CASE REPORT

Major haemorrhage in pubic rami fractures

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SUMMARY

A 62-year-old man presented to the emergency department, having fallen 6 ft from a ladder, with pain over his left hip and shoulder. He was managed according to the Advanced Trauma Life Support (ATLS) protocol, and his primary survey showed no haemodynamic compromise. Initial radiographs showed a unilateral left superior and inferior pubic rami fracture, which was treated conservatively. Forty-eight hours post-admission, the patient became tachycardic and hypotensive and was found to have dropped his haemoglobin from 125 to 89 g/L. After resuscitation, a repeat contrast CT scan revealed an enlarging haematoma in his pelvis. This was treated with urgent angioembolisation and the patient was further stabilised in the intensive care unit. This report shows the need for a low threshold in suspecting intrapelvic bleeds in patients with pubic rami fractures, and the need for prompt treatment of such patients, either surgically or radiologically.

BACKGROUND

Traumatic high-energy pelvic fractures have a prevalence of between 5% and 16%.¹⁻⁴ They are associated with significant disability and mortality, hence early diagnosis, immediate resuscitation and communication with an experienced pelvic surgeon is essential to improve patient survival.

Owing to the high-energy nature of pelvic fractures, up to 90% of patients with pelvic fractures can have other associated injuries, with 50% having another source of major haemorrhage besides the pelvic fractures.⁵⁻⁸ This can often pose a diagnostic dilemma, during the acute presentation, as to the true source of haemorrhage. This can be further complicated by the large variation in types of pelvic fractures.

Pelvic fractures are commonly classified, using the Young and Burgess system, into lateral compression (LC I-III), anteroposterior compression (APC I-III) and vertical shear fractures (table 1). Although most clinicians may associate an 'open book' (APC type) pelvic fracture with significant haemorrhage, many would not associate isolated pubic rami fractures (LC I type) with this.

We present a case of an initially stable patient with isolated pubic rami fractures, and describe how this commonly benign injury can still be associated with major haemorrhage. It is hoped that this will improve clinicians' understanding of pelvic fractures frequently seen in primary and secondary care, and the investigative and resuscitative methods required to manage these patients, along with the specialist definitive treatments available.

CASE PRESENTATION

A 62-year-old man was admitted to a Level I Trauma Centre after falling 6 ft from a ladder. He reported pain in his left hip and left shoulder.

On arrival, he was managed using the Advanced Trauma Life Support protocol (table 2).¹¹ His cervical spine was triple immobilised and he was maintaining his airway. Oxygen saturations were 99% on 15 L oxygen. He had no signs of respiratory compromise. His heart rate was 77 bpm, with a blood pressure of 121/73 mm Hg. His Glasgow Coma Score was 15/15 throughout. He was otherwise a relatively fit and well man with only ankylosing spondylitis as a significant medical history to note.

INVESTIGATIONS

Blood indices such as haemoglobin (Hb; 125 g/L), urea and electrolytes, and lactate, were within normal ranges.

Plain radiographs showed a displaced left superior and inferior pubic rami fracture, which was confirmed on a contrast trauma CT (figure 1). A pelvic haematoma was subsequently noted on the CT though not reported at the time. No other injuries were found on secondary survey.

TREATMENT

The patient was admitted for monitoring, analgesia and physiotherapy. The following day, however, the patient became hypotensive with a blood pressure of 91/60 mm Hg and tachycardic with a pulse of 110 bpm. Repeat blood tests showed a fall in Hb to 89 g/L. He was also noted to be suffering from acute kidney injury with an estimated glomerular filtration rate (eGFR) of 31 mL/min/1.73 m², which was >90 mL/min/1.73 m² previously. The patient was given fluid resuscitation and 2 units of packed blood cells, after which he became normotensive.

On day 2 of his admission, the patient became shocked again, with a systolic pressure of 90 mm Hg and a pulse of 120 bpm. He was also becoming increasingly more confused and obtunded. His Hb was 83 g/L post-transfusion, and his renal function had worsened (urea 18.1 mmol/L, creatinine 179 µmol/L and eGFR 34 mL/min/1.73 m²). He was supported with intravenous fluids and cross-matched for another 6 units of red blood cells. With no obvious cause of this patient's hypovolaemic shock apart from his pelvic fractures, the pelvic binder was reapplied and a repeat contrast CT performed.

