II injuries of SVS, who can be closely monitored with tomographic images to

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establish lesion progression and intervene. Thoracic endovascular aortic repair (TEVAR) and open surgery are reserved for lesions classified as grades II to III of ESVS or III to IV of SVS [1,3]. Finally, the recommendation of the guidelines of the ESVS is for open surgical repair in selected patients with blunt aortic injury requiring intervention and those with an aortic anatomy unsuitable for a stent graft [3]. Regarding these therapeutic possibilities, since 2011 TEVAR has been recommended as the first-line treatment because it provides a greater chance of survival, and a lower probability of paraplegia, renal failure, transfusions, re-operation due to bleeding, cardiac complications, pneumonia, and hospital stay when compared to open surgery [4].

Despite the indication for TEVAR in closed aortic trauma, there is little evidence concerning the long-term prognosis of TEVAR, probably related to the diagnosis having low incidence. Some studies show a low mortality rate in patients with traumatic closed aortic injury managed with TEVAR (9%), compared to open surgical management (19%). This difference is greater when compared to patients who do not undergo surgical management (46%) [2].

In Colombia, a retrospective study evaluated endovascular versus open management of aortic injuries of non-traumatic origin, finding lower mortality, shorter surgical time, and shorter hospital stay for endovascular treatment [5]. The following describes the first case series on the use of TEVAR in aortic injury due to closed thoracic trauma in Colombia, which is the result of a review of five years of clinical records in a referral center in the city of Cali.

Ethical Approval and Informed Consent

This manuscript does not contain official information; the data presented is anonymous and has been reviewed and approved by the institution's ethics committee.

CASE SERIES

Case No 1

A 14-year-old male patient with polytrauma and hemodynamic instability secondary to a traffic accident as a pedestrian was admitted to a level II clinic. They in turn, rapidly referred the patient to a level IV emergency department in the same city, a few kilometers away from the reference center. This center had the capacity for endovascular and open surgical management of traumatic injuries.

He was diagnosed with a traumatic aortic injury grade II (described as a hematoma content of 19 mm) located at the exit of the left subclavian artery. Therefore, an endovascular repair with a femoral approach was performed (Table 1). No complications during the procedure were reported. A type c-tag 28 × 150 mm stent was used with subsequent arteriography showing the patency of the renal, celiac trunk, and superior mesenteric arteries (Table 2). The stent size was chosen with an oversizing of 30%.

During the peri- and postoperative period, he required vasopressor support with subsequent gradual withdrawal. Twenty days after hospitalization, he was transferred to another institution due to administrative agreements to continue management of other bone lesions.

Table 1 Summary of variables characterizing aortic trauma.

Variables	Patient 1	Patient 2	Patient 3	Patient 4
Age	14 years	29 years	27 years	18 years
Sex	Male	Male	Male	Male
Time of evolution	Unknown (not described)	24 hours	24 hours	1 hour
Referred	Yes	Yes	Yes	Yes
Time between admission to the emergency department and surgery	29 hours	7 hours	42 hours	19 hours
Associated trauma	Severe TBI, chest trauma, sternal fracture, left tibial spine fracture	ASIA A spinal cord trauma, blunt chest trauma, pulmonary contusion, femur fracture	Severe TBI, subdural hematoma, closed thoracoabdominal trauma, open femur and humerus fracture	Mild TBI, thoracoabdominal trauma, pelvic trauma, grade IV hepatic trauma
Location of injury	Descending thoracic aorta	Descending thoracic aorta	Descending thoracic aorta	Descending thoracic aorta
Mechanism of trauma	Unknown traffic accident (unknown kinematics)	Victim of a landslide	Motorcycle driver versus car	Motorcycle collision with a truck
Grade of injury (SVS scale)	II: 19 mm mural hematoma	II–III: mural hematoma and pseudoaneurysm.	II: mural hematoma	II: mural hematoma

TBI, Traumatic brain injury; ASIA, American Spinal Injury Association; SVS, Society of Vascular Surgery.

Table 2 Summary of the variables that characterize the intervention performed and the clinical outcomes measured.

Variables	Patient 1	Patient 2	Patient 3	Patient 4
Approach	Right femoral	Right femoral, right brachial	Right femoral, right brachial	Right femoral, left radial
Type of stent	Core tac thoracic 28 × 150 mm	Tag active control system 26 × 100 mm	Valiant thoracic 24 × 100 mm	Cook Medical Zenith 24 × 105 mm
Secondary complications	None	None	None	None
Days of stay	20 days	120 days	3 days	14 days
In-hospital mortality	No	No	No	No

Case No 2

A 29-year-old male patient, who presented with polytrauma due to crushing from a landslide, was admitted to the emergency service of a level II institution (in a city of 100,000 inhabitants and located 1 hour from the referral site by road), where tomographic studies were performed and a lesion of the thoracic aorta found. He was therefore referred to a level IV institution to consider endovascular management.

The lesion was described by radiology as a traumatic rupture of the thoracic aorta with pseudoaneurysm and hematoma in the wall due to blunt trauma (Table 1). A procedure was performed to insert a 26 × 100 mm stent graft using the femoral approach (Table 2).

Subsequent arteriography showed adequate patency of the renal, celiac trunk, and superior mesenteric arteries, without documenting immediate complications.

The patient was discharged from the institution in less than 24 hours to continue comprehensive in-hospital management.

Case No 3

A 27-year-old male patient was referred to a level II center in a small city (about 100,000 inhabitants) after a motorcycle accident, where management requirements were evaluated. He was then referred to a level IV center for endovascular treatment of a traumatic injury.

