



Case report

Azygos vein lacerations, a rare injury from high-impact chest trauma: Two cases and a review of the literature

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ABSTRACT

Introduction: Thoracic trauma is a significant cause of mortality, being responsible for 25% of trauma deaths. Despite this, azygos vein lacerations are rare, with only 35 published cases. We present two cases of azygos vein laceration over 21 years from 1999 to 2020 at a Level One Trauma Centre in Melbourne, Australia, as well as a review of the literature.

Case presentations: The first case is a 38-year-old male who fell eight metres from a motorbike jump. He arrived in our emergency department in extremis. The second case is an 81-year-old female driver who presented following a motor vehicle crash. Both patients had massive right haemothorax and haemodynamic instability, so were transferred to the operating theatre for emergency thoracotomies. Both patients survived to hospital discharge.

Discussion: Of the 37 cases of azygos vein injury, including our two, 36 were due to blunt trauma and one from penetrating trauma. Sixteen survived to hospital discharge, producing a 43% mortality rate. Only one of these survivors was managed non-operatively, the remainder underwent emergency thoracotomy and azygos vein ligation. The mortality rate reduced to 31% in those who underwent thoracotomy ($n = 29$). Presentation was predominantly with shock (83%) and right hemithorax white-out on chest x-ray (81%).

Conclusion: Azygos vein injuries are a rare but important cause of thoracic haemorrhage in high-impact blunt trauma. They are often fatal, so management relies on expedient transfer to theatre.

1. Introduction

Thoracic trauma is a significant cause of morbidity and mortality, being responsible for 25% of trauma deaths [1]. Despite this, traumatic azygos vein injuries are a rare occurrence with only 35 previously published cases in medical literature. A review of the literature demonstrates a mortality rate of 43%. Management of this condition requires early recognition and surgical intervention. We present two cases of azygos vein laceration out of 15,897 major trauma patients over a 21-year period from 1999 to 2020 at a Level One Trauma Service in Australia. This case series is compliant with the SCARE Guidelines 2020 [2].

2. Presentation of case one

The first case was a previously well 38-year-old male involved in a

dirt-bike accident, falling approximately 8 m from a jump and landing prone. He lost consciousness at the scene, which spontaneously improved to a Glasgow Coma Scale (GCS) score of 14 on arrival of ambulance crew.

On arrival to the emergency department (ED), he was found to be haemodynamically unstable with a heart rate of 140 bpm, blood pressure of 70/40 mmHg and oxygen saturation of 98% on 15 L of oxygen. Additionally, his trachea was deviated to the right with decreased chest wall movement and air entry on the left and left-sided subcutaneous emphysema.

A left intercostal catheter (ICC) was inserted for presumed tension pneumothorax with slight haemodynamic improvement afterwards. At this point a chest X-ray (CXR) was obtained, which demonstrated right-sided chest whiteout (Fig. 1). A right ICC was inserted with immediate drainage of 700 mL of blood, followed by a further 600 mL shortly afterwards. Cardiothoracic surgeons were called urgently, and

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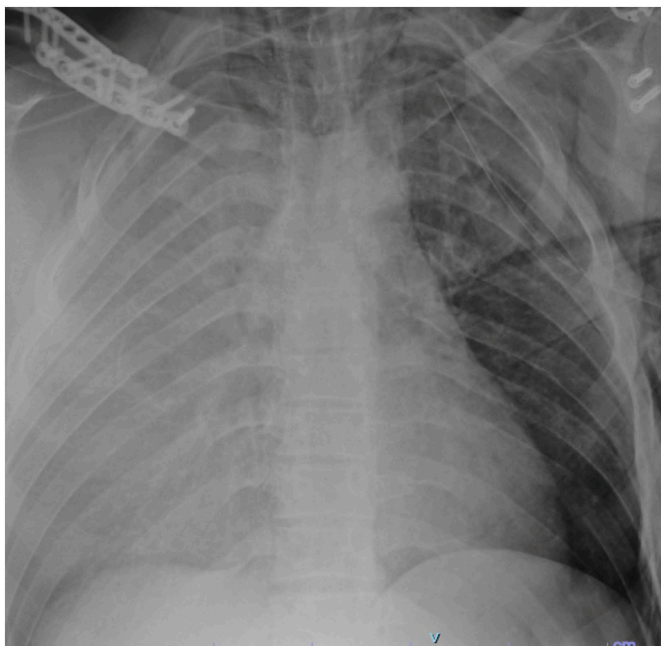


