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PRE-HOSPITAL MANAGEMENT OF THE PATIENT WITH SUSPECTED PELVIC FRACTURE, REVIEW LITERARY AND CLINICAL PRACTICE

Abstract. *Potential risks of missing an occult pelvic injury outweigh the risks or complications associated with pelvic binding. Therefore, all patients with suspected pelvic trauma should be immobilized or fixed. This paper aimed to review the literature and analyse current practices in order to identify the optimum management for a patient with a suspected pelvic fracture in the prehospital environment.*

Keywords*: pelvic trauma, prehospital assessment, haemorrhage control.*

Introduction to Pelvic Trauma

Pelvic fractures represent approximately 3% of all skeletal injuries annually in the United States and account for 9% of trauma patients admitted to the hospital.[19] These injuries range from benign to rapidly life-threatening, with an overall mortality of 10–16%. However, open pelvic fractures, which represent approximately 2–4% of pelvic injuries, have the highest mortality rate at nearly 45%. Pelvic fractures most frequently occur in patients 15–28 years old who sustain high-energy, side-impact mechanisms of injury such as high-level falls or motor vehicle collisions (MVCs), but serious pelvic injuries can also occur from minor mechanisms such as ground-level falls. [19] This is especially true in elderly patients.

Pelvic fractures are one of the potentially life-threatening injuries that should be identified during the primary survey in patients sustaining major trauma. Early suspicion, identification and management of a pelvic fracture at the prehospital stage is essential to reduce the risk of death as a result of hypovolaemia and to allow appropriate triage of the patient. The assessment and management of pelvic fractures in the prehospital environment is reviewed here. It is advocated that the pelvis should not be examined by palpation or springing, and that the patient should not be log rolled. Pelvic immobilisation should be used routinely if there is any suspicion of pelvic fracture based on the mechanism of injury, symptoms and clinical findings.

Pelvic fractures are one of the potentially life-threatening injuries identified during the primary assessment of patients with major trauma. The prevalence of pelvic fracture in studies of patients with blunt trauma is between 5% and 12%. [1] Early suspicion, identification and management of a pelvic fracture at the prehospital stage are essential for reducing blood loss. Pelvic fracture is also a marker for considerable energy transfer and severity of injury, and therefore allows appropriate triage of the patient.

Pelvic trauma can lead to severe, uncontrollable haemorrhage and death related to prolonged shock and multiple organ failure. Massive retroperitoneal haematoma should be assumed to be present in cases of post-traumatic haemodynamic instability associated with pelvic fracture in the absence of extrapelvic haemorrhagic lesions.

The mortality from pelvic fractures in patients who reach hospital is reported to be between 7.6% and 19%. [2] The mortality from open pelvic fractures is much higher and approaches 50%.[3]

Pelvis Anatomy

The pelvis is a ring-shaped bony structure consisting of the sacrum, coccyx, and three innominate bones: the ilium, ischium and pubis. The innominate bones join to form the acetabulum–the socket in which the head of the femur sits to form the hip joint. The joint between the sacrum and ilium (sacroiliac joint, or SI joint) is the strongest joint in the body, and the pubic symphysis is the weakest link in the pelvic ring. (See Figure 1 below). The strength and stability of the pelvis is a result of several ligaments that connect the sacrum to the other pelvic bones, and potentially dangerous pelvic instability can result when these ligaments are disrupted.

The primary organs lying within the pelvis are the bladder, rectum, anal canal and urethra, along with the prostate in males and the uterus and vagina in females. Also contained within the pelvis is a vast array of blood vessels, nerves and internal organs. When trauma causes pelvic instability or a fracture, injury to the large network of arteries and thin-walled veins that lie anterior to the sacrum can cause severe internal hemorrhage. Injury to nerve roots, which course through the pelvis, can result in bowel, bladder and sexual dysfunction.

