

Case Report

Pediatrics vascular injury management with total replacement of blood volume- Anesthesia challenges: A case report

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ABSTRACT

Background: Vascular injuries with significant blood loss causing ischemia and revascularization for limb salvage are rarely done in developing countries. Hence, most hospitals and surgeons lack the experience to deal with vascular injuries.

Case Presentation: A 9-year-old child presented with left subclavian artery transection and massive hemorrhage. The patient required massive transfusions during the repair of the injured vessel. Herein, we describe the challenges faced during the management of this patient.

Conclusion: In an emergency setting, full optimization is not always possible. Every effort should be made to manage the patient by utilizing the available resources without undue delays.

Keywords: Pediatric, Vascular, Anesthesia, Blood transfusion, Revascularization.

INTRODUCTION

Traumatic rupture of the subclavian artery is a rare lesion occurring in patients subjected to violent injury. Ischemia requiring surgical revascularization is also rare among the pediatric population. [1] Vascular injuries can result in significant blood loss, limb loss, serious life-long threatening disability, and even death. Injuries can result from blunt or penetrating trauma, and these injuries can be isolated or in the setting of complex multisystem trauma. [2] Vascular trauma (i.e. arterial and venous) in the pediatric population is uncommon, as it occurs only in 0.6 - 1.4% of all pediatric injuries. [3] Penetrating trauma is the most common vascular injury affecting children. Arterial injury in children presents a challenge to the surgeon and the anesthetist; pediatric patients are different from adults as they usually have atherosclerosis-free, spasm-prone, and smaller vessels, with small intravascular volume. [4] Herein, we report anesthesia challenges faced during the management of a patient with vascular injury.

CASE REPORT

A 9-year-old male, weighing 20kg, was presented with a stab wound in the left supraclavicular region 12 hours

before presentation to our hospital. The patient had a deep stab wound accidentally at home. The patient started bleeding profusely from the injury and was rushed to the nearest hospital. Fluid resuscitation started with crystalloid pressure applied to the wound and the patient was immediately referred to a tertiary care center from where he was further referred to the pediatric tertiary care center. The patient presented there almost 4 hours after the injury.

On presentation his left upper limb was cold and there was no radial and brachial pulse palpable. There was a dull percussion note on the left side and on auscultation no air entry. Chest X-ray performed on suspicion of haemothorax showing left side opaque lung field (Fig. 1).

He was maintaining an airway, and a chest tube was inserted, which drained 1100 ml of blood in 2 hours. The patient was further resuscitated with fluid and blood products (5 Packed Cell Volume (PCVs) and 2 Fresh Frozen Plasma (FFPs)). Still, he developed hemorrhagic shock and collapsed for which he was intubated and ventilated but no chest compressions were required. The patient was taken to the Operating room (OR) and wound exploration was done but unsuccessful; the patient was

referred to our hospital for vascular and cardiothoracic facilities.

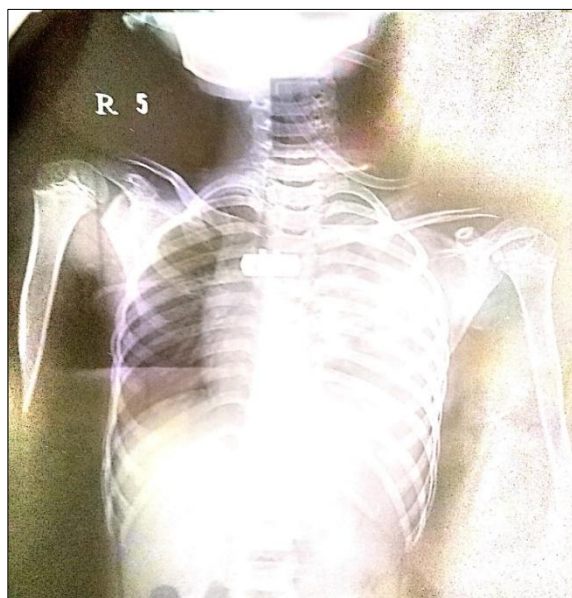


Figure 1: Chest X-ray performed on suspicion of haemothorax showing left side opaque lung field

