Management of a Penetrating Brachiocephalic Trunk Injury

(A Case Report)

Mohammed Al-Musawi*, Abdulameer Hussein, Laith S. Abood***, Sabah N Jabir**, Firas Fakhri***, Viviane Leite Abude***

ABSTRACT

A case report of a young man with penetrating brachiocephalic artery injury without neurologic deficit. After performing CTA patient was managed by median sternotomy and right trans-clavicular bed approach to control the inflow and outflow. Successful GORE-TEX interposition graft was used to perform end to end anastomosis and restoration of circulation.

Iraqi Medical Journal Vol. 65, No. 2, July 2019; p. 182-184.

The brachiocephalic trunk (BCT), which was previously been known as the innominate artery, is the first of the three main branches of the aortic arch. It measures 4-5 cm in length with a diameter of 12.1 ± 1.6 mm[1]. Only 4% of thoracic traumas involve injuries to thoracic vessels, including the aorta, innominate veins and artery, left carotid artery and pulmonary hilar vessels[2]. Injuries of the subclavian or BCT arteries demand immediate operation and are associated with a reported mortality as high as 30%[3,4]. Beside the high mortality, this type of injury is associated with development of brain stroke[5]. Thoracic outlet injuries are particularly concerning when the injury pattern is one of a high velocity missile traversing the upper mediastinum[6]. In this situation, the absence of significant bleeding does not rule out vascular injury and it is interesting to note that even significant injuries clot and stop bleeding a point used in arguing the possible disadvantageous of vigorous resuscitation[7]. Yet many of the victims of this type of injury do not survive transport to the hospital[8].

*Department of Surgery, School of Medicine, University of Colorado, USA.
**Ghazi Al-Hariri Surgical Specialty Hospital, Baghdad, Iraq.
***Iraqi Center for Heart Diseases, Baghdad, Iraq.

BCT is less accessible causing difficulty in exposure and in obtaining proximal and distal control. As a result, a relatively extensive operative procedure is required for exploration[9]. Recent advances in technology have resulted in endovascular therapy becoming a common first-line treatment[10]. Prior to exploration angiography is paramount to assess the extent of the damage specially in relatively stable patients, and CT angiography (CTA) is the most commonly available first line imaging, rapidly providing information on associated injuries[6].

Case Report

This a case report of young man who was injured in the battlefield with penetrating upper chest injury traversing superior mediastinum with high velocity missile. He was transferred by ambulance for around 400 kilometers to reach our hospital. Patient was conscious, alert and without any neurologic deficits. The inlet was from left side above the clavicle and the exit was from right upper chest. Patient referred with right side chest tubes, which stopped draining, and he was hemodynamically stable due to the resuscitation during transfer.

The trajectory of the injury necessitated an immediate

computerized tomography angiography (CTA). It showed a total transection of the BCT where only few threads of adventitia was connecting the proximal and distal ends with surrounding hematoma and no associated injury to other structures in vicinity.

Patient taken immediately to the operating room and anesthesia started in supine position with a pillow between his shoulders to assist pushing the thoracic outlet structures forward. The proximal BCT was accessed and clamp controlled via median sternotomy and pericardiotomy to access the short proximal end, which was less than 2 centimeters stump of the proximal BCT, (Figure 1). The pericardium was accessed in order to gain an access of the proximal part without disturbing the stable clot and spasm of the stump, which was covered by large hematoma in the superior mediastinum, which was obscuring the field. While the right subclavian and right carotid artery were accessed and clamp controlled via subperiostial resection of medial part of clavicle. The bifurcation of BCT to right carotid and subclavian arteries was intact so a vascular clamp was used proximal to bifurcation to preserve retrograde carotid perfusion from right subclavian artery, and the separate carotid and subclavian clamps were removed. After completing the control, proper dissection of the hematoma surrounding the BCT was completed to show subtotal transection of the BCT which was closed by spasm and clots. A GORE- TEX graft with inner diameter of 8 millimeters and 3 centimeters length was used as interposition graft. Then distal clamp was removed to allow de-airing before tying the last knot, then proximal clamp was removed and there was no leak and no additional stiches were required. All wounds were closed in layers and an anterior mediastinal drains were left in the surgical field to ensure drainage and monitor for any possible bleeding. Patient was taken to intensive care unit for post-operative care.

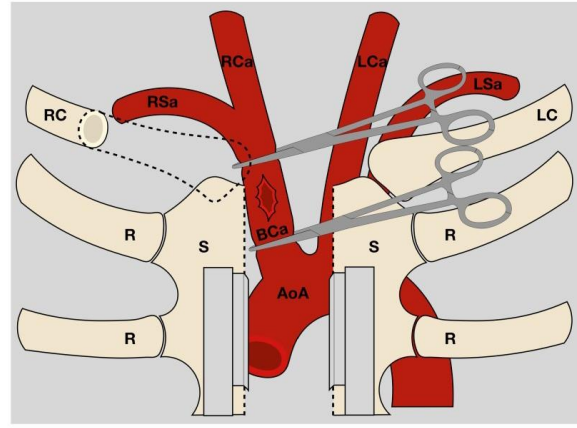

Figure 1: Site of injury and the surgical approach
(Designed by the co-author).