Primmari assessment

Pelvic pain is the most common finding in patients with pelvic fractures who are awake and alert,[20] but pain in the lower back, groin or hip may also be an indication.[20] In addition, patients may have a leg length discrepancy (one leg shorter than the other) or a rotational deformity. Bruising over the flank, bony prominences of the pelvis, pubis, perineum or scrotum are also suggestive of significant pelvic injury. Wounds over the pelvis or bleeding from the rectum, vagina or urethra are signs that a bone fragment may have penetrated the skin and thus an open pelvic fracture may exist. If pelvic trauma is causing an associated nerve injury, the patient may experience loss of bowel or bladder control. [20]

It’s strongly recommended that providers avoid rocking the pelvis. Instead, gently palpate the bony structures of the pelvis and lower spine for tenderness. Some clinicians also recommend a cautious, one-time only inward compression maneuver of the iliac crests to assess for instability.

Prehospital assessment

The most common mechanism of injury resulting in pelvic fracture is road traffic collisions (20–66%), with an increased likelihood if the patient is sitting in the front of the vehicle in head on collisions, on the struck side or with near intrusion. Pelvic fractures resulting from pedestrian collisions (14–59%) and motorcyclist collisions (5–9.3%) are also common.[2] Falls from heights, or from a low level by elderly patients with osteoporosis are also implicated in the aetiology and, more rarely, crush injuries.

Pelvic fractures should be identified by the circulatory assessment of the CAcBCDE assessment following resuscitation of catastrophic haemorrhage, airway and breathing problems.

Traditional teaching encourages the practice of “springing” the pelvis as part of this assessment to identify tenderness or instability as an indicator of pelvic fracture and therefore a source of internal haemorrhage.[4] A variety of methods of springing have been described: most involve compression or distraction of the fracture site. However, the current belief is that this is an unreliable test, which will only detect major pelvic disruption and is dangerous in dislodging clots and promoting further blood loss.

The prehospital practitioner first needs to assess the mechanism of injury to be able to predict a potential pelvic fracture.

Alerting features suggestive of significant pelvic injury during examination include deformity, bruising or swelling over the bony prominences, pubis, perineum or scrotum. Leg-length discrepancy or rotational deformity of a lower limb (without fracture in that extremity) may be evident. Wounds over the pelvis or bleeding from the patient's rectum, vagina or urethra may indicate an open pelvic fracture.

Neurological abnormalities may also rarely be present in the lower limbs after a pelvic fracture. Discrete rectal or vaginal bleeding or a high-riding prostate will not be detected in the prehospital environment.

In the alert, orientated, cooperative patient with no distracting injury, it will be possible for the prehospital practitioner to ask the patient about the presence of pain in the pelvic area, including the lower back (assessing the sacroiliac joint), groin and hips. Any positive reply should call for routine immobilisation of the pelvis. In the absence of any symptoms or signs of pelvic fracture as described above, discharge from scene is an option, provided there are no other injuries requiring transfer to a hospital.

