THORACIC GUNSHOT WOUND WITH VASCULAR LESION

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Abstract: The thoracic gunshot wounds may cause high morbidity and mortality, especially if accompanied by vascular injuries. *Therefore, immediate management and precise decision are needed. A 35-year-old man who was referred from the regional hospital presented with thoracic gunshot wound and a history of hemorrhagic shock. A projectile was found through the chest wall and caused axillary artery rupture. The patient underwent exploratory thoracotomy and axillo-brachial artery bypass using a great saphenous vein graft. The patient's postoperative condition showed improvement in hemodynamic and distal limb perfusion.*

Keywords: *Chest trauma, gunshot wound, axillary artery, vascular injury*

INTRODUCTION

Everyday more than 250 people in the United States have gunshot wounds with a mortality rate of 10-30%. This is the highest among developed countries.[1] In the last two decades the management of trauma cases has grown rapidly and the mortality rate has also decreased, but armed violence has also increased and more gunshot injury patients have suffered more severe injuries.[2] Criminality causes 63% of these injuries, a quarter were caused by accidents (23%), and 8.3% due to attempted suicide. In addition to the abdomen and extremities, gunshot wounds can also occur on the head, neck and thorax.[3]

For 20-25% of traumatic deaths result from thoracic trauma, which is also the leading cause of death between 30-39 years of age. Thoracic gunshot wound is the most fatal form of thoracic trauma with a high mortality rate. Immediate death is caused by massive bleeding from the heart or large blood vessels. Aspiration associated with severe injury can lead to early death of thoracic trauma, as can airway obstruction and cardiac tamponade. Immediate identification and management is needed because the injury can get worse over time.[4]

The incidence of penetrating thoracic trauma varies in various places and overall reaches 1-13% of trauma cases. Exploration is carried out in 15% to 30% of patients who are unstable or who have active bleeding and early exploration is needed in 5% to 15% of cases.[5] Vascular trauma, especially axillary artery injuries that accompany thoracic penetrating trauma are rarely reported and require revascularization to maintain the viability of extremities.

CASE ILLUSTRATION

A 35-year-old man was referred from a remote area hospital with a thoracic gunshot wound and a history of hemorrhagic shock. The patient was shot from a distance of about 2 meters with a homemade weapon. A gunshot wound was found in the left anterior axilla with a diameter of 2 cm. Arterial pulsation in the distal region of the injury was a bit weakened and oxygen saturation (SpO2) of the fingers of the left hand were 95-97%. An x-ray examination revealed bullet projectile in the thoracic region.

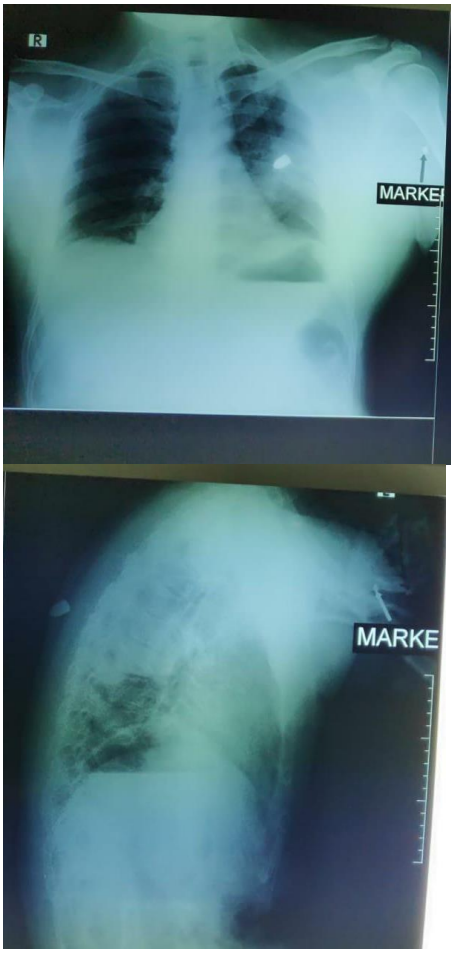

Figure 1. A bullet projectile was presented in the thoracic regio

Exploratory thoracotomy was performed. A bullet (projectile) was obtained in the left posterior chest wall causing posterior V and VI rib fractures that were managed conservatively. Exploration showed that the wound entered through the pulmonary hilum and caused hematoma around the pulmonary artery.