Fig. 1. Chest X-ray of case one demonstrating right chest whiteout.

preparations were made to transfer the patient to theatre. However, at this point the ICC output plateaued at 1300 mL and the patient's haemodynamic status had stabilised. It was decided between the Trauma and Emergency teams that the patient was stable enough for a computed-tomography (CT) scan of his chest, abdomen and pelvis.

The CT scan demonstrated re-accumulation of his large right haemothorax causing mediastinal shift to the left with no identifiable active bleeding Fig. 2). At this point the patient deteriorated again and was taken immediately to the operating theatre with cardiothoracic and trauma surgeons.

A right thoracotomy was performed and the right haemothorax evacuated. This was then extended to a clamshell thoracotomy and the bleeding was identified to be coming from the superior right hilum and

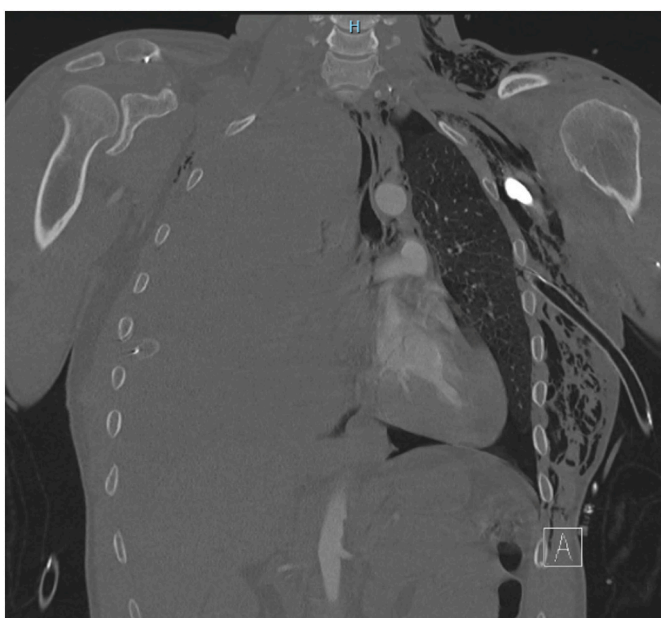


Fig. 2. Sagittal view of CT chest demonstrating re-accumulation of right-sided haemothorax.

controlled by direct pressure. The pericardium was opened and the superior vena cava (SVC) and azygos junction identified. A laceration in the azygos arch immediately superior to the right hilum was found to be the source of bleeding. The azygos vein was divided at the SVC junction and the posterior end of the arch with an Echelon stapler.

Throughout his resuscitation, the patient received 20 units of packed red blood cells, 8 units of fresh frozen plasma, 30 units of cryoprecipitate and 8 units of platelets. His other traumatic injuries included extensive bilateral rib fractures, left T3 transverse process fracture, L4 spinous process fracture and comminuted left iliac fractures. The patient recovered well post-operatively and was discharged home on day 21 of his admission. At follow-up 2 months later, he was noted to have a small asymptomatic left-sided pleural effusion as well as some neuropathic chest wall pain but had otherwise recovered well.

3. Presentation of case two

The second case was an 81-year-old female driver who was T-boned by another car on the driver's side. Her past medical history included atrial fibrillation, for which she was anticoagulated with warfarin.

On arrival to ED her haemodynamics were borderline, with a heart rate of 100 bpm, blood pressure of 115/90 mmHg and oxygen saturation of 99% on 8 L of oxygen. She had reduced breath sounds on the right and a CXR demonstrated right-sided chest whiteout with mediastinal shift to the left. At this point she became haemodynamically unstable and was taken immediately to the operating theatre.