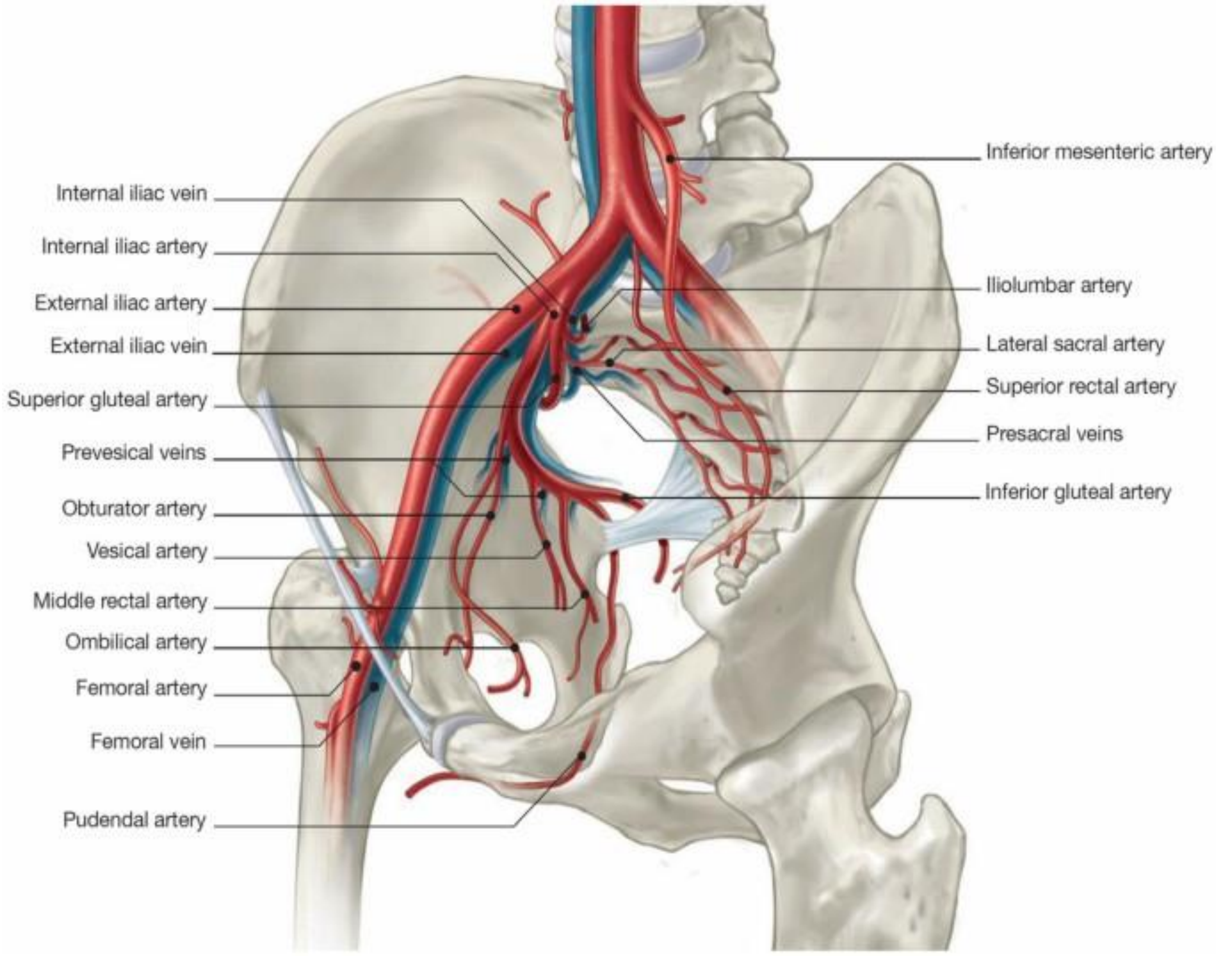
In the case of the unresponsive trauma patient, the pelvis should not be palpated for tenderness or instability. A pelvic fracture should be assumed to be present and routinely immobilized.

Haemorrhage control

The initial management of patients presenting with pelvic fracture and haemodynamic instability remains difficult. An early evaluation of severity is essential in these patients, many of whom have suffered multiple trauma. The immediate risk to life is linked to the possible occurrence of refractory haemorrhagic shock, with the associated major coagulation disorders.

Pathophysiology of haemorrhage in pelvic fractures

Most pelvic fractures result from motor vehicle accidents, but severe complex pelvic fractures may also result from falls from buildings [5]. The pelvic ring is much more solid than many other bone structures, and high-energy trauma is required to disrupt this complex. Consequently, these fractures are rarely found in isolation, and patients with pelvic fractures often have multiple trauma. The seriousness of pelvic fractures lies in the possible occurrence of retroperitoneal haematomas and haemorrhagic shock [6]. The pelvic ring is anatomically connected to a large number of blood vessels (Figure 1). The internal iliac (or hypogastric) artery originates in the sacro-iliac joint and gives rise to the superior and inferior gluteal arteries. The external iliac artery follows an oblique path, in front of the arcuate line. The venous system follows a pattern similar to that of the arterial system, but in a more posterior position. In older series, haemorrhage was the main cause of death (two-thirds of cases) in patients presenting with pelvic fracture [7]. Mortality rates of 40% to 80% have been recorded in patients with major haemodynamic instability [8]. Recent progress in resuscitation, medical, surgical and endovascular techniques has made it possible to decrease the overall mortality rate, which nonetheless remains at about 20% [8].



