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CASE REPORT

TEVAR for blunt thoracic aortic injury - Case Report

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Blunt thoracic aortic injuries (BTAIs) stand as a prominent cause of mortality in trauma scenarios due to high-energy blunt trauma, such as in motor vehicle accidents. Thoracic Endovascular Aortic Repair (TEVAR) has emerged as the preferred treatment modality for BTAIs owing to its minimally invasive approach and superior outcomes compared to open surgery. Here, we present the case of a 31-year-old woman involved in a severe motor vehicle accident, resulting in acute thoracic aortic injury managed with TEVAR in Mater Dei hospital.

Upon admission, the patient demonstrated signs of hemodynamic instability, prompting urgent CT imaging which revealed aortic injury alongside other traumatic injuries. Emergency TEVAR was successfully executed under general anesthesia, followed by revascularization for a concurrent popliteal artery injury. Subsequent imaging confirmed proper stent positioning and resolution of the aortic injury. The patient experienced a satisfactory recovery with a hospital stay lasting 25 days.

Diagnosing BTAIs poses challenges due to their nonspecific clinical manifestations, necessitating reliance on imaging modalities, primarily computed tomographic angiography (CTA). TEVAR offers distinct advantages over open surgery, including reduced invasiveness, shorter operative times, and decreased postoperative complications. However, long-term surveillance remains crucial due to potential complications. TEVAR persists as the primary treatment modality for eligible BTAIs, ensuring favorable patient outcomes and enhanced recovery.

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Autopsy based studies indicate that blunt thoracic aortic injury (BTAI) is the second most common cause of death in trauma cases in young adults, preceded only by head injury.[1] The two most frequently noted factors contributing to BTAIs are high energy blunt trauma and rapid deceleration. Motor vehicle accidents, especially head on collisions, account for 81% of cases of BTAIs.[2] BTAIs are defined as a tear in any part of the aorta that arises secondary to a combination of stretch and shear forces, precipitate deceleration, raised intravascular pressures and compression of the aorta between the anterior chest wall and the vertebral column.[3] These injuries may occur within any part of the aorta, from the aortic root to the common iliac artery bifurcation, however, are more common at sites of aortic tethering, such as the aortic isthmus, as shear forces tend to act more vigorously at such points.[4]

The mainstay treatment of BTAIs, barring any contraindications, is now considered to be Thoracic Endovascular Aortic Repair (TEVAR). TEVAR confers superior outcomes to open surgery due to its minimally invasive approach and associated lower complication rates as well as a shorter recovery period.

We present the case of a 31 year-old lady who presented to the emergency department after a high impact motor vehicle accident, who sustained acute thoracic aortic injury and was treated with TEVAR.

CASE REPORT

A 31 year-old woman who was previously healthy, was brought to the emergency department by ambulance after being involved in a high impact motor vehicle accident between her car and a heavy truck. The patient was found unresponsive in the drivers' seat with the steering wheel impacted into her chest and both lower limbs entrapped. She endured a difficult extraction and was given intraosseous fluids, her spine was immobilized and a pelvic splint was applied. Tranexemic acid was given intravenously and oxygen was administered via a non-rebreather mask on site. She regained consciousness after on-site resuscitation with fluids and oxygen.

Upon initial primary survey, her airway was patent with no obvious signs of obstruction. She was tachypneic with oxygen saturations of 99% on non-rebreather mask, her radial pulse was thready on the right side but her carotid pulse was palpable on the same side. Her blood pressure was 126/75 but tachycardic. She was otherwise hemodynamically stable. Focused assessment with sonography for trauma (FAST scan) was performed and free fluid was noted in the right upper quadrant and left upper quadrant of her abdomen. She was noted to have a Glasgow coma scale of fourteen but was at times agitated and confused.

