Assessment and Management of High Energy Pelvic Fractures in Adults

Abstract

Pelvic fractures caused by high energy trauma such as falling from a height or road traffic collisions have a high mortality rate and many patients are left with life changing and debilitating injuries. High energy fractures to the pelvis can be associated with major haemorrhage and injuries to internal organs in the pelvis [Vaidya et al 2016]. Emergency nurses have a fundamental role in caring for these patients and the nurse assessment and management of the patient in the acute phase is important to improve the patient's overall outcome. This article focuses on the anatomy of the pelvis, initial assessment and management of patients presenting with high-energy pelvic fractures and complications associated with pelvic fractures.

Keywords

Pelvic fractures, major trauma, nurses' role

Introduction

High energy pelvic fractures are complex injuries that put the patient at high risk of catastrophic haemorrhage and other complications. Pelvic ring fractures can range from being minor (requiring no treatment) to life-threatening, depending on the extent of the injury, and the involvement of solid organs and blood vessels in the pelvis. The mortality rate of pelvic ring fractures is estimated to be as high as 60% depending on severity of injury and the haemodynamic state of the patient [Jang et al 2016]. In the first six hours following injury, death occurs most commonly due to abdominal and pelvic haemorrhage [Vaidya et al 2016]. Nearly all patients with fractures will have associated injuries and patients may be left with significant comorbidities and a diminished quality of life following injury due to mobility issues and ongoing pain [McMinn et al 2020].

Pelvic ring fractures occur due to force being applied to the pelvic ring, for example from falls or crush-type injuries. Between 2 and 8% of all fractures involve the pelvis [Frane et al 2020], and of these the most severe pelvic injuries account for 2-4% of all pelvic fractures [Grotz et al 2005]. In the UK, a recent study identified pelvic fractures as being present in 7% of patients at a single major trauma centre [Leach et al 2019].

Emergency nurses have a fundamental role in the care and management of patients with pelvic fractures whilst in the Emergency Department (ED), both as members of the trauma team and in their ongoing care. This article provides an overview of pathophysiology, assessment and management of pelvic ring fractures in patients who have sustained major pelvic trauma.

Anatomy of the pelvis

The pelvis is a ring-shaped bony structure that supports the weight of the upper body and provides a level of protection to the reproductive organs, kidneys, colon and bladder within the pelvic cavity [Mahadevan, 2018].

The bony pelvis is formed of two parts, the anterior and posterior pelvis, which form the pelvic ring. In the anterior part the ilium, pubis and ischium become fused together in puberty to form the acetabulum and are known as the innominate bone. The posterior pelvis starts below the lumbar spine and is made up of the sacrum and the coccyx (Figure 1). The pelvis has several major joints. The main two are the sacroiliac joint which connects the ilium and sacrum and the pubis-synthesis, a cartilaginous joint between the right and left pubic bones. Stability of the pelvis comes from surrounding muscles and ligaments which support the pelvis and prevent unwanted movements in the joints.

The major blood vessels that supply the pelvis, lower limbs and abdominal organs are the iliac arteries (where the aorta divides) forming the internal iliac artery providing blood supply to the pelvis, and the external iliac arteries which supply blood to the lower limbs. There is a complex venous system located posteriorly in the pelvis as the blood returns to the vena cava [Knops et al 2011].

INSERT FIGURE 1. Anatomy of the pelvis

Pelvic ring fractures

Pelvic ring fractures occur from high-energy trauma that results in a force being applied to the pelvis causing it to break. Fractures occurring in more than one part of the pelvis are unstable, particularly where they involve the sacroiliac joint. Pelvic fractures can be classified according to their location and stability and provide a guide to their definitive management [Wong and Bucknill 2017]. The classification of pelvic fractures only occurs following imaging, the most commonly used system is the Young-Burgess classification which categorises pelvic fractures according to stability, low or high impact force and anatomy [Burgess et al 1990] (Figure 2).

INSERT FIGURE 2: Young and Burgess Fracture classification.