A right anterior thoracotomy was performed and 2 L of clot evacuated. The source of the bleeding was a rupture of the arch of the azygos vein at its confluence with the superior intercostal vein. The azygos and superior intercostal veins were both suture ligated.

Her other traumatic injuries included a right diaphragmatic laceration, liver, omental and retroperitoneal bruising and left superior and inferior pubic rami fractures. She recovered well and was discharged to rehabilitation after 43 days in hospital.

4. Discussion and review of literature

Traumatic azygos vein injuries are a rare cause of thoracic haemorrhage. As a result, the diagnosis can be a challenge and is typically only made intra-operatively. Diagnosis in the first case was further confounded by the initial left tension pneumothorax. With immediate drainage of 700 mL of blood from his right ICC and further drainage of 600 mL within the next hour, this patient met the definition of massive haemothorax [3], and his haemodynamic instability meant operative exploration was crucial. Of note, the CT scan was not able to localise the injury to the azygos vein.

A literature search of Ovid Medline and PubMed was performed using keywords "azygos vein" and "trauma". This identified 24 case reports and case series, describing 35 cases of traumatic azygos vein injuries. Table 1 presents a summary of the known cases since it was first identified in 1978 [4].

Azygos vein lacerations are predominantly a blunt force injury, with only one reported case due to penetrating trauma [5]. The mechanism of injury is believed to be a sudden deceleration force that causes, firstly, an abrupt increase in venous pressure by compression of the heart against the sternum, or compression of the abdominal cavity [6,7]. Secondly, an axial or rotational force on the mobile azygos arch as it is pulled by the decelerating heart while being fixed posteriorly by the intercostal veins [4,8,9]. Salizzoni [6] also proposed nearby vertebral fracture or subluxation as another mechanism, however most azygos vein injuries occur without associated vertebral injuries (Table 1).

This injury carries a 43% in-hospital all-cause mortality rate. By comparison, the mortality rate for those who underwent thoracotomy was only 31%, demonstrating the importance of urgent surgery in these patients. There has been only one case of successful conservative management of a presumed azygos vein laceration described by Mcdermott

Table 1
Summary of published cases of traumatic azygos vein injuries.