The CT scan (figure 2) showed the pelvic haematoma had increased in size but with no clear evidence of active bleeding. An immediate angiogram was performed, which showed generalised oozing from the left superior gluteal and obturator

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Table 1 Young-Burgess classification of pelvic fractures^{9 10}

Type of fractures	Mode of injury	I	II	III
LC	Lateral force directed onto the sacrum and pubic rami	Ipsilateral transverse pubic rami fractures	Anterior transverse pelvic fracture with 'crescent' iliac wing fracture	LC I or II with contralateral AP type fracture
AP	Force directed anteroposteriorly	Pubic rami vertical fracture <2.5 cm widening of pubic symphysis	Widening of anterior aspect of sacrum (anterior SI ligaments torn, posterior ligaments intact) >2.5 cm widening of pubic symphysis	Complete disruption of pubic symphysis with torn posterior SI ligaments
VS	Massive axial loading force	Complete disruption of hemipelvis with tearing of all ligaments±vertical fracture of the sacrum with disruption of pubic symphysis±vertical fracture of pubic rami		
Combined mechanism	Combination of any of the above fracture types			

AP, anteroposterior; LC, lateral compression; SI, sacroiliac; VS, vertical shear.

arteries, which were subsequently embolised (figures 3 and 4).

Postembolisation, the patient was taken to the adult intensive care unit, where he received a further 6 units of packed red blood cells and 1 unit of platelets. A repeat pelvis X-ray performed on day 5 showed displacement of bilateral pubic rami fractures, with the right side thought to have occurred at the time of injury but only subsequently displaced, hence not visible on the original trauma CT.

Once the patient was haemodynamically stable, the pelvic trauma surgeons treated him with an internal fixation device.

OUTCOME AND FOLLOW-UP

The patient's total length of stay was 10 weeks, with the majority of the time spent due to slow ventilatory weaning. He was subsequently discharged to an intermediate respite hospital to improve his mobility prior to discharge home.

DISCUSSION

Anatomy of the pelvic ring

The pelvic ring is an osseous-ligamentous structure that is formed by two symmetrically opposite innominate bones. These are joined by strong secondary cartilaginous fibrocartilage forming the pubic symphysis anteriorly and posteriorly by the anterior and posterior sacroiliac, sacrotuberous and sacrospinous ligaments.¹² These posterior ligaments are among the strongest in the body. Pathologically, it requires quite a large exterior force to cause deformation and disruption of these pelvic ring structures. The musculofibrous pelvic floor can also act to provide some support and stability to the pelvic ring.¹² In trauma, depending on the vector of the force, which as seen in

table 1 originates either anteriorly or laterally, the majority of the force will subsequently be directed via the pubic rami or sacroiliac joints (SIJ), hence the propensity of either or, more commonly, both of these structures sustaining some amount of damage.

The vascularity of the pelvis is also an important aspect in this topic of discussion. The superior gluteal and obturator arteries are the vessels most commonly disrupted in pelvic ring fractures,¹² primarily due to their close association with the SIJ and pubic rami, which are the commonest sites of injury in pelvic fractures, as described above. In addition to this, there are also vast amounts of venous plexuses that form in and around the viscera, and along the posterior wall of the pelvis. This explains the increased likelihood of disruption to this complex vasculature network, even during minor pelvic fractures such as grade 1 LC types (table 1). In addition, the pelvic bones are supplied by rich amounts of nutrient arteries that can result in the loss of quite a significant amount of blood, at exposed fracture sites.

Management of pelvic fractures

Pelvic fractures, no matter the classification, have the potential to become life-threatening injuries. This case report demonstrates the presence of major haemorrhage that can occur as a result of such fracture patterns, while giving evidence for multiple successful treatment options. It is essential that doctors across all medical specialties are aware of the potential treatment options available to treat such complications from pelvic fractures, as patients with these injuries can present to the emergency department, general medicine, surgical or orthopaedic

Table 2 ATLS management of acute trauma

Protocol	Details
A—Airway	Spontaneous conversation, otherwise maintain in-line triple immobilisation, with jaw thrust. Consider airway adjuncts
B—Breathing	Chest inspection, palpation, percussion and auscultation. Respiratory rate, oxygen saturations
C—Circulation	Skin colour; pulse rate, rhythm and character; blood pressure; capillary refill time Venous access, bloods and intravenous fluids
D—Disability	Blood glucose levels; alert, voice, pain, unconscious scale; Glasgow Coma Score scale; pupillary size and reaction; medication review
E—Exposure	Complete exposure (monitoring temperature closely)

ATLS, Advanced Trauma Life Support.

Figure 1 CT of the pelvis demonstrating left pubic rami fracture.

Figure 2 CT of the pelvis showing haematoma collection.

departments, especially with the advent of major trauma centres. Initial and definitive management options are detailed below.

The basic initial management of any patient with trauma should follow the American College of Surgeons Advanced Trauma Life Support (ATLS) protocols¹¹ (table 2). As part of the primary survey, chest and pelvic radiographs can be obtained to identify life-threatening injuries or the source of haemodynamic instability.

