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Original Research Article

General surgical unit experience of traumatic vascular injuries in an Australian regional hospital

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ABSTRACT

Background: Vascular trauma is a significant burden to the regional community due to the associated high morbidity and mortality from the complications of the injuries. This may be due to the complexity of the injuries and the issues with initial management at the regional hospitals. Vascular injury management training should improve the outcome of initial surgical management by the general surgical team in regional centres. The study aims to describe the epidemiology and management of vascular injury in regional hospitals in Queensland, Australia.
Methods: A retrospective descriptive analysis was performed using the data of patients with traumatic vascular injuries between January 2017 and July 2021 presented to Hervey Bay hospital in Queensland, Australia.
Results: Fifty-nine patients with vascular injuries were reviewed. The reported number of penetrating and blunt trauma cases were 43 (72.9%) and 16 (27.1%) respectively, and 42 (71.2%) were males. Most mechanisms of injury were cuts (n=32, 54.2%), followed by falls (n=16, 27.1%) and stabs (n=11, 18.7%). Fifty-one (86.4%) were initially surgically managed regionally, with 21 (35.6%) requiring transfer to a tertiary trauma centre. Outcomes of the incidents resulted in one (1.7%) patient requiring amputation, three (5.1%) needing a fasciotomy and the mortality of two (3.4%) patients.
Conclusions: Vascular trauma causes a significant burden to Australian regional hospitals. Identifying injury patterns and common causes for vascular injury will help in early identification and prompt management. Vascular trauma management training should improve the quality of care from the general surgeons in the regional centres.

Keywords: Vascular injury, Trauma, Penetrating, Blunt, Epidemiology

INTRODUCTION

Trauma is a common cause of morbidity and mortality worldwide, leading to a significant burden on the community.[1] Vascular injuries comprise 4-6% of all major trauma.[2] It has been noted that compared to their urban counterparts, residents of rural areas in the USA have extended hospital stays and higher mortality rates following vascular trauma.[3] This has raised concerns regarding initial management at the regional hospital and transferring patients to a tertiary care hospital. This is relevant to Australia due to its size and large regional population.[4] The initial management of trauma is usually the responsibility of the general surgeons of regional hospitals in Australia, who performs the initial damage control surgery and liaises with the vascular surgical team for complex cases needing tertiary care facilities.[5] Training in vascular injury management for general surgeons in regional centres should optimise the outcome by improving the quality of care.[5] Limited evidence exists regarding the features of vascular trauma encountered within a regional hospital, with most literature focusing on the experiences of primary trauma centres. This article

aims to provide an overview of vascular injuries admitted to the Hervey Bay hospital, one of the regional hospitals in the Queensland about three hundred kilometres away from the main tertiary care hospital. The purpose is to describe the epidemiology and overview of the management of the vascular injuries in the regional centres in Australia as well as to the compare with international literature.

METHODS

We performed a retrospective review of the data collected over a five-year period between 01st January 2017 and 1st July 2021 in Hervey Bay hospital, Queensland, Australia. A patient list was generated from the Emergency department database and operative notes. This included the emergency department admission codes S15.0 to S85.9. Data points collected for each patient were age, sex, mechanism of injury, injury pattern and management. Management of vascular injuries at the regional hospital is either definitive surgery to control haemorrhage or damage control surgery to control bleeding until the patient is transferred to a tertiary vascular centre for definitive management. Surgical management for vascular injury varies from ligation to repair of the vessel depending on the severity of the injury, perfusion distal to the vessel and haemodynamic stability. The exclusion criteria for the study were: the patients who did not require any surgical intervention for traumatic vascular injuries and iatrogenic vascular injuries. Data were collected from 94 patients; following exclusion criteria, a total of 59 patients across this population were included in the study. Three groups of extracted fields were included in the analysis: patient demographic factors (age, gender), injury details (cause and mechanism of incident, alcohol or drugs involvement, body part affected, vessels compromised) and outcome measures (requirement of blood transfusion, need for regional surgery, tertiary trauma centre transfer, duration of hospital admission, need for amputation or fasciotomy, mortality). Statistical analysis was primarily descriptive using the Statistical Package for Social Sciences (SPSS) software. Ethics approval was gained through the exception pathway as this project does not meet the NHMRC "National statement on ethical conduct in human research" 2007 definition of research and is compliant with the NHMRC guidance "Ethical considerations in quality assurance and evaluation activities" 2014, on the basis that this is a quality assurance project.