Figure 2. The projectile was succesfully evacuated

Exploration of the gunshot wound showed axillary artery rupture. An axillo-brachial bypass was done with a reverse vein graft. Extubation was done less than 24 hours postoperatively with a good result.

DISCUSSION

Gunshot wounds can be divided into two types, namely low or high-speed injuries. In the community, pistols usually are the most frequent cause of low speed injuries (muzzle velocity less than 600 m/s). The severity of the wound is lower than a high-speed ballistic wound, caused by a military weapon or hunting weapon.[6]

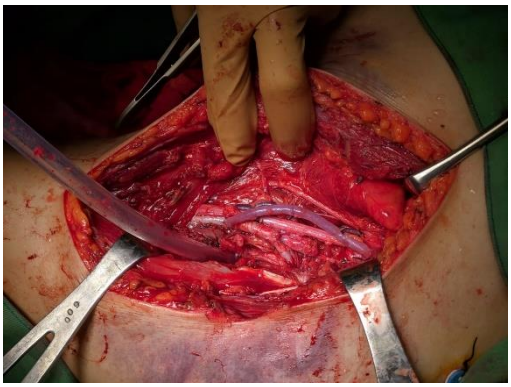

Figure 3. Axillo-brachialis artery bypass with great saphenous vein conduit

Two areas due to projectile and tissue interactions are divided into permanent cavities and temporary cavities. The projectile size is proportional to the extent of the damage it inflicts on low velocity injuries. Meanwhile, cavitation or extended damage to the surrounding tissue is often the result of high-speed injury. Transient lateral displacement of the tissue even as far as 10-40 times the diameter of the bullet can occur after the bullet is inserted. The skin, skeletal muscles, and blood vessels are elastic tissue through which a bullet can be pushed sideways and then recovered. However, if the bullet passes through the inflexible tissue, it can cause damage, such as to the liver and bones.[7] This can be seen in the case, where the ribs fracture occurred even though the bullet did not directly hit them.

Penetrating chest trauma in this report was caused by a gunshot wound that enters through the anterior axillary region and projectiles left in the posterior chest wall. Gunshot wounds to the thorax can have varied presentations and require different treatments. The risk of heart, large blood vessel, and pulmonary injury must be evaluated in every patient with a rapid clinical examination and basic monitoring. Surgery must be considered as early as possible whenever possible if there is an indication. Campbell et al. states 94% of

patients with penetrating thoracic trauma die before reaching the hospital. Prompt management is very important and the right decision regarding bullet evacuation operations is the most important for the survival of these patients.[8]

Clinical presentation and management of thoracic trauma cases depend on three interrelated factors: stability, mechanism, and location of the wound. Stability means safe airway (with or without intubation), oxygenated and ventilated patients at an acceptable level, and continuous hemodynamic stability. Patients who presented with shock or collapse (systolic blood pressure < 90 mmHg and/or persistent tachycardia > 120 times per minute, which are not caused by pain or anxiety and / or persistent hypoxemia) should be treated with airway control accompanied by aggresive resuscitation with blood products. Essentially, stable patients are patients who have time to be considered for differential diagnoses and therapeutic choices, whereas unstable patients are patients who are predicted to have immediate surgery without delay for unnecessary investigations.[5]

The indication for surgery does not depend solely on the presence of a foreign object/projectile left in the lung, pleural cavity, or chest wall. The nature of the foreign body, its size, the location of the wound close to vital organs such as large blood vessels, pulmonary hilum, esophagus, and heart, as well as the presence of complications, are considerations for surgical intervention. Surgery is usually unnecessary in conditions where the foreign object has a smooth surface, is less than one centimeter in size (as with most bullets), and causes only local inflammatory symptoms.[4] Indications for foreign body evacuation includes significant hemothorax, persistent pulmonary collapse, delayed pulmonary collapse, major vascular injury and the presence of a bulging mass with no known cause. Manifestations of sepsis, foreign body migration, and signs of lead intoxication are also other indications for evacuation surgery.[9] In this case the bullets were 9 mm in caliber, but exploratory thoracotomy was performed due to a history of shock.

