



Case report

Case report: Endovascular embolization of the thoracoacromial branch of axillary artery after gunshot trauma at a regional trauma center[☆]Boyoung Kim^{a,b,*}, Kejia Wang^{a,b}, Andrew Kiat^{a,b}, Gratian J. Punch^a, Anthony S. Leslie^b^a Department of General Surgery, Lismore Base Hospital, Lismore, New South Wales 2480, Australia^b Department of Vascular Surgery, Lismore Base Hospital, Lismore, New South Wales 2480, Australia

ARTICLE INFO

Keywords:

Subclavian-axillary artery injury
 Penetrating trauma
 Endovascular repair
 Hybrid operating theatre
 RAPTOR suite
 Regional trauma center

ABSTRACT

Introduction and importance: Penetrating subclavian-axillary artery injury is a rare vascular injury associated with high morbidity and mortality rates traditionally treated with open surgical repair, however endovascular treatments have been utilized in selected cases.

Case presentation: We report a case of a 31-year-old male with a traumatic gunshot injury to the thoracoacromial branch of the left axillary artery successfully managed with endovascular embolization at a regional trauma center.

Clinical discussion: The availability of a hybrid operating suite in severely injured patients is associated with reduced time to intervention, reduced operative duration and improved clinical outcomes. Our experience demonstrates the utility and benefit of a hybrid operating theatre in a regional trauma center. The availability of a hybrid suite allowed rapid diagnostic and therapeutic angiography with a minimally invasive approach and eliminated the need for urgent open surgical management. However, the high costs associated with a hybrid operating theatre remain the major barrier for most regional centers.

Conclusion: The availability of hybrid operating theatre at a regional trauma center allowed early diagnosis and successful management of the injury with a minimally invasive endovascular approach.

1. Introduction and importance

Penetrating subclavian-axillary artery injury is uncommon but associated with high morbidity and mortality due to complex associated anatomical structures [1,2]. Since the emergence of endovascular surgery, a number of studies and case reports have shown that endovascular techniques are effective in managing selected subclavian-axillary artery injuries [3–5]. The published experience to date is largely confined to large tertiary hospital settings. We present a case of an injury to the thoracoacromial branch of axillary artery inflicted by a gunshot, which was effectively managed by endovascular embolization at a regional trauma center. This work has been reported in line with the SCARE 2020 criteria [6].

2. Case presentation

A 31-year-old male with no significant past medical history sustained a close-range gunshot wound in his left upper chest. In the pre-hospital

setting active pulsatile bleeding was noted from the entrance wound, to which manual pressure was applied. Resuscitative measures at the scene included intravenous (IV) fluids and morphine. The patient was subsequently transferred to the nearest regional trauma center.

On presentation the patient's airway was patent and he had neither sign of respiratory compromise nor evidence of pneumothorax. He was haemodynamically normal with a blood pressure of 150/80 mm Hg and a heart rate of 90 beats per minute. His Glasgow Coma Score was 15. A mobile chest x-ray showed a bullet in the left supraclavicular region, but no evidence of pneumothorax or fracture. Bedside ultrasound showed no evidence of pericardial effusion or pneumothorax.

Secondary survey revealed a 10 mm sized left anterior chest entrance wound, located 1 cm inferior to the left clavicle in the midclavicular line, and this was associated with an underlying haematoma approximately 5 cm in diameter. Bruising was seen in the region of left deltoid and pectoral muscles and left posterior chest. The left upper limb was neurovascularly intact with a strong radial pulse.

Laboratory tests were performed which revealed a haemoglobin of

[☆] The case was presented at the VERVE (Visionary Endovascular and Vascular Education) symposium in December 2019 in Sydney, Australia.

* Corresponding author at: Lismore Base Hospital, 60 Uralba street, Lismore, NSW 2480, Australia.

E-mail address: boyoungkim31@gmail.com (B. Kim).