Discussion

Trauma to the innominate artery is distinctly rare. The true incidence of these injuries is unknown as it is estimated that between 48 to 71% of these patients die before reaching the hospital[11]. These injuries have a very high morbidity and mortality as a result of their inaccessibility, frequent associated injuries, the risk of cerebral hypoperfusion and stroke, a propensity for massive hemorrhage and inexperience[12]. Usually BCT injury is associated with 5%-50% of development of stroke[13,14]. In the present case, there were few things which helped minimizing mortality and morbidity despite the long distance of transfer from the battlefield. He had no significant associated injury, which significantly increase the morbidity[15]. The usual underlying pathologic lesion is ischemic cerebral infarction caused by hypoperfusion[16]. This

patient had a clot and spasm of the two ends of the severed BCT protected him from shock, and there was a retrograde flow from the right subclavian to the right carotid artery, which might help preventing cerebral hypo perfusion. Many surgeons question the value of revascularization in patients with established neurologic deficit and many studies advocate against vascular repair in patients with fixed preoperative neurologic deficit[17-20]. Luckily, this patient did not have any neurologic deficit which justified the efforts to repair rather than ligate the artery. The hemodynamic stability of the patient allowed time for having detailed CTA images, which helped in having planned surgery. The operative approach should provide flexibility without compromising exposure of the suspected injury[8] and that was done by full exposure of the proximal and distal part of the BCT which allowed excellent vascular control with very minimal loss, preserving carotid flow and smooth graft interposition.

References

1. Last's Anatomy. Churchill Livingstone. 2011. ISBN:0702033952.
2. Lim JY, Wolf AS, Flores RM. Thoracic vessel injury. Minerva Chirurgica 2013;68(3):251-62.
3. Bricker DL, Noon GP, Beall AC, Jr., DeBakey ME. Vascular injuries of the thoracic outlet. The Journal of Trauma 1970;10(1):1-15.
4. Flint LM, Snyder WH, Perry MO, Shires GT. Management of major vascular injuries in the base of the neck. An 11-year experience with 146 cases. Archives of surgery (Chicago, Ill: 1960). 1973;106(4):407-13.
5. Schonholz CJ, Uflacker R, De Gregorio MA, Parodi JC. Stent-graft treatment of trauma to the supra-aortic arteries. A review. J Cardiovasc Surg 2007;48(5):537-49.
6. Wall MJ, Granchi T, Liscum K, Mattox KL. Penetrating thoracic vascular injuries. Surgical Clinics of North America 1996;76(4):749-61.
7. Bickell WH, Wall MJ, Jr., Pepe PE, Martin RR, Ginger VF, Allen MK, et al. Immediate versus delayed fluid resuscitation for hypotensive patients with penetrating torso injuries. The New Engl J Med 1994;331(17):1105-9.
8. Richardson JD, Smith JM, Grover FL, Arom KV, Trinkle JK. Management of subclavian and innominate artery injuries. The American Journal of Surgery 1977;134(6):780-4.
9. Francis F, Castier Y, Mussot S, Leseche G. Trauma of the brachiocephalic trunk. Presse Medicale (Paris, France: 1983). 2002;31(23):1089-96.
10. Almazedi B, Lyall H, Bhatnagar P, Kessel D, McPherson S, Patel JV, et al. Endovascular management of extra-cranial supra-aortic vascular injuries. Cardiovascular and Interventional Radiology 2014;37(1):55-68.
11. du Toit DF, Odendaal W, Lambrechts A, Warren BL. Surgical and endovascular management of penetrating innominate artery injuries. European Journal of Vascular and Endovascular Surgery 2008;36(1):56-62.
12. Johnston RH, Wall MJ, Mattox KL. Innominate artery trauma: A thirty-year experience. Journal of Vascular Surgery 1993;17(1):134-40.
13. George SM, Jr., Croce MA, Fabian TC, Mangiante EC, Kudsk KA, Voeller GR, et al. Cervicothoracic arterial injuries: recommendations for diagnosis and management. World Journal of Surgery 1991;15(1):134-9.
14. Ramadan F, Rutledge R, Oller D, Howell P, Baker C, Keagy B. Carotid artery trauma: A review of contemporary trauma center experiences. J Vasc Surg 1995;21(1):46-55.
15. du Toit DF, van Schalkwyk GD, Wadee SA, Warren BL. Neurologic outcome after penetrating extracranial arterial trauma. J Vasc Surg 2003;38(2):257-62.
16. Meyer JS. Importance of ischemic damage to small vessels in experimental cerebral infarction. Journal of Neuropathology and Experimental Neurology 1958;17(4):571-85.
17. Ledgerwood AM, Mullins RJ, Lucas CE. Primary repair vs. ligation for carotid artery injuries. Archives of Surgery (Chicago, Ill : 1960). 1980;115(4):488-93.
18. Weaver FA, Yellin AE, Wagner WH, Brooks SH, Weaver AA, Milford MA. The role of arterial reconstruction in penetrating carotid injuries. Archives of Surgery (Chicago, Ill : 1960). 1988;123(9):1106-11.
19. Karlin RM, Marks C. Extracranial carotid artery injury. Current surgical management. Am J Surg 1983;146(2):225-7.
20. Rao PM, Ivatury RR, Sharma P, Vinzons AT, Nassoura Z, Stahl WM. Cervical vascular injuries: a trauma center experience. Surgery 1993;114(3):527-31

IMJ 2019; 65(2):182-184.