The most frequent indication of urgent thoracotomy in penetrating trauma is the large production of WSD (28% in stab wounds and 50% in gunshot wounds). Exploratory thoracotomy should be considered immediately if initial blood production is more than 1,500 cc and persistent bleeding is 200 cc / hour for four hours or more. Delay in management and the high number of complications can be prevented by setting a limit of WSD production 1,500 cc for 24 hours as an indication to consider surgery.[5]

Retained hemothorax, history of unstable hemodynamics, or other clinical indicators (such as acidosis without other causes, air leakage, suspicion of relevant injuries such as diaphragm) can be indicative of exploration other than the amount of WSD production. Considering WSD production alone can reduce alertness to injury severity. Intercostal bleeding can be controlled with clips, pulmonary bleeding with wedge resection and diaphragmatic laceration repaired with sutures. doubt about the source of the bleeding or the stability of the patient.[5]

A thoracotomy is recommended if the bleeding continues or if there is doubt about the source of bleeding or the stability of the patient.[5]

The choice of technique (posterolateral vs. anterolateral vs sternotomy) is based on the location of the bleeding (whether unilateral or not) and the structure that is thought to be involved. The posterolateral approach (VATS or thoracotomy) provides the greatest exposure to stable patients with unilateral injury.[5]

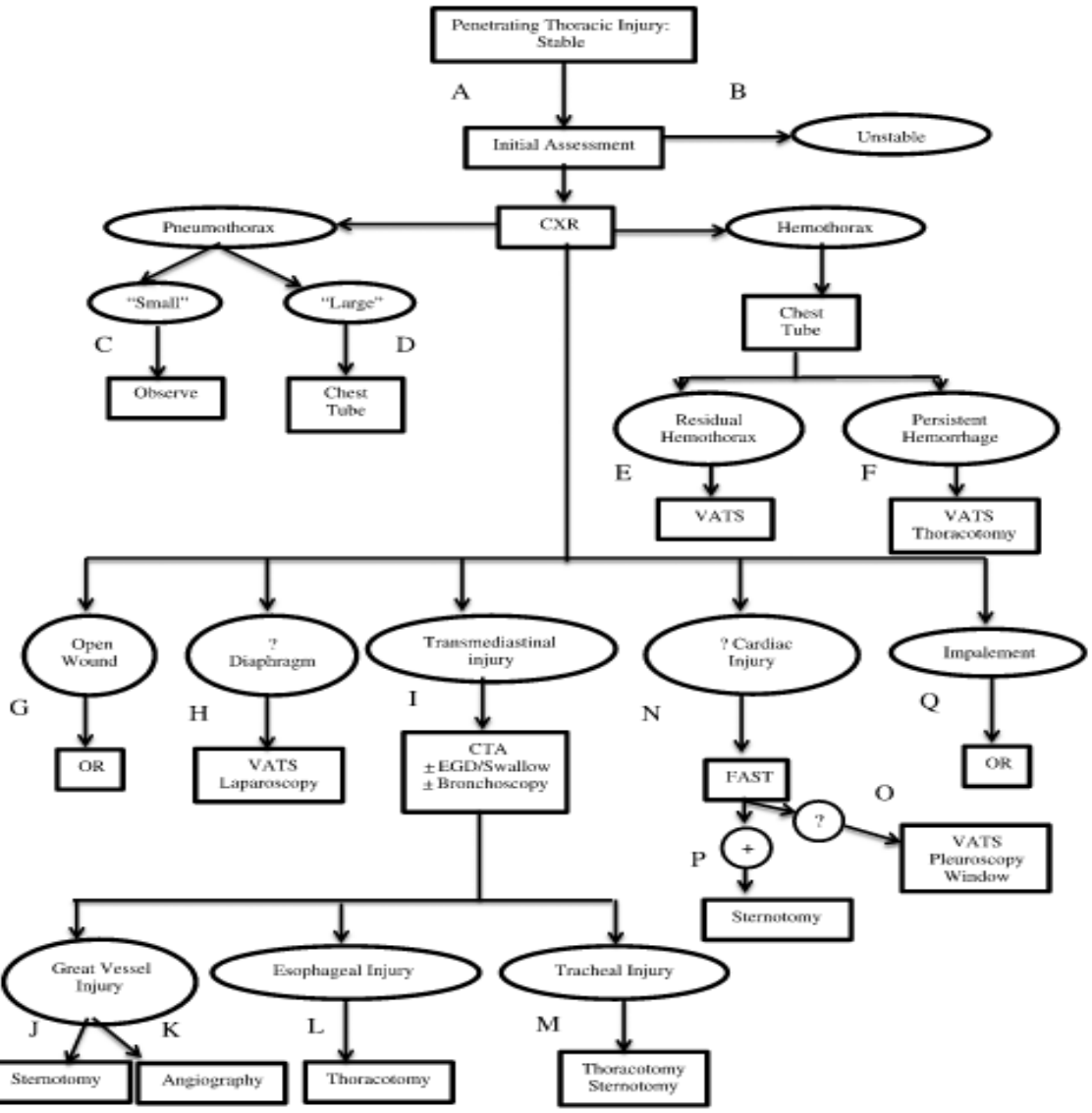

Figure 4. Clinical presentation and management algorithm in penetrating chest trauma (modified from Western Trauma Association)[5]

The left axillary artery rupture was found in this patient after the exploration of the gunshot wound entry. Generally, axillary blood vessels are less protected than subclavian vessel, so they are slightly more susceptible to injury. Penetrating trauma mechanism dominates more.[10]

In axillary artery injury, tissue perfusion to the arm is still possible due to collateral circulation originating from the suprascapular artery anastomosis, which is a branch of the thyrocervical trunk, with the subscapular artery which is a branch of zone III of the axillary artery. In addition, the subscapular artery also anastomoses with the transverse cervical artery and intercostales artery. Therefore, injury or ligation of the axillary artery in the proximal region of the subscapular and distal arteries of the thyrocervical trunk may still not lead to ischemia of the arm.[11]

