Case Report

An isolated brachiocephalic artery rupture on penetrating trauma in a 9-year-Old child – A case report

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ABSTRACT

Introduction and Importance: A stab or penetrating wound is one of the etiologies of chest trauma. In the case of penetrating chest trauma, assessment of probable major vascular injuries must be done. Thoracic, vascular injuries, in particular brachiocephalic rupture, require the surgeon to make swift decisions for repair as the wrong approach or incision could quickly lead to mortality.

Case presentation: Here, we report a case of a hemodynamically stable 9-year-old boy presenting with a stab wound by a fishing arrow. CT scan showed the fishing arrow projection at the suprasternal notch extended to the right hemithorax where the tip was near the brachiocephalic artery posterior wall. A sternotomy exploration and preservation of the proximal brachiocephalic artery, subclavian artery, and common carotid artery was done. We found a 0.5 cm rupture on the brachiocephalic truncus and performed a direct suture repair.

Discussion: Through this case, we present a vascular technique repair after the major thoracic artery rupture caused by a stab or penetrating wound. The principle of artery repair is to save the proximal and distal end of the ruptured artery, followed by a further safe and precise procedure. The overall combination of approaches of chest trauma by a penetrating wound and vascular injury like brachiocephalic rupture without pseudoaneurysm or other asymptomatic high risks of vascular injury resulted in a satisfactory evaluation. In this case, leaving the arrow undisturbed is the key to the success of the first aid management before the patient is sent to the operating room.

1. Introduction

Brachiocephalic rupture is a lethal injury, most are due to blunt, penetrating, and iatrogenic trauma. Thoracic, vascular injuries, especially brachiocephalic rupture, require the surgeon to make swift decisions for repair as the wrong approach or incision could quickly lead to mortality [1]. Thoracic injury directly accounts for 20%–25% of deaths from trauma, resulting in more than 16,000 deaths annually in the United States with no exact amount of data for the mechanism itself [2]. A few studies mention the total incidence of blunt chest trauma of approximately 72%–76% and penetrating injury chest trauma of 24%–28% [3,4]. A stab or penetrating wound is one of the etiologies of chest trauma. The incidence of penetrating injuries is hard to count due to the survivability of brachiocephalic artery injury or previously known innominate artery [5,6]. In terms of penetrating injury to the chest, stab wounds are the most common mode of injury, which varies from 67% to 89% worldwide, followed by gunshot wounds around 11%–33% [3]. It is stated in some papers that adults over 18 years old dominate the total incidence of chest trauma. Those studies show a range of 65.9%–79.7% cases in adults and 20.2%–34.1% of chest trauma cases in children [7,8]. There was no number showing the highest mortality factor concluded although conditions such as the presence of associated extrathoracic injury (mostly brain injury), delayed presentation longer than 24 hours, and severe chest injury characterized by bilateral chest involvement were the causes of death in chest trauma patients [9]. In diagnosing chest trauma by penetrating or stab wound mechanism, some radiology modalities might be used, such as eFAST, CT scan, endoscopy, bronchoscopy, and electrocardiography. However, CT scan remains the gold standard due to its accurate detection [6,10]. The brachiocephalic artery is one of the three great vessels of the aortic arch that supplies blood to the head, neck, and upper extremities. Specifically, the artery goes on to form the right subclavian artery and the right common carotid artery.
2. Presentation of case

A hemodynamically stable 9-year-old boy presented with a stab wound of the fishing arrow on the hemithorax dextra with compo mens consciousness. He was accidentally hit by a fishing arrow from 3 m away. He was referred to the emergency room of our academic referral hospital after getting the first aid management in the rural district hospital on a travel distance of 57 miles for about 3 hours by car. The patient was prevented from shock hypovolemic by infusion Ringer Lactate, anti-tetanus serum, and the wound was covered with sterile gauze. Complete blood count and chest x-ray are enclosed with the referral letter. The fishing arrow was left undisturbed along the way as the only complaint was pain sensation on the stab wound, neither while the stab wound was found from the fishing arrow projection at the suprasternal notch of 1 cm in diameter. The patient had a vital sign with BP of 110/70 mmHg, heart rate of 90 bpm, a respiration rate that slightly increased to 26 times per minute, normal SpO2, symmetrical chest inspection, absence of crepitation, and normal vesicular sound in auscultation, Show a normal vital sign.

On the physical examination, a primary survey was clear; meanwhile, the stab wound was found from the fishing arrow projection at the suprasternal notch of 1 cm in diameter. The patient had a vital sign with BP of 110/70 mmHg, heart rate of 90 bpm, a respiration rate that slightly increased to 26 times per minute, normal SpO2, symmetrical chest inspection, absence of crepitation, and normal vesicular sound in auscultation, showing a normal vital sign.

On the first assessment and management, a vulnus punctum with fishing arrow corpal alienum on the hemithorax dextra was determined as a working diagnosis. Initial management was performed for Ringer Lactate infusion 15 drips each minute and Metamizole injection of 500 mg per 8 hours.

The complete blood count examination revealed hemoglobin of 12.4 g/dl, hematocrit of 37%, leucocyte of $14.9 \times 10^9/\mu l$, blood glucose of 97 mg/dl, a normal range of hemostasis indicators, ureum of 18 mg/dl, creatinine of 0.5 mg/dl, non-reactive HbsAg, and a normal range of electrolyte. Blood gas analysis showed a normal pH of 7.410, BE of 0.7 mmol/L, PCO2 of 40.0 mmHg, PO2 of 170.0 mmHg, hematocrit of 31%, HCO3 of 25.4 mmol/L, total CO2 of 26.6 mmol/L with 100% oxygen saturation, and artery lactate of 1.20 mmol/L.