She was transferred to the radiology department for a CT-Polytrauma which revealed an abnormal contour of the proximal descending aorta just distal to the origin of the left subclavian artery which was associated with luminal filling defects and massive surrounding loss of planes in the mediastinum, suggestive of a large mediastinal haematoma which spread caudally along the abdominal aorta. Evidence of pulmonary embolism was noted in the lower branch of the right pulmonary artery with a small right sided pneumothorax. The abdominal aorta was also noted to have a decreased diameter with an adjacent collapsed inferior vena cava and hypoperfusion defects in both kidneys. A comminuted fracture of the middle third of the right femur was also confirmed on CT.

The major trauma protocol was initiated and the patient was transferred directly to the operating theatre for a TEVAR.

Emergency planning was performed to size the defect and select the appropriate stent size. The procedure was performed under general anesthesia and broad spectrum prophylactic antibiotics were administered intravenously. Ultrasound guided percutaneous access to the left common femoral artery was achieved and a stiff Lunderquist wire was placed in the ascending aorta. A pigtail vascular catheter was inserted percutaneously through the right common femoral artery and placed in the aortic arch. On-table angiography was performed and the left subclavian artery orifice was marked and the aortic lesion identified. A proximal freeflow straight Valiant stent graft 22-22-112 (Medtronic) was inserted in the arch of the aorta and an on-table angiography was performed to confirm correct position relative to the left subclavian artery origin and the stent deployed beyond the origin. A post-deployment angiogram

Table 1 *Stanford Classification*

Stanford Type	Definition
Type A	Involves the ascending aorta alone, or in addition to the arch and descending aorta
Type B	Involves the descending aorta alone while sparing the ascending aorta and arch
Type Non-A Non-B	Involves the arch and descending aorta but not the ascending aorta

confirmed correct positioning and flow through the stent-graft. Proglide closure system (Abbott Cardiovascular) was used to close the common femoral artery access site.

Immediately postoperatively, the patient's right foot was cold and pale despite normal movement. Review of the CT-Aorta revealed a right popliteal artery injury requiring revascularization. The patient underwent a successful right femoral to popliteal artery bypass procedure using ipsilateral great saphenous vein.

Follow up CT-Aorta performed on the following day confirmed that the stent was positioned correctly, the walls of the thoracic aorta were smooth with no residual internal dissection flaps. The branches of the aortic arch were widely patent and did not contain any dissection flaps. A repeat CT-Aorta performed one month post-TEVAR confirmed correct stent-graft position with patent left subclavian artery and complete sealing of the wall defect.

The patient remained in hospital for a total duration of twenty five days for the management of other injuries and complications of the trauma sustained. Follow-up scan at one year was unremarkable and the patient was doing well and eager to start a family.

DISCUSSION

Clinical Presentation of BTAIs

Blunt thoracic aortic injuries are not reliably diagnosed clinically due to the variability and non-specificity of the clinical signs and symptoms. BTAIs are commonly recognisable clinically at the point where hemodynamic instability develops secondary to aortic failure. The most commonly observed clinical signs include: upper limb hypertension and lower limb hypotension, systemic hypotension and discrepancy in blood pressure between the left and right brachial arteries. Advanced Trauma Life Support (ATLS) algorithm should be followed in managing such trauma patients due to the high likelihood of multiple associated injuries.[5]

Imaging

Chest x-rays (CXR) are widely used as an adjunct to the primary survey in the ATLS algorithm and multiple findings through this modality may suggest the presence of BTAIs. Such findings include but are not limited to: widening of the mediastinum, obliteration of the aortic knuckle, apical capping due to blood in the apex, sizeable left sided pleural effusions representing an underlying haemothorax and displacement of the left mainstem bronchus. Focused assessment with sonography in trauma (FAST) scanning may also give valuable information to support the presence of BTAIs such as the presence of a left haemothorax and pericardial tamponade in the case of free rupture of the aorta. Unfortunately, both CXR and FAST findings have very poor specificity and sensitivity and they may only heighten the index of suspicion of BTAIs without confirming or excluding their presence and without contributing to the planning of surgical management.

The gold-standard imaging modality to diagnose BTAIs remains computed tomographic angiography (CTA).[6] The most common finding on CTA which suggests an aortic dissection is the presence of an intimal flap which is depicted as a linear filling defect within the aorta, typically due to an intimal tear. Damage to the tunica intima as well as the tunica media may be depicted by pseudoaneurysm formation. If damage to the tunica adventitia occurs, implying that a transmural tear of the aorta is present, contrast may appear to be extravasating.