155 g/L and lactate of 1.2 mmol/L. Computed tomography angiogram (CTA) revealed small metallic fragments superior and anterior to the medial aspect of the left scapula. There was contrast extravasation in the arterial phase originating from a branch of the left axillary artery (Fig. 1). The left subclavian and brachial arteries were intact.

The patient was transferred to the hybrid operating theatre (operating theatre containing built in radiology C-arm). Emergency angiogram was performed by a vascular surgeon with arterial puncture via the left common femoral artery, through which a catheter was positioned in the left axillary artery.

Active contrast extravasation was identified from the thoracoacromial branch of the axillary artery (Fig. 2). The origin of the thoracoacromial branch was cannulated and angioembolization was performed with one 3 mm and two 5 mm coils. Completion angiogram showed no contrast extravasation from the target artery (Fig. 3). The procedure was completed within approximately 1 h and the patient was transferred to the ward postoperatively.

Repeat CTA on postoperative day one did not show any evidence of contrast extravasation and repeat haemoglobin was 138 g/L. The patient was treated symptomatically for his haematoma and was discharged two days after the endovascular procedure without complication.

3. Clinical discussion

Subclavian-axillary artery injuries account for 5% of all vascular injuries, but they are associated with high morbidity and mortality rates [1,2]. Penetrating trauma is the most common cause of injury often presenting with active bleeding and haemodynamic instability [7]. Open surgical repair remains the mainstay of management in subclavian-axillary artery injuries, but this is challenging due to the complex anatomical structures surrounding the arteries [7,8].

A number of case reports and studies have demonstrated a role for endovascular management in subclavian-axillary artery injuries [3–5]. Endovascular repairs in haemodynamically stable patients have been associated with significantly improved mortality and lower complication rates in a retrospective study [3]. However published research to date is largely based on experiences at major trauma centers.

Our case report describes the successful endovascular embolization of an isolated thoracoacromial branch of the axillary artery injury at a regional trauma center. Traumatic injuries in rural populations are



Fig. 1. CTA chest showed abrupt cutoff of contrast in a branch of the left axillary artery, with associated surrounding haematoma.



Fig. 2. Active contrast extravasation was identified from the thoracoacromial branch of the axillary artery during emergency angiogram (the black arrow).



Fig. 3. Completion angiogram with distal balloon occlusion showed no contrast extravasation after embolization of the thoracoacromial branch of left axillary artery.

known to be associated with higher morbidity and mortality compared to urban populations due to a number of factors including the vast transport distances, limited resources and dangerous injury mechanisms [9]. Our experience demonstrates the use of a hybrid operating theatre in a regional trauma setting, with our patient having an effective angioembolization procedure whilst still being in an operating theatre environment which would allow opportunity to promptly convert to a traditional surgical exposure should it be required. The hybrid operating theatre also typically provides a superior environment for the provision of the required anesthetic monitoring and resuscitation compared with most radiology departments.

The utility and benefit of a hybrid theatre in severely injured trauma patients has been discussed in literature [10]. A recent prospective study showed that the availability of a hybrid environment is associated with reduced time to intervention, reduced total operative duration and improved clinical outcomes [11]. The availability of a hybrid operating suite at our regional trauma center eliminated the need for urgent open surgical exposure and management. We employed our hybrid suite

urgently to facilitate rapid diagnostic and therapeutic angiography with a minimally invasive approach. Although not demonstrated in our case, an endovascular approach can also play a significant role in more destructive subclavian-axillary artery injuries, with endovascular techniques used as a diagnostic and temporizing measure until definitive surgical control is obtained [12]. Outcomes in endovascular surgery may be improved with immediate access to a hybrid operating suite and skilled personnel [8]. However, the costs associated with a hybrid operating theatre remain a challenge for most regional centers.

4. Conclusion

This case demonstrates the effective endovascular management of a thoracoacromial branch injury of axillary artery at a regional trauma center. The availability of hybrid operating theatre at the regional trauma center allowed early diagnosis and successful management of the injury with a minimally invasive endovascular approach.