There are three main types of pelvic fractures:

1. Lateral Compression (LC) which are usually stable (the pelvic ring is maintained), low energy pelvic fractures which occur commonly as a fall from standing in elderly patients with osteoporosis [Rommens et al 2015]. These are the most common pelvic ring fractures and are caused by a laterally applied force to the pelvis leading to internal rotation of the hemipelvis on the side of the injury [Khurana et al 2014].

2. Anterior Posterior Compression (APC) happens when a high energy force travels from the front to the back of the pelvis causing an unstable pelvic ring

fracture (the pelvic ring has been disrupted) [Trainham et al 2015]. APC fractures are also known as ‘open book’ fractures as the force causes the pubic ramus to open at the front, which can cause tearing of the sacroiliac joint with severe enough force which can lead to complete hemipelvis separation [Greaves and Porter, 2019]. The most common mechanism of injury (MOI) for APC fractures is blunt trauma which can vary between a fall from height to road traffic collisions [American College of Surgeons (ACS), 2018].

3. Vertical Shear (VS) fractures can be caused by jumping from a height and landing on one foot which will transmit the force up through the leg and acetabulum causing sacro-iliac joint disruption which can result in severe injury [Greaves and Porter, 2019].

Patients can have more than one type of fracture at a time, known as combined mechanism (CM) fractures [Humbyrd et al 2012].

Initial assessment and management

Following high-energy trauma, patients should be transferred to a Major Trauma Centre (MTC) and on arrival to the Emergency Department be immediately assessed by a multi-specialty trauma team [National Institute of Clinical Excellence (NICE), 2017]. This assessment is called the ‘primary survey’ and is a common approach to assessment and initial treatment of patients following major trauma. It includes assessment of airway, breathing and circulation [ACS, 2018] and can be carried out sequentially by a single clinician, or with each component assessed simultaneously by a trauma team. Key elements of the primary survey are outlined in Box 1.

INSERT TABLE 1: Key elements of the primary survey

Specific considerations in pelvic ring fractures

Patients with pelvic ring injuries are at significant risk of major bleeding from disruption of the venous system within the pelvis and haemodynamic instability occurs in around 10% of pelvic ring injuries resulting from bleeding from major vessels in the pelvis [Cheun et al 2018]. The source of pelvic bleeding is usually venous and most common from the presacral venous plexus and the lumbar venous plexus [Gordon et al 2018]. Arterial bleeding can occur from damage to the internal iliac arteries which are the main blood supply for the pelvis, or from the bony surfaces of the pelvic fracture [Incagnoli et al 2019]. Large quantities of blood can collect in the space behind the abdomen known as the retroperitoneal cavity. Patients can lose 30% of blood their volume, approximately 1500mls in a 70kg patient [Wong and Bucknill, 2017].

The priority in the management of high-energy pelvic trauma is haemorrhage control, restoration of blood volume, pain relief and definitive management to stabilise the pelvis [Holbery and Newcombe, 2016; Greaves et al 2022]. Restoration of blood

volume is with blood products using one unit of platelets to one unit of red blood cells [NICE, 2016]. This should occur alongside early administration of tranexamic acid. Crystalloids should be avoided so that dilutional coagulopathy is minimised [Chatrath et al 2015]. In patients with suspected or known major haemorrhage due to pelvic injury the assessment and management of circulation may take place concurrently with airway and breathing assessment.

Circulatory assessment and management should include cardiac monitoring, and regular blood pressure readings. A haemodynamically stable patient with pelvic ring injury will have no tachycardia and a normal blood pressure whilst a haemodynamically unstable patient will have hypotension and tachycardia [Trainham et al 2015]. The position, shortening, rotation and any asymmetry of the lower limbs should be part of the assessment as these can all be signs of pelvic fractures [Haq et al 2014].