The axial CT scan with contrast showed the fishing arrow projection at suprasternal notch extending to the right hemithorax where the tip was 5.53 mm from the brachiocephalic artery posterior wall. The arrow body was attached to the brachiocephalic artery posterior wall.

According to the complete history and clinical manifestation, followed by clear radiology modality on CT scan, some managements with sternotomy exploration, vascular exploration, corpus alienum evacuation, brachiocephalic partial repair, and chest intercostal drainage were initiated. In the theatre room, the patient was under general anesthesia in a supine position. 2-cm incision to costae VI linea anterior mid axillaries dextra was fixated with multifilament non-absorbable string no.1 horizontal mattress stiches. Blunt dissection was made to pleura parietals with the presence of air and blood, followed by digital examination through cavum pleura with no adhesion. A sternal midline incision was extended from jugular notch to processus xypoidses. The procedure was continued with sternotomy exploration and preservation of the proximal brachiocephalic artery, subclavian artery, and common carotid artery was done. We found a 0.5–cm rupture on the brachiocephalic truncus on the posterior side blocked by the arrow body. direct suture repair using non-absorbable monofilament 6.0 continuous stitches was applied after the arrow had been removed. Upon sternotomy, we prepared a backup heart-lung machine. An evaluation of a 30-cm fishing arrow found penetrating superior lobes of the lung of 0.5 cm diameter without any complications.

A substernal drain was installed and fixated using sternal wire, and layered stitches were installed using multifilament absorbable 2.0 continuous and 3.0 simple interrupted. The treatment was well tolerated with no complications. Follow up visits show good recovery, and the patient was able to return to normal activity.

3. Discussion

Brachiocephalic rupture is a lethal injury mostly due to blunt, penetrating, and iatrogenic trauma. A stab or penetrating wound is one of the etiologies of chest trauma. Thoracic injury directly accounts for 20%–25% of deaths from trauma with no actual data for the mechanism itself. The incidence of penetrating injuries is hard to count due to the survivability of brachiocephalic artery injury or previously known innominate artery [1,5,6]. In this case, an isolated brachiocephalic rupture happened to a 9-year-old boy who was hemodynamically stable, showing a complex combination of chest trauma, a possibility of lung injury, and vascular injury. These indicated proper management of primary, secondary, to supporting invasive and non-invasive modalities. The fishing arrow was left undisturbed while the boy was referred our center for better management and facilities than the previous hospital.

After the initial primary and secondary management were given, where no complaints such as shortness of breath or coughing up blood were found, crystalloids such as RL and analgesics such as metamizole were given while waiting for the preparation of a CT scan with contrast. The management carried out was in line with the basic principles of management of chest trauma, which requires serial control, early pain management, and giving a tetanus shot for any puncture trauma caused by sharp objects. CT scan showed the fishing arrow projection at the suprasternal notch extended to the right hemithorax where the tip was near the brachiocephalic artery posterior wall, noted as a better imaging modality with the more specific and sensitive result, especially for stable patients with chest trauma [10,14].

Penetrating or stab wound on chest trauma might lead to discharge on the wound site due to the arrow structure shape and the high velocity. Most arrow structures are ordinarily pierced to their first position and work as blood vessel tamponade. This is why a foreign body that
penetrated the chest should be left undisturbed from both stable and unstable patients until the definitive treatment and management decision is made by the surgeon [15, 16].

Modality like contrast CT scan was performed to confirm the presence of blood vessel extravasation as the sign of vascular rupture, bone injury, and other vital parts around. In this case, a CT scan on the thorax with contrast showed an isolated brachiocephalic rupture with minimal extravasation, which might be due to the fishing arrow working well as tamponade. Some modalities might help, but a CT scan remains the gold standard if the patient is stable [10, 17].

After all surrounded vital parts were well confirmed, the decision had to be made on whether the foreign material needed to be released or inserted more deeply. This was considered based on the depth of the penetrating wound and the injured organs [14, 15]. The management
was then followed by sternotomy exploration. An incision was made from the jugular region as the identification method to the distal artery and vena. Vascular preservation and exploration were performed to assess the location, characteristics, and the total number of vascular injuries on the site. A 0.5-cm rupture on the brachiocephalic truncus was found on the posterior, followed by the released technique of corpus alienum and a direct suture repair to a brachiocephalic artery using monofilament non-absorbable 6.0 continuous with satisfactory evaluation. A substernal drain was installed and fixated using a sternal wire.

4. Conclusion

In this paper, we present a hemodynamically stable 9-year-old boy admitted with a stab wound by a fishing arrow on the hemithorax dextra region. CT scan on the thorax with contrast showed the fishing arrow projection at suprasternal notch extended to the right hemithorax where the tip was near the brachiocephalic artery posterior wall. The sternotomy exploration found a 0.5 cm-rupture on the brachiocephalic truncus on the posterior and so did a direct suture repair. Upon sternotomy, we prepared a backup heart-lung machine. Proximal and distal blood vessels are claimed to control bleeding. The overall combination of approaches of chest trauma by a stab or penetrating wound and vascular injury like brachiocephalic rupture without pseudoaneurysm or other asymptomatic high risks of vascular injury resulted in a satisfactory evaluation ahead to this 9-year-old boy. In this case, leaving the arrow undisturbed is the key to the success of the first aid management before the patient is sent to the operating room.

Consent

Written informed consent was obtained from the patient’s parents for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Ethics approval

This study has received approval from the Ethics Committee of Dr. Moewardi General Hospital, Surakarta, Indonesia. Reference Number 01501781.

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Declarations of competing interest

No conflict of interest exists regarding the publication of this article. The authors declare that this case report is their exclusive opinion in management of brachiocephalic artery rupture and does not represent the official positions of the associated hospital, health care system, or professional societies.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.103789.

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