Classification and Grading of BTAIs

Traditionally, aortic dissections are classified using the Stanford system (Table 1) which separates these pathologies into Type A, Type B and Non-type A Non-

Table 2 *Grading of BTAIs*

Grade of Injury	Determinants
1	Intimal Tear
2	Intramural Haematoma
3	Pseudoaneurysm
4	Rupture

type B depending on the extension of dissection in relation to the left subclavian artery.[12]

The most widely used grading system for BTAIs is depicted below (Table 2) and endorsed by both the Society for Vascular Surgery (SVS) and the European Society for Vascular Surgery (ESVS).

Management

The ESVS clinical practice guidelines for the treatment of BTAIs suggests that operative intervention, either in the form of open repair, or ideally TEVAR when not contraindicated, should be considered for most cases of BTAI. It is suggested that only minimal aortic injuries presenting as an intimal tear, be eligible for expectant management with serial imaging. These cases account for only ten percent of BTAIs.

If operative intervention is indicated, the data suggests no significant difference in mortality between immediate intervention and delayed intervention, hence most recent guidelines allow for delayed intervention in the case of other life threatening injuries requiring intervention or medical attention.[13]

Conservative Management

Once BTAI is suspected or confirmed, tight blood pressure control and heart rate control should be achieved to prevent rupture or end-organ damage. Systolic blood pressure should be kept below 100 mmHg and heart rate less than 100 bpm. Beta blockade is the strategy of choice in controlling blood pressure and heart rate unless contraindicated. Calcium channel blockers or arterial vasodilators are used when additional supplementation is necessary. Antiplatelet therapy and anticoagulation also form part of initial management of BTAIs.

A CTA should be repeated within the first 48 to 72 hours when treating BTAIs conservatively to confirm stability and exclude extension.[8]

Open versus endovascular repair

Open repair typically involves a high posterolateral thoracotomy in the majority of injury patterns. This is a highly invasive procedure which may exacerbate other injuries incurred during the trauma and lead to significant morbidity and mortality. In open approaches, an interposition graft is sewn over the dissected segment while a bypass circuit is used to perfuse distal organs. Commonly encountered complications are: major blood loss, paraplegia, stroke and other ischemic injuries.[9]

TEVAR confers a much less invasive approach which has revolutionized the treatment of BTAIs. It is worth noting that not all BTAIs are eligible for TEVAR. Candidacy depends on the anatomy of the patient and the exact nature of the injury. Open surgery may still be necessary due to anatomical features that prohibit an endovascular approach. Open repair is nowadays viewed as a complementary treatment modality to endovascular intervention as opposed to a competing approach.[10]

CONCLUSION

TEVAR has many advantages over open surgical approach, notably the avoidance of invasive measures, such as open thoracotomy, single lung ventilation, aortic cross-clamping and the associated significant haemodynamic changes as well as the requirement for cardiopulmonary bypass. The endovascular approach also confers a shorter operative time and postoperative hospital stay while inflicting less trauma on a multi-trauma patient.

The main disadvantage of TEVAR is the need for long-term and potentially life-long radiological surveillance due to the risk of endograft collapse in case of oversizing as well as endograft migration and endoleak secondary to the natural growth of the aorta in younger individuals. This exposes patients to significant radiation and may be a limiting factor for patients living in rural areas where radiological imaging is not readily available.

In acute type B aortic dissections, follow-up scans are recommended at three and six months and then yearly for three years. If in stable condition, the interval may be increased to two to three years. If aortic growth is more than five millimeters per year or aortic diameter is more than fifty millimeters, increased monitoring or intervention are warranted. However, the evidence supporting these guidelines is limited.[13]

TEVAR is now the main treatment modality for eligible BTAIs in Mater Dei hospital as in the case reported here. Review of local data is recommended to ensure that outcomes are comparable to those in other international centers.

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