Stabilisation of the pelvis

Patients with high energy pelvic trauma should have a pelvic binder applied [NICE, 2016]. Pelvic binders reduce bleeding by stabilising the fracture (similar to splinting in long bone fractures) [Wong and Bucknill, 2017]. Pelvic binders must be correctly placed to splint the pelvis and provide stabilisation (Figure 3). Binders must be placed at the level of the greater trochanters to bring the pelvic bones closer together and therefore splint the pelvis [Bonner et al 2011] [Pizanis et al 2013]. This reduces the pelvic volume, helps to tamponade any bleeding and prevents any disruption to blood clots [American College of Surgeons, 2018]. Good stabilisation will reduce pain, but analgesia will still need to be given. In patients who are haemodynamically stable they should be removed prior to pelvic x-ray or CT imaging as they can obscure pelvic fractures [British Orthopaedic Association Standards for Trauma (BOAST), 2018]. Once pelvic fractures are confirmed as stable or have had definitive management the binder should be removed [NICE, 2016].

INSERT FIGURE 3: Pelvic binder showing correct placement.

Log rolling is a manoeuvre which allows the patient to be turned whilst minimising movement of the neck and spine to reduce the risk of further injury. Patients with suspected pelvic fractures should not be log rolled before CT imaging as it causes movement of the pelvis and is linked to haemodynamic instability caused by clot disruption [Rowell, 2014]. Once imaging is completed and any bleeding has been ruled out, the patient can safely be log rolled [NICE, 2016].

Imaging

Imaging for major pelvis fractures must include a CT scan with intravenous contrast which includes head, chest, abdomen and pelvis [BOAST, 2018].

Embolization

For patients with ongoing arterial bleeding from pelvic fractures angiographic embolization can be used [Wong and Bucknill, 2017]. Embolization is a procedure to control bleeding in a particular area by using a catheter to access the effected blood vessel and use either a balloon or haemostatic agents to partially block the vessel to control bleeding [Lopera, 2021]. This can be used as a first line intervention in haemodynamically unstable pelvic ring injuries [NICE, 2017]. Angiography is when a contrast is inserted into blood vessels under X ray so that the site of bleeding in a particular blood vessel can be located [Lopera, 2021]. It cannot be used to treat arterial bleeding from multiple sources [Parry et al 2020]. Angiographic embolization usually takes place in an interventional radiology area or a hybrid operating theatre.

Complications associated with pelvic ring fractures

In addition to major haemorrhage, patients with pelvic ring fractures are at risk of genitourinary trauma, sepsis, chronic pain and bowel damage [Wong and Bucknill, 2017]. Up to 90% of patients with unstable pelvic fractures have associated injuries [Cheng et al 2018].

Pelvic ring disruption, particularly of the anterior section, increases the risk of damage to urogenital organs due to the anatomical proximity of these organs in the pelvis [Trockels et al 2021]. Symptoms that indicate a bladder injury include suprapubic pain and tenderness, and the urge to urinate but inability to pass urine [Humbyrd et al 2012]. Blood from the urethral meatus, genitals or rectum are signs of urological or colorectal injuries [Wong and Bucknill, 2017]. Swelling, bruising and haematomas to the scrotum or perineum can be signs of testicular dislocation and internal injury, as can inguinal and abdominal pain [Bernhard et al 2021].

INSERT TABLE 2: High energy pelvic fracture complications

Ongoing care in the Emergency Department

Prior to transfer, patients with high-energy pelvic trauma should be closely monitored. Pedal pulses, capillary refill and skin colour and warmth should be checked regularly to ensure good vascular supply to the lower limbs.

Pain is a chief complaint in major trauma patients and pain management should be a priority once airway is secured and major haemorrhage is controlled [Khosa et al 2019]. Pelvic trauma patients often present with pain in the groin, pubic area, posterior pelvis, or lower back and this can also be a red flag for injuries to other organs in the pelvic area [Cheung et al 2018]. All major trauma patients should have pain regularly assessed using a pain assessment tool suitable for the patients age and cognitive function [NICE, 2018]. This can be difficult in practice as the patient may be unconscious, cognitive function may be impaired and any language barrier can create obstacles to pain assessment. Vital signs, such as tachypnoea, tachycardia and hypertension can be associated with pain in the unconscious patient and should be regularly monitored [Jafari et al 2017].