Consent

Written informed consent was obtained from the patient 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.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Ethical approval

The case report was notified to the ethical committee of the hospital. Ethical approval has not been requested for this case report, according to hospital protocol.

Funding

None.

Guarantor

Boyoung Kim and Anthony S. Leslie.

Research registration number

Not applicable.

CRedit authorship contribution statement

Boyoung Kim – data collection, analysis, writing – original draft, review, and editing.

Kejia Wang – data collection, analysis, review and editing.

Andrew Kiat – review and editing.

Gratian J. Punch – study concept/design, review and editing, supervision.

Anthony S. Leslie – study concept/design, analysis, review and editing, supervision, performed the surgery.

Declaration of competing interest

None.

References

- [1] J.M. Graham, D.V. Feliciano, K.L. Mattox, A.C. Beall Jr., M.E. DeBakey, Management of subclavian vascular injuries, *J. Trauma* 20 (7) (1980) 537–544.
- [2] A.G. McKinley, A.T. Carrim, J.V. Robbs, Management of proximal axillary and subclavian artery injuries, *Br. J. Surg.* 87 (1) (2000) 79–85.
- [3] B.C. Branco, M.L. Boutros, J.J. DuBose, S.S. Leake, K. Charlton-Ouw, P. Rhee, et al., Outcome comparison between open and endovascular management of axillosubclavian arterial injuries, *J. Vasc. Surg.* 63 (3) (2016) 702–709.
- [4] A. Mousa, B. Chong, A.F. AbuRahma, Endovascular repair of subclavian/axillary artery injury with a covered stent. A case report and review of literature, *Vascular* 21 (6) (2013) 400–404.
- [5] M.A. Ostovan, J. Kojuri, P. Dehghani, Endovascular repair of the traumatic dissection of the subclavian-axillary artery: report of four cases, *J. Tehran Heart Center* 12 (2) (2017) 88–91.
- [6] R.A. Agha, T. Franchi, C. Sohrabi, G. Mathew, A. Kerwan, S. Group, The SCARE 2020 guideline: updating consensus Surgical CAse REport (SCARE) guidelines, *Int. J. Surg.* 84 (2020) 226–230.
- [7] L.D.G. Angus, N. Gerber, S. Munnangi, R. Wallace, S. Singh, J. Digiacomo, Management and outcomes of isolated axillary artery injury: a five-year National Trauma Data Bank analysis, *Ann. Vasc. Surg.* 65 (2020) 113–123.
- [8] C.J. Waller, T.H. Cogbill, K.J. Kallies, L.D. Ramirez, J.M. Cardenas, S.R. Todd, et al., Contemporary management of subclavian and axillary artery injuries—a Western Trauma Association multicenter review, *J. Trauma Acute Care Surg.* 83 (6) (2017) 1023–1031.
- [9] P.D. Danne, Trauma management in Australia and the tyranny of distance, *World J. Surg.* 27 (4) (2003) 385–389.
- [10] A.W. Kirkpatrick, C. Vis, M. Dube, S. Biesbroek, C.G. Ball, J. Laberge, et al., The evolution of a purpose designed hybrid trauma operating room from the trauma service perspective: the RAPTOR (Resuscitation with Angiography Percutaneous Treatments and Operative Resuscitations), *Injury* 45 (9) (2014) 1413–1421.
- [11] D. Carver, A.W. Kirkpatrick, S. D'Amours, S.M. Hameed, J. Beveridge, C.G. Ball, A prospective evaluation of the utility of a hybrid operating suite for severely injured patients: overstated or underutilized? *Ann. Surg.* 271 (5) (2020) 958–961.
- [12] S. Sobnach, A.J. Nicol, H. Nathire, S. Edu, D. Kahn, P.H. Navsaria, An analysis of 50 surgically managed penetrating subclavian artery injuries, *Eur. J. Vasc. Endovasc. Surg.* 39 (2) (2010) 155–159.