On arrival in our hospital (12 hours from injury), the patient was received intubated and on inotropic support (epinephrine at 0.08mcg/kg/min and dopamine at 10 mcg/kg/min) being given through peripheral IV line; laboratory tests were sent immediately, chest X-ray repeated and the patient was rushed to OR with suspected left subclavian artery injury. The patient was put on an anesthesia machine ventilator, maintaining hemodynamics with inotropic support which was, therefore, continued the same. Midazolam 2mg, ketamine 40mg, and cisatracurium 4mg were given initially, but no inhalational agent started as inotropes were used. The right femoral arterial line was inserted and a sample for preoperative Arterial Blood Gases (ABGs) was drawn. Central Venous Catheter (CVC) insertion was attempted in both femoral but was unsuccessful due to collapsed veins. Draping was completed and surgery started without undue delay of vascular access. After the start of surgery, the endotracheal tube (ETT) was changed under vision to 5.5mmID and fixed at 17cm. 18G cannula secured at the right forearm. Pre-operative ABGs showed pH 7.06, pCO₂ 56.30mmHg, pO₂ 157.30mmHg, HCO₃ 15.7mEq/L, BE -14.9mEq/L and SO₂ 97.50%. Other laboratory tests reported after the start of surgery showed Hb 11.3g/dl, HCT 33.9%, rest of the laboratory test results were within normal limits except HCO₃ 13.9mmol/l, PT >180s and INR >18. The patient continued to bleed which was further replaced with 3 PCVs, 6FFPs, and 6 platelets. A cardiopulmonary bypass was arranged and kept on backup, to be used in case of need. Sternotomy was done immediately, the injured site

was identified, and the bleeding was secured. Since sternotomy was done, arrangements were made to secure central access by the surgeon directly if necessary. Until then, inotropes were continued by peripheral access. As bleeding was controlled, inotropes started to get tapered and it was decided to establish central access at the end of surgery. Surgical findings revealed a large hematoma in situ, at the injured junction of the left subclavian vein and internal jugular vein and transection of the first part of the subclavian artery distal to the origin of the vertebral artery. Almost 2 liters of blood and clots were evacuated from the left thorax. The repair was done with a PTFE interposition graft. The patient had almost 5 liters of blood intraoperatively. Intraoperative ABGs showed pH 7.29, pCO₂ 29.20mmHg, pO₂ >480mmHg, HCO₃ 13.8mEq/L, BE -11.1mEq/L and SO₂ 100%. There were multiple episodes of hemodynamic instability intraoperatively which were managed by adjusting infusion rates of epinephrine and dopamine and boluses of phenylephrine. The patient also received 600mg of calcium gluconate and 150mEq of NaHCO₃. The surgery lasted for 5.5 hours. In summary, the patient received 5 PCVs, 2 FFPs, 1-liter colloid, and 1-liter crystalloid pre-operatively, while 3 PCVs, 6 FFPs, 6 Platelets, and 1-liter crystalloid intraoperatively. Urine output was almost 50 ml/hr. (total 300ml) and he had a blood loss of almost 5 liters. Postoperative ABGs showed pH 7.38, pCO₂ 37.50mmHg, pO₂ 121.20mmHg, HCO₃ 21.50mEq/L, BE -3.5mEq/L and SO₂ 98.7%. Left femoral CVP was inserted postoperatively and the patient was shifted to PICU for further management. His CBC sent from PICU after initial management showed Hb 8.1g/dL, HCT 23.3%, and platelets 116,000 X 10⁶ /L. The patient was extubated after 30 hours and discharged from the hospital after 72 hours of surgery in stable condition with normal cognitive function and no report of ischemia.