In vascular injury, it is important to evaluate the extremity of the injured side. This injury has a spectrum of clinical signs

that are classified into two groups, namely hard signs and soft signs. Clinical signs that are included in hard signs are active bleeding, diminished pulse, rapidly enlarging hematoma, audible bruit or palpable thrill, and signs of tissue ischemia (pain, pale, paralysis, paresthesia, poikilothermia). A history of decreased unilateral distal pulses, arterial bleeding in the injured body part, neurological deficits, small hematomas, and abnormal blood flow velocity on Doppler examination or abnormal ankle-brachial index (ABI <0.9) are soft signs of vascular injury.[10]

The existence of hard signs determines what action needs to be done, whether it requires immediate surgery, or further examination, or may only need to be observed continuously (Figure 4).[12] In penetrating trauma, hard signs can be a marker of the anatomical level of vascular injury and require immediate surgery. ABI measurements and CT angiography if available should be done if the condition of the blood vessels is difficult to evaluate.[12]

Surgical exploration should also be urgent if there is external bleeding or a rapidly enlarging hematoma. General anesthesia or, if possible, a hybrid technique is best used for exploration of vascular injury. Intravenous heparin should be given if there are no signs of acute limb ischemia and other sources of bleeding.[10]

The surgical field should cover all parts of the injured limb so that vascular and distal control is easy if necessary. To facilitate venous grafting, a healthy limb should also be prepared in the surgical field. A longitudinal incision is made to the injured area which can be extended in both directions. Exercise proximal control of the uninjured vessel when exploring a large hematoma. If the bleeding is active, a direct surgical approach is carried out at the wound site and direct bleeding control using finger presses. Proximal control of vascular injuries in more distal limbs the axillary artery.[13]