In patients with known pelvic fractures, simple emergency measures such as internally rotating the hips and strapping the ankles together are useful, especially pre-hospital, to reduce haemorrhage.¹³ Pelvic binders can also be placed. A pelvic binder is a non-invasive piece of material applied circumferentially around a patient's pelvis, and manually tightened to compress and stabilise the pelvis. Pelvic binders aim to stabilise the pelvic ring, decrease overall pelvic volume and reduce bleeding from fractures.^{13–16} In addition, stabilisation of the pelvic ring achieves the tamponade effect on bleeding bone and protects the initial, and most effective, clot from disruption,¹⁷ although the evidence for this is controversial.^{18 19}

Figure 3 Interventional radiograph showing bleeding from superior gluteal artery.

Figure 4 Interventional radiograph showing obturator artery with metal coil in situ.

Pelvic packing±external fixator

In a persistently haemodynamically unstable patient, post-fluid resuscitation attempts, a Focused Assessment using Sonography for Trauma (FAST) scan can be performed, which, if positive, necessitates an urgent transfer to the operating theatre for a diagnostic laparotomy. During this procedure, a small vertical incision could also be made inferior to the pubic rami, but keeping the peritoneum intact, to inspect the pelvis for any obvious collection of blood, which, if positive, requires urgent pelvic packing to control the bleeding.^{20 21} A major source of haemorrhage from pelvic injuries is venous, and so packs can be placed directly in the pre-peritoneal and retroperitoneal spaces, thus tamponading the visualised areas of bleeding.²⁰ This has been shown to improve mortality rates, especially if performed early, and not when the patient is in extremis.²²

The need for an external fixator device while the patient is in theatre can also be considered, with experimental studies showing that this decreases the motion at bony points, hence allowing a clot to form, and also acts as a stable background on which the packing sponges can act.⁷ It is most suitable for APC injuries.^{23 24} However, the disadvantage of not providing any posterior and vertical stability,^{13 23 25} coupled with the risk of infections over the pin sites⁷ along with aseptic loosening of the pins, often requiring revision surgery,²⁶ makes this a controversial decision, with some surgeons electing to consider single one step definitive management when the patient is much more stable.

Angiography±embolisation

In contrast, if the patient's haemodynamic status can be stabilised, with no obvious source of the shocked state, then an urgent contrast CT scan may identify a pelvic haematoma with or without a blush, indicative of an arterial bleed, further emphasising the need for an urgent angiography±embolisation. This ideally should be performed as soon as possible, with 24/7 service being available, as Agolini *et al*²⁷ demonstrated that embolisation within 3 h of arrival exhibited a superior survival rate. Balogh *et al*²⁸ went a step further, demonstrating that

pelvic angiography performed within 90 min after admission improved mortality. Despite this, the overall prevalence of patients with pelvic fractures needing embolisation remains low, with reports of it being less than 10%.^{9 27 29 30}

The positive predictive factors for angiography in patients is a much debated topic with various indications including haemodynamic instability, specific pelvic fracture patterns and evidence on CT of extravasation being noted as the main predictors.^{31 32} A prospective study carried out by Salim *et al*³³ found that in the presence of all three factors of SIJ disruption, female gender and prolonged duration of hypotension (SBP <100 mm Hg for more than 90 mins), the probability of a positive angiography being carried out was 99%, and conversely the probability was 20% if none of the factors were found.

However, embolisation is not without its complications, such as overwhelming sepsis brought about by necrosis of pelvic tissues.³ However, it is a useful tool if used in potentially haemodynamically unstable patients with a pelvic fracture and should be available for use when necessary.^{34–36}

In a stable patient with no apparent blush or bleeding identified on CT scan, the subsequent step would be to admit the patient for close monitoring and observation over the coming days. The patient should be carefully monitored for early signs of shock, for example, tachycardia, hypotension and skin clamminess, and have regular haematological tests performed, checking, most importantly, the haemoglobin levels. Where any suspicion exists, an early decision should be made to rescan the patient for any presence or enlargement of the haematoma collection with a view toward immediate interventions if necessary.

Learning points

- ▶ Pelvic fractures, no matter the classification, can remain a source of haemodynamic instability in patients.
- ▶ Prompt diagnosis and treatment is potentially life saving, as 'turning off the tap' has been shown to be more effective than repeated blood transfusions.
- ▶ The investigation of choice is a contrast CT scan as it is sensitive enough to identify minor bleeding arterial points.
- ▶ Angiography±embolisation is the preferred management option if the patient is stable.

Contributors CHT's role in producing this manuscript was to determine the topic of interest to be discussed, finding a relevant patient case and writing up the case report on the patient. His role also encompassed the literature and evidence search necessary for the manuscript. FS's role was to advise on the basic management of pelvic fractures, to provide further knowledge on the subject matter and to help edit the completed document, adding essential evidence and literature searches to the document. DF is the consultant in charge of the patient's care and provided overall supervision for this project.

Competing interests None.

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