DISCUSSION

Pediatric thoracic trauma itself is a unique challenge owing to the peculiar characteristics of anatomy, physiology, metabolism, and therapeutic options in children. [5] Penetrating trauma occurs nearly 6-fold less than blunt trauma in children while penetrating thoracic wounds even less. About 35% of such patients require surgical intervention. [5] In our patient, the injury resulted in hemorrhagic shock. Children develop hypoxemia more rapidly due to diminished FRC which gets deteriorated in case of chest trauma. Therefore, the targets of anesthetic management were to prevent any physiological injury due to shock, minimize hypoxia and hypoxemia, and maintain perfusion. [5] Hemothorax due to thoracic vascular trauma leads to significant blood loss, hypovolemic shock, lung volume loss, empyema, and possible lung entrapment. [6] Chest tube placement for hemothorax may lead to further blood loss due to the loss of tamponade effect on the injured vessel. [7] This

leads to severe hemodynamic alterations and warrants emergent surgical exploration of the wound.

In addition to this, arterial trauma in children also remains a significant challenge. When this occurs within the thoracic cavity, it further aggravates the situation. Such injury usually results in massive blood loss leading to massive transfusion. [7] In our case, a massive transfusion had already been done before arrival and had led to known complications which were coagulopathy, hypothermia, and citrate toxicity causing hypocalcemia. Still, during surgery, further transfusion was necessary for maintaining hemodynamic stability and end-organ perfusion along with managing the complications of massive transfusion. Another important objective was the prevention of the lethal triad of coagulopathy, acidosis, and hypothermia. [8] Since CVP could not be secured therefore permissive hypotension was tolerated. A balanced blood transfusion strategy of delivering PCV, FFPs, and platelets was employed. Hypothermia and hypocalcemia were also managed by active warming, blood warmer, and giving calcium. With the collaboration of the anesthetic and surgical team,

such a difficult case was managed quite successfully and the patient's life and arm were saved.

In conclusion, In an emergency, waiting for optimization is not always possible. One needs to know the available resources and how to use them for the maximum advantage. Sometimes decisions have to be taken clinically even if they are not recommended. In such cases time is always a key factor, therefore a pragmatic approach towards a life or limb-threatening emergency should always be the priority.

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REFERENCES

1. Harris LM, Hordines J. Major vascular injuries in the pediatric population. *Annals of vascular surgery*. 2003 May 1; 17(3):266-9.
2. Grigorian A, Wilson SE, de Virgilio C, Kabutey NK, Fujitani RM, Gabriel V, Schubl SD, Joe V, Nahmias J. Humerus fracture and combined venous injury increases limb loss in axillary or subclavian artery injury. *Vascular*. 2019 Jun; 27(3):252-9.
3. Wahlgren CM, Kragsterman B. Management and outcome of pediatric vascular injuries. *Journal of Trauma and Acute Care Surgery*. 2015 Oct 1; 79(4):563-7.
4. Nystrup KB, Stensballe J, Böttger M, Johansson PI, Ostrowski SR. Transfusion therapy in paediatric trauma patients: a review of the literature. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2015 Dec; 23(1):1-9.
5. Minervini F, Scarci M, Kocher GJ, Kestenholz PB, Bertoglio P. Pediatric chest trauma: A unique challenge. *Journal of Visceral Surgery*. 2020; 6(8).
6. Guraya SY. Extremity vascular trauma in Pakistan. *Saudi medical journal*. 2004 Apr 1; 25(4):498-501.
7. Peter SD, Ostlie DJ. A review of vascular surgery in the pediatric population. *Pediatric surgery international*. 2007 Jan; 23(1):1-0.
8. Usman R, Jamil M, Anwer MF. Evaluation, surgical management and outcome of traumatic extremity vascular injuries: a 5-year level-1 trauma centres experience. *Annals of Vascular Diseases*. 2018 Sep 25; 11(3):312-7.