RESULTS

Over the 5-year period, fifty-nine patients presented to Hervey Bay hospital with vascular compromise. The mean patient age was 42.5 y/o with 42 male (71.2%) and 17 (28.8%) female. The average duration of admission was 6.4 days, with four patients requiring a hospital stay greater than 20 days. Of the 59 patients in the audit, 43 (72.9%) experienced penetrating trauma, and 16 (27.1%) experienced blunt trauma. Most mechanisms of injury were cuts (n=32, 54.2%), followed by falls (n=16, 27.1%) and stabs (n=11, 18.7%). The most cited causes of trauma were accidental injury (n=25, 42.4%), self-harm (n=10, 16.9%), assault (n=9, 15.3%), machinery incidents (n=8, 13.6%), MVAs (n=3, 5.1%), aggression (n=2, 3.4%) and dog bites (n=2, 3.4%).

Appendageal trauma was more commonplace than truncal trauma, with 29 (49.2%) cases affecting the upper limb and 19 (32.2%) affecting the lower limb, compared with 6 (10.2%) injuries to the neck, 5 (8.5%) to the abdomen, 4 (6.8%) to the pelvis and 3 (5.1%) to the chest. Injury to the ulnar artery (n=9, 15.3%) as well as the saphenous vein (n=4, 6.8%) had the highest incidence.

Of the 59 patients who presented to HBH with vascular trauma, 51 (86.4%) were initially surgically managed regionally, with 21 (35.6%) requiring transfer to a tertiary trauma centre. Primary surgeries at the regional centre included ligation of the arteries in 21 (41.1%) and ligation of veins in 17 (33.3%) cases. Eleven patients underwent definitive arterial repair at the regional hospital. The 17 operative procedures were performed at the tertiary vascular centre for the transferred patients, and upper limb arterial primary repair (41.2%) was the commonest surgery to perform. There were four cases of major arterial repair and one iliac vein repair in the tertiary hospital.

Table 1: Gender distribution of the patients.

Gender	N (%)
Male	42 (71.2)
Female	17 (28.8)

Table 2: Affected regions associated with vascular injury.

Region of affected trauma	N (%)
Upper limb	29 (49.2)
Lower limb	19 (32.2)
Neck	6 (10.1)
Abdomen	5 (8.5)
Pelvis	4 (6.8)
Chest	3 (5.1)

Table 3: Patient management and outcomes following vascular trauma.

Patient management/outcomes	N (%)
Regional surgery at HBH	51 (86.4)
Tertiary trauma centre transfer	21 (35.6)
Surgery at tertiary trauma facility	18 (30.5)
Blood transfusion	9 (15.3)
Mortality	2 (3.4)
Amputation	1 (1.7)

Table 4: Mechanism of injury.

Cause of injury	N (%)
Accidental	25 (42.6)
Self-harm	10 (16.9)
Assault	9 (15.3)
Machinery	8 (13.6)
MVA	3 (5.1)
Aggression	2 (3.4)
Dog-bite	2 (3.4)

Table 5: Anatomical location and pattern of vessel injuries.

Region of injury	N
Neck, (n=7)	
Vertebral artery	2
Jugular vein	2
Unspecified neck vessel	2
Thyroid artery	1
Thorax, abdomen, and pelvis, (n=7)	
Intercostal vessels	2
SMA	1
Iliac artery	1
Iliac vein	1
Intramuscular abdominal artery	1
Superficial epigastric vein	1
Inferior epigastric artery	1
Upper limb, (n=30)	
Radial artery	9
Ulnar artery	9
Unspecified blood vessel	9
Cephalic vein	2
Brachial artery	1
Lower limb, (n=15)	
Saphenous vein	5
Femoral artery	3
Unspecified artery	3
Unspecified vein	3
Femoral vein	1

Table 6: Types of surgeries performed at the regional hospital.

Regional vascular surgeries performed	N
Ligation of artery	15
Ligation of vein	12
Radial artery repair	3
Ulnar artery repair	3
SMA repair	1
Femoral artery shunt	1
Lower limb fasciotomy	1

Outcomes of the incidents resulted in 1 (1.7%) patient requiring amputation, 3 (5.1%) needing a fasciotomy and the mortality of 2 (3.4%) patients.

Table 7: Types of interventions performed at the tertiary hospital.