Retroperitoneal haematoma

Retroperitoneal haematomas in patients with pelvic fracture are secondary to the vascular and/or bone lesions that may cause massive haemorrhagic syndrome. Vascular lesions are more frequently venous (90%; mostly lesions of the presacral or prevesical veins) than arterial (10%; trunk or distal lesions) [9]. However, arterial lesions are more frequent in cases of haemodynamic instability [10]. Traumatic vascular damage is frequently bilateral. Clinical experience is that bleeding of venous origin may stop spontaneously if the local venous pressure and the pressure of the retroperitoneal space equalize. However, in cases of pelvic fracture, the retroperitoneal diffusion space is profoundly modified; the retroperitoneal space may indeed cease to be 'closed'. Grimm and coworkers [11] showed that, for a given pressure, four times more liquid could be injected into the retroperitoneal space following an 'open book' type fracture than in the absence of fracture. This increase in injectable volume probably reflects diffusion beyond the retroperitoneal space. The volume of the retroperitoneal space may thus reach up to 4 litres. This is of particular importance for treatment, because the theoretical efficacy of pelvic ring fixation is based on the principle that the retroperitoneal space is closed or can be closed by fixation of the pelvic ring.

Traditional teaching advises that the emergency management of pelvic fractures includes internal rotation of the lower limbs to reduce the pelvic volume and circumferential wrapping of a sheet around the pelvis as a sling.[4] Reduction and stabilisation of pelvic ring injuries should occur as soon as possible after injury, while clotting mechanisms are still intact, before irretrievable haemorrhage has occurred and before the patient's movement and transport.

Haemorrhage after a pelvic ring fracture commonly occurs from injury to the sacral venous plexus, branches of the hypogastric artery, the fracture surfaces and surrounding soft tissue injury. With circumferential pressure and stabilisation, bony bleeding is reduced by apposition of the fracture site, and the reduced movement of bone ends prevents disruption of a formed clot. The increase in volume of the true pelvis, which results from a fracture with massive diastasis, is fairly small, and therefore it is unlikely that the mechanism of reducing pelvic volume by external reduction will create a tamponade effect. Haemodynamic stability may be achieved after reduction and stabilisation of a pelvic ring fracture in the absence of a major arterial injury. Hypotensive shock on admission to hospital correlates with mortality.[12]

Successful realignment of open-book fractures with basic methods of applying a circumferential bedsheet were described in case reports of one patient in 1997 and of two patients in 2002.[13] The authors acknowledged that the use of bed sheets was an inexact and irreproducible method. There is no control over how tightly the sheet should be applied, they are sometimes a challenge to secure with sufficient reduction force and it is not certain whether overcompression of fractures could occur from using this method.

Pneumatic anti-shock garments also known as military or medical anti-shock trousers or G suits, have also been a popular choice for splintage of pelvic fractures.[14] However, their use restricts critical access to the abdominal and pelvic area, they are difficult to apply and do not allow for controlled pelvic reduction. Prospective randomised studies have not shown any definite benefits in reducing mortality or hospital/intensive care length of stay, and there are potential complications from their use related to compression of the lower extremities and abdomen.[14]

External fixators are clearly not practical for use in the prehospital environment, are often applied incorrectly and are associated with a high rate of complications (up to 47%). Meighan et al [15] interviewed 31 major accident units in Scotland to determine their ability to stabilise a pelvic fracture if a patient were to present to their department. Only 8 of 31 (25.8%) departments would have been able to potentially stabilise a pelvis within 1 h. Eight units had no appropriate emergency treatment devices available at all. Therefore, a pelvic splint that can be applied in a prehospital setting is a rapid, safe alternative for haemorrhage control, and equally has benefits as a simple method for use by the junior medical and nursing staff in an emergency department setting.

An improvised use of splints, which has been suggested, is to use a Kendrick extrication device, slid under the patient upside down (with the head support towards the feet) and the straps secured around the waist and legs. This also does not use a specific amount of tension.

Vermeulen et al [16] first described the prehospital use of an external pelvic compression belt (Geneva belt) in a series of 19 patients in 1999. Their device was applied by paramedics at the accident scene within 3 seconds on clinical suspicion of unstable pelvic fractures. Thirteen patients were found to have a pelvic ring lesion. Of note were two patients who showed no abnormalities on an initial pelvic x ray despite fractures being present, thus proving adequate reduction by this method.