Case	Author (year)	Age/sex	Mechanism	Haemodynamic status	CXR	VB fractures	Location	Management	Outcome
1	Spaggiardi (1978)	50F	MVC	Shock	RHTx	-	-	OT	Discharged
2	Salizzoni (1980)	50F	MVC	Shock	RHTx	-	-	OT	Discharged
3				Shock	RHTx	-	-	No OT	Death
4	Baldwin (1984)	28F	MVC	Shock (SBP 80)	WM	-	Azygos/SVC junction	OT (R thoracotomy & median sternotomy)	Discharged
5	Sherani (1986)	25F	MVC	Shock	RHTx	-	-	OT	Discharged
6	Coates (1987)	63F	MVC	Shock	RHTx	-	-	OT	Discharged
7	Snyder (1989)	52F	MVC	Shock (SBP 80)	RHTx	None	Azygos arch 3 cm from SVC	OT (R anterolateral)	Discharged
8	Walsh (1991)	41M	Fall (9 m)	Shock	RHTx	-	-	OT	Death
9	Shkrum (1991)	23M	Fall (17 m)	Shock		-	Level of T5	OT	Death
10		39F	MVC	Shock	WM	-	Level of T4	OT	Death
11		48F	MVC	Shock	RHTx	-	Level of T6	OT	Death
12		24F	MVC	Shock		-	Level of T4	OT	Death
13	Thurman (1992)	19M	MVC	Shock (SBP 60)	RHTx	-	Mid-azygos arch	OT (R anterolateral)	Discharged
14	Inoue (1993)	41F	MVC	-	RHTx	-	Azygos arch	OT	Discharged
15	Butler (1995)	23M	MVC	Shock	RHTx	T3–4	Azygos arch	OT (R thoracotomy)	Discharged
16	Sugimoto (1998)	44M	Ped vs car	Shock (SBP 80)	WM, RHTx	None	-	OT (R thoracotomy)	Death
17	Cagini (1998)	18F	MVC	Shock	RHTx	-	-	OT (median sternotomy)	Discharged
18	Sharma (1999)	75F	MVC	Shock (SBP 56)	RHTx	None	Azygos arch	OT (R thoracotomy)	Discharged
19	Bowles (2000)	36F	MVC	Shock (SBP 76)	RHTx	-	-	OT	Discharged
20	Endara (2001)	26M	Cross bow	Stable	Bolt in thorax	None	-	OT (R posterolateral)	Discharged
21	Nguyen (2006)	21M	MVC	Shock	RHTx	None	Azygos/intercostal veins	OT (R posterolateral)	Discharged
22	Drac (2007)	36M	Ped vs car	Shock (SBP 70)		-	Azygos arch 1 cm from SVC	OT (R anterolateral)	Discharged
23		22M	MVC	Stable (SBP 130)	RHTx	-	-	OT	Death
24		58M	MVC	Shock (SBP 90)	RHTx	-	-	OT	Death
25	Endara (2010)	28M	MVC	Shock	RHTx	-	Azygos arch	OT (R anterolateral)	Discharged
26	Cao (2012)	60M	Hit by heavy object	Shock	RHTx	-	-	OT	Discharged
27	McDermott (2012)	48M	MVC	Stable (SBP 100)	WM, RHTx,	None	-	Conservative	Discharged
28	Yang (2014)	52F	CPR	-	RHTx	None	-	OT	Death
29	Papadomanolakis (2016)	28F	MVC	-	Bilateral HTx	None	-	No OT	Death
30		50 M	Crush	-	RHTx	C6, T6	-	-	Dead on arrival
31		28M	MVC	-	Bilateral HTx	None	-	-	Dead on arrival
32		35M	MVC	-	RHTx	None	-	No thoracotomy	Death
33		41M	Fall	-	Bilateral HTx	None	-	-	Dead on arrival
34		20M	MVC	-	Bilateral HTx	None	-	-	Dead on arrival
35	Laohathai (2019)	33F	MVC	Stable	RHTx (CT)	None	Azygos arch	OT (R posterolateral)	Discharged
36	Case 1	38M	MBC	Shock (SBP 70)	RHTx	T3, L4	Azygos arch	OT (clamshell)	Discharged
37	Case 2	81F	MVC	Stable (SBP 115)	RHTx	None	Azygos arch/superior intercostal vein junction	OT (clamshell)	Discharged

MVC: motor vehicle crash; MBC: motorbike crash; RHTx: right haemothorax; WM: widened mediastinum; SVC: superior vena cava; OT: operating theatre; -: not stated.

[10], where diagnosis was made on a CT scan demonstrating a right paratracheal haematoma at the level of the azygos vein.

The presentation of this injury is characterised by haemodynamic shock (83%) and right-sided chest whiteout on CXR (81%) following significant blunt trauma. Other CXR findings can include a widened mediastinum ($n = 4$) and bilateral chest whiteout ($n = 4$).

Most patients were managed operatively with a thoracotomy (78%). A number of documented approaches have been successful, including right anterolateral ($n = 4$), right posterolateral ($n = 3$), median

sternotomy ($n = 2$) and clamshell ($n = 2$). All of these patients survived to discharge.

5. Conclusion

Traumatic azygos vein laceration is a very rare injury, with only two cases presenting to our service out of 15,897 major trauma patients over a 21-year period. However, this injury carries a significant mortality risk and the diagnosis must be considered in any blunt trauma patient who

presents with haemodynamic instability and right-sided chest white-out on CXR. The mainstay of treatment is an urgent thoracotomy.

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Ethical approval

Case reports are exempt from ethical approval in our institution.

Consent

Written informed consent was obtained from the patients 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.

Author contribution

Christine Li – data collection, literature review, manuscript writing.
David Read – critical revisions.
Katherine Martin – critical revisions.

Research registration

N/A.

Guarantor

Christine Li.

Declaration of competing interest

No conflicts of interest are declared.

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