Tertiary vascular surgeries performed	N
Ulnar artery repair	4
Radial artery repair	3
Refashioning of artery repair	2
Thrombectomy	2
Femoral artery repair	1
Iliac artery repair	1
Iliac vein repair	1
Vertebral artery repair	1
Brachial artery bypass	1
Upper limb fasciotomy	1

DISCUSSION

Trauma remains a significant public health burden among all countries as it is one of the commonest causes of morbidity and mortality worldwide.[1-3] According to urban vascular centres, peripheral vascular injuries occur in 5% of all major traumas.[4] In the USA, vascular trauma in rural areas causing more morbidity and prolonged hospital stay compared to the major cities.[5] This may raise concerns regarding the response times, regional hospital management and transferring issues to a tertiary hospital with a vascular surgical unit to manage vascular injuries.[6] These concerns are relevant to Australia as it is a large country with a remote regional population and inadequate training for general surgeons in regional centres regarding vascular injury management. Regional centres' experience in vascular injury management is not well reported through trauma involving vascular injuries is a major burden to the regional community.

Considering the magnitude of the issue, the role of general surgeons in the regional centres is vital. General surgeons require sound knowledge and experience in vascular injury management to have a better outcome following these injuries. Dedicated vascular surgical rotation with vascular trauma management training can be incorporated into the general surgical training programme in Australia to improve the outcome following vascular injury management in the regional centres.

In our study, vascular injuries were more common in males (71.2%) compared to females (28.8%), which is comparable to other studies.[7,8] This is likely due to the males being involved in more road traffic accidents and mechanical injuries at work.

Penetrating injuries were present in 72.9% of cases, and 27.1% had blunt injuries. This is similar to the USA, where penetrating mechanisms involve 50-90% of all vascular injuries, mainly from firearm injuries.[9] In our population, the causes of penetrating injuries were accidental cuts and stab injuries, and blunt injuries were due to road traffic accidents and assaults. The median length of hospital stay was 6.4 days, comparable to Irish

regional hospital vascular injuries, which was 7.5 days of median hospital stay.[10] Appendageal trauma was more common than truncal trauma, with 29 (49.2%) cases affecting the upper limb and 19 (32.2%) affecting the lower limb. Upper limb injuries were mainly from accidental cut injuries at work and injuries to the other parts of the body due to motor vehicle injuries.[6,11]

Identifying the hard signs of vascular injuries will guide the clinical diagnosis of the majority of vascular trauma, which should be managed with exploration to control bleeding immediately.[12] Doppler and computerised tomography will help identify the injured vessels before the surgery when the patients present with soft signs or complex injuries.[8]

The general surgical team in the regional centre managed 86.4% of cases surgically, but 35.6% were required to transfer to a tertiary trauma centre due to the complexity of the injuries needing vascular surgical interventions in the tertiary centre. The primary surgical intervention at the regional centre was wound exploration and ligation of the artery or the vein to control the bleeding. Shunting of the femoral artery was performed in a young girl with a severed femoral artery following a motor vehicle accident to transfer the patient to the tertial hospital, where femoral artery repair was performed to save the limb.

Lower limb fasciotomy was performed for a patient with a severe crush injury following a motorbike accident to prevent the potential risk of compartment syndrome from reperfusion injury, known as a limb salvaging procedure for injured ischemic limbs following vascular injuries.[13] Arterial repair was the commonest surgery performed for patients transferred to the tertiary hospital. Some of these arterial repairs could have been performed at the regional hospital if the general surgical team had adequate technical expertise and equipment in the regional hospital, which would have been more cost-effective and reduced the burden on the tertiary hospitals.[10] An emergency laparotomy was needed for a 70-year-old male presented haemodunamically unstable following a fall from height to isolate an injured branch of the superior mesenteric artery, which was ligated to control the life-threatening intraabdominal bleeding.

Two mortalities were reported following the complications of severe vascular injuries from blunt trauma, evident by other studies in Australia.[14,15]

Surgical education on vascular trauma management and trauma care courses will improve the care given by the general surgical teams in regional hospitals. It will help to reduce the errors in vascular trauma care and improve the outcomes following damage control surgeries for vascular injuries performed in the regional centres.[14]

The limitations of the study are the small sample size and single institution-centred study, which may not represent all the regional hospitals in the state. A multicentre study is necessary to increase the sample size and accurately represent the populations of all regional areas.

CONCLUSION

Vascular trauma causes a significant burden to regional care centres due to its severity and complexity of the nature. This study will help to understand the epidemiology of vascular trauma in regional Australia. Identifying common injury patterns and common causes for vascular injury will help in early identification and prompt management. Given that most vascular injuries occurred due to accidental penetrating injuries, accidental injury awareness and prevention programmes will reduce the hospital burden from the injuries. Dedicated vascular rotation with vascular trauma management training in the general surgical training programme should improve the outcome following vascular injury management by the general surgeon work in the regional centres.

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