He had polytrauma with subsequent blunt trauma to the abdomen. In the emergency room of the level IV center, a mural hematoma in the descending aorta with traumatic dissection below the subclavian artery without active bleeding, classified as grade II (Table 1), was documented.

A femoral approach was performed for the passage of a Valiant thoracic 24 × 100 mm stent, without evidence of leakage in the control aortogram (Table 2). He presented with a satisfactory evolution and was discharged from the hospital after 3 days.

Case No 4

An 18-year-old male patient was referred to a level IV center (with capacity for endovascular and open management of traumatic injuries) after a motorcycle

accident. He presented with a polytrauma, with closed chest and abdomen trauma, with a tomographic finding of a hepatic trauma, which was managed endovascularly.

An aortic dissection type lesion of grade II was confirmed on the descending aorta by computed tomography (Table 1). Therefore, an endovascular implantation of a thoracic 24 × 105 mm Cook Medical stent using a femoral approach was performed, without evidence of immediate complications and with verification of adequate perfusion to vital organs (Table 2). The patient completed inpatient management after 14 days for the resolution of other abdominal lesions.

DISCUSSION

Endovascular management of aortic injury due to closed thoracic trauma has evolved significantly in recent decades, gradually displacing open surgery as the follow up treatment. This change is largely due to lower mortality and morbidity associated with endovascular repair compared to open surgery. Specifically, fewer complications, such as paraplegia, renal failure, transfusion support, re-operation for bleeding, and shorter hospital stay have been reported [4]. The magnitude of the reduction of complications of stroke is 11.8% and of permanent spinal cord injury is 13.1%. The prevention of prolonged mechanical ventilation is reduced by 21.9% [6], compared to the reduction of mortality evaluated at 30 days, which is 22% lower [7]. These results are predominantly observed in patients with hemodynamic instability or multiple intra-abdominal injuries derived from trauma [2,8]. This is probably because a minimally invasive approach does not require the use of prolonged clamping of the aorta, added to the fact that surgical time is usually shorter. This decreases the probability of tissue ischemia and provides for a better recovery of the tissues, especially when the aortic injuries are high [9].

The indication for endovascular treatment is preferred in lesions classified as type II or III, i.e. when the damage is partial or involves the aortic wall, due to the risk of progression to rupture. It is also the recommended option for hemodynamically unstable patients, where a less invasive procedure results in better outcomes, including better survival [10].

However, endovascular repairs present certain technical challenges that require attention. For example, vascular access and the correct evaluation of the aortic anatomy are key for the precise placement of the stent. It is necessary to make an adequate selection of the size of the stent (since the aorta can vary in diameter according to the age and other conditions of the patient), in order to minimize the risk of displacement or endoleaks as complications associated with the procedure at an early stage.

For these reasons, it is necessary to transfer poly-trauma patients to centers with multidisciplinary management capacity, which have trained surgical and endovascular teams.

The level IV center from which the presented case series was collected has a hybrid operating room for trauma cases and for cases where Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) is required. The center has health personnel trained to take tomographic studies (in the arterial and venous phases) as the first choice for analyzing vascular traumatic injuries, and the 24/7 availability of multiple specialties, such as emergency medicine, intensive care, interventional radiology, and vascular surgery, for the management of trauma.

Patient first-choice is key to the success of TEVAR use, and imaging studies such as tomography or magnetic resonance imaging are employed to identify and treat any short-term complications on time. However, the time in which such follow-up should be performed in the acute context has not been stipulated and protocolized, and it varies according to the clinical condition of the patients during their postoperative evolution.

Long-term follow-up is conducted in 1, 6, and 12 months, and from then on every year, usually with angiotomography [11]. In addition, the complications derived from the procedure itself must be taken into account. Some examples described are spinal cord ischemia, paraplegia, stroke, and acute renal injury, so clinical examination is important during the follow-up of patients so that it can guide the moment at which patients require imaging control in the short term.

For the cases presented, no follow-up records were found in the institution (because of the insurance system in which follow-up studies are directed to institutions where the patient has greater accessibility).

An attempt was made to follow-up with the patients by telephone, but it was only possible to communicate with the patient in case 1, where his family mentioned that an annual angiotomography study was performed for the first 3 years with no apparent record of complications.

Long-term results are still being evaluated, especially in young patients who may require new interventions due to factors such as aortic growth or stent wear, an aspect that could not be evaluated in our case series

because we did not have a follow-up of the patients over time.

The case series described is the first case series reported in Colombia on endovascular management of closed traumatic aortic lesions. Although experiences of endovascular management with penetrating trauma [12] and closed chest trauma with a hybrid approach have been described previously [13], the present series shows how the implementation of endovascular management in these types of pathology (including in developing countries) results in favorable clinical outcomes. This is due to survival during in-hospital follow-up, with no record of complications and short hospital stays (except for cases due to lesions in other segments that require a longer time of in-hospital management).

## CONCLUSION

Endovascular repair has been established as the treatment of choice for closed traumatic aortic injury, including scenarios of hemodynamic instability, due to its better results in terms of survival, reduced complications, and improved recovery time when compared to open surgical repair of the aorta.

This technique requires having endovascular intervention centers with experience in its use, as well as permanent availability of resources.

## Ethics Statement

- (1) All the authors mentioned in the manuscript have agreed to authorship, read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript.
- (2) The authors declare that they have read and abided by the JEVTM statement of ethical standards including rules of informed consent and ethical committee approval as stated in the article.

## Conflicts of Interest

All authors declare that they have no conflicts of interest.

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## Declaration of the Use of Generative AI and AI-assisted technologies in the writing process

The authors have not used artificial intelligence during the writing process of the paper. However, the authors admit to having tools to facilitate the translation of the manuscript from the Spanish language.

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