Opioids should be used for first line management of pain and intravenous morphine is the drug of choice unless contraindicated [NICE, 2016]. The nurse should monitor the patient for associated side effects. Respiratory depression, nausea, vomiting and sedation are all associated with opioids which can all have a detrimental effect on assessment of trauma patients [Dattatri et al 2021]. Use of sedative drugs and opiods in trauma patients can potentially compromise airway patency and increases risk of gastric content aspiration as they impair gastric emptying [Saranteas et al 2019, Robinson and Davidson 2013]. Vomiting is difficult to manage in patients with pelvic ring fractures as the patient cannot be log rolled onto their side. Patients with pelvic ring fractures will require anaesthetic drugs for emergency surgery, increasing the risk of gastric content aspiration as patients are unlikely to be starved. Opioids can also cause respiratory depression and patients receiving these require regular observation [Greaves et al 2022].

For patients with severe pelvic injury a urinary catheter will be required to minimise unnecessary movement and monitor urine output. This should be inserted by an experienced doctor (usually a urologist), and can be done even if urethral injury is present [BOAST, 2016]. In female patients, pregnancy status should be documented. Menstruating women and girls should also have a pregnancy test recorded.

Good communication is vital and can be challenging when so many different teams are involved with one patient. Trauma teams should have a clear point of contact for providing information to the patient and their family [NICE, 2016].

Conclusion

Patients with high energy pelvic ring fractures pose a significant challenge to nurses working in the emergency department as their injuries are complex and life-threatening. It is important for nurses working in the emergency department to have knowledge of the pelvis and injuries associated with this type of fracture. Assessment and timely interventions can prevent further complications. Effective communication between clinical teams and the patient is vital. Nurses are the patient’s advocate and have a fundamental role in ensuring the patient receives optimal care in the acute phase of treatment to improve their outcome in the rehabilitation phase.

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Tables and figures

Figure 1: Key elements of the primary survey

Figure 2: anatomy of the pelvis

Figure 3: Pelvic binder showing correct placement.

Table 1: Elements of the primary survey

	Assessment	Management principles
Airway	Airway patency Identification of life-threatening injuries to face and neck	Maintain airway patency (basic or advanced airway techniques) Treatment of life-threatening neck injuries Restricting movement of the cervical spine if relevant
Breathing	Respiratory rate Inspection, palpation, percussion and auscultation of the chest Oxygen saturation levels Identification of life-threatening injuries to the chest	Treatment of life-threatening chest injuries Maintain adequate oxygen levels and support ventilation as required
Circulation	Pulse, blood pressure, capillary refill	Control of bleeding Restoration of blood volume

	Identification of life-threatening haemorrhage: blood ‘on the floor’, chest, abdomen, pelvis, long bones [Holbery and Newcombe, 2016]	Administration of tranexamic acid
Disability	Assessment of neurological function - Glasgow Coma Scale (GCS) Pupil reaction	Neuroprotective measures to reduce secondary brain injury
Exposure	Pain assessment Temperature measurement Identify any other wounds	Provision of adequate pain relief Maintain normal temperature Treatment of other life-threatening wounds

Table 2: High energy pelvic fracture complications

Area	Complication	Occurrence
Genitourinary	Urethral disruption	Up to 29% of patients with pelvic fractures [Figler et al 2012].
	Bladder rupture	3% of patients with pelvic fractures [Johnsen et al 2017].
Nerve damage	Sexual dysfunction in males and females	30% of patients with pelvic fractures [Ayik et al 2021].
	Chronic pelvic pain	64% of patients with pelvic fractures [Gerbershagen et al 2010].
Male specific	Erectile dysfunction	30% of men with pelvic fractures [Cheung et al 2018].

	Testicular dislocation	<1% [Bernhard et al 2021].
Female specific	Vagina fistula	<1% [Vallier et al 2012].
	Complications in childbirth requiring Caesarean section	Up to 50% of women [Riehl, 2014].
	Dyspareunia	30% of women with pelvic fractures [Vallier et al 2012].