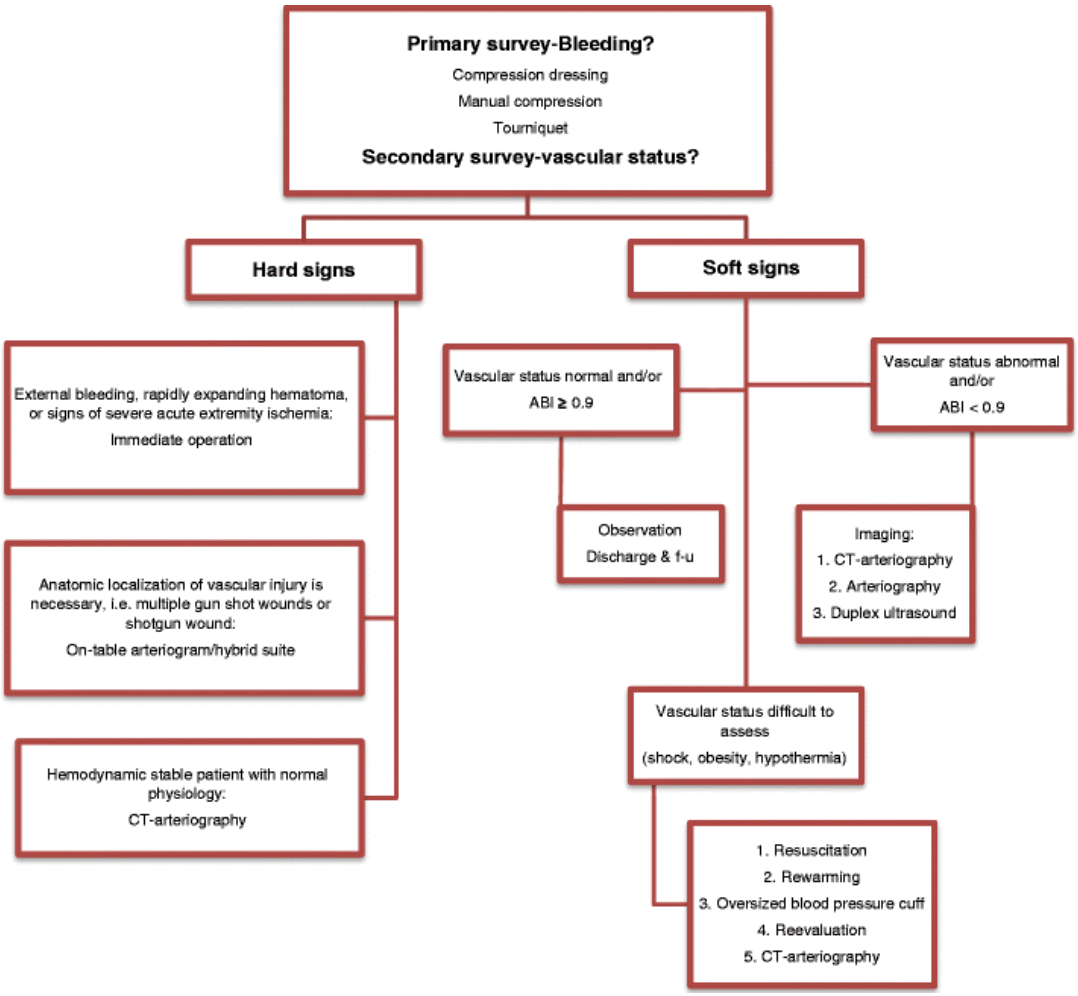

Figure 5. Surgical management algorithm in penetrating vascular injury (modified from Western Trauma Association)[12]

More normal physiological conditions are required for a definitive vascular reconstruction. In cases of penetrating trauma, patch angioplasty with a vein or synthetic graft can be performed for larger lacerations. If there is no excessive stress, an end to end anastomosis technique can be employed. The great saphenous vein is the primary graft of choice and is extracted from a healthy limb. Another alternative can be the lesser saphenous, the cephalic, or the basilic veins. If the ideal vein is not available, prosthetic grafts such as Dacron or polytetrafluoroethylene (PTFE) can be used. If necessary, perform a routine completion arteriogram. Use soft tissue to close the repaired blood vessels. Check for distal vascular condition and confirm that there is no compartment syndrome. A fasciotomy should be performed in cases where the limb has been ischemic for a long time.[10]

CONCLUSION

The success of the thoracic gunshot wounds management with vascular lesions is influenced by the accuracy and rapid diagnosis so that the correct decision can be taken. If diagnostic modalities cannot be performed quickly, such as in remote areas, early intervention including exploratory thoracotomy and revascularization should

not be delayed, especially in patients with a history of unstable hemodynamics.

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