Since then, a variety of commercial material compression splints have been manufactured. Examples include the Stuart splint, the London splint, the Dallas pelvic binder and the Trauma Pelvic Orthotic Device (Cybertech Medical TM, California, USA). They are generally applied at the level of greater trochanters/symphysis pubis directly on to the patient's skin.

One study determined the mean (SD) force required to reduce unstable open book pelvic fractures (180 (50) N) on cadaveric models. This led to the development of new commercial splints (SAMsling, SAM Medical Products TM, Oregon, USA), which use controlled and consistent stabilisation with an autostop buckle to reduce the risk of overcompression in case of internal rotation injuries of the pelvic ring. Krieg et al [17] used this device to temporarily stabilise pelvic fractures in 13 patients (6 unstable fractures) and reported effective reduction based on radiological findings, with an absence of complications and anecdotal evidence of pain relief in several alert patients.

A review of the literature found only one case report of complications (bilateral peroneal nerve palsy) after the application of an “external non-invasive compression device”. In this example, sheets were wrapped around the patient at the level of the pelvis, knees and ankles. Therefore, direct compression over the fibula heads was the cause, which is not applicable to the use of a pelvic compression splint.

Effective anatomical reduction described by Vermeulen et al [16] was also described in two case reports in 2005. Both patients had pelvic fractures detected by a plain x ray as part of the trauma series. An external compression splint (Stuart pelvic harness) was applied, after which the patient underwent computed tomography scanning that showed almost complete anatomical reduction. This highlights the need for prehospital practitioners to ensure that the receiving emergency department is aware that the pelvic splint should remain in situ throughout resuscitation, should not be removed prematurely and that imaging may appear normal despite the presence of relevant fractures. If initial plain x rays show no evidence of fracture but clinical suspicion is high, it would be advisable to slightly loosen the splint and repeat the plain x ray or to proceed with computed tomography imaging.

Fluid resuscitation

After the arrest of external haemorrhage and splintage of pelvic and femoral fractures, fluid resuscitation should be considered based on the presence or absence of a radial pulse. Cannulation should take place en route to avoid unnecessary delays in the transport to definitive care and only two attempts should be made (the exception to this being where intravenous access is necessary in a stable patient for analgesia to facilitate patient handling). Boluses of 250 ml normal saline should be titrated until restoration of the radial pulse. [18]

Transport and handover

The patient should be provided with analgesia if awake, haemodynamically stable and complaining of pain, before movement. Cannulation should not delay transport to the hospital in the critically injured or unstable patient.

Following application of pelvic splint, the patient should have a scoop stretcher placed under the body, with a maximum log roll of approximately 15° to facilitate positioning. The scoop can then be lifted directly on to an ambulance trolley cot, a spinal board or a vacuum mattress for transportation. On arrival at the emergency department, the patient can be moved on to the hospital trolley using a scoop stretcher which can be split and removed to avoid pressure complications.

Prehospital practitioners should select the most appropriate emergency department facility with trauma capabilities for their patient.

The handover to hospital staff should include information that the pelvic splint should not be removed until an assessment has been made by senior medical staff in the emergency department. This clinician should recognise the risk of removing a properly applied splint in the presence of a suspected unstable pelvic injury. In these cases, the pelvic splint should not be removed until radiology excludes a fracture (beware of false reassurances from anatomical reduction by splint) or the patient is in a theatre where direct haemorrhage control can be undertaken.

Conclusion

Pelvic fractures can range from benign to life-threatening depending on the mechanism of trauma, the extent of vascular injury and the severity of coexisting organ damage. Because pelvic deformities can be difficult to detect and the resulting internal hemorrhage is unseen, timely diagnosis of pelvic injuries is a challenge in the prehospital setting. It's important for all providers to remember that in a blunt trauma patient with altered mental status or a distracting injury, the ability to assess for a pelvic injury is extremely unreliable. However, by maintaining a high, on-scene suspicion for the presence of a pelvic fracture, EMS providers are uniquely positioned to improve outcomes through rapid pelvic stabilization, calculated resuscitation and timely transport.

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This study was carried out with the financial support of the
National Research and Development Agency within the framework of a research project
no. 20.80009.8007.07