

An algorithm to avoid missed open-book pelvic fractures

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Abstract. – OBJECTIVE: In polytrauma patients, to limit the pelvic space favouring internal bleeding, the use of pelvic binders is now a standard practice. In case of external pelvic binder placement with anatomic reduction of the symphyseal and sacroiliac joints, delayed diagnosis and missed injuries could occur. The aim of this study is to document the risk of missed diagnosis, as well as to identify a possible algorithm for optimal management of traumatized patients with pelvic binders, in order to reach an early diagnosis of pelvic fractures without additional risks.

CASE REPORT: We report three cases of open-book pelvic fractures that were initially missed. The external pelvic binders applied had adequately reduced the fractures. The computed tomography on arrival excluded a diastasis of the symphysis pubis. On removal of the pelvic binder and repetition of the radiological imaging, the fractures were evidenced.

CONCLUSIONS: We have accordingly created an algorithm for polytrauma patients to determine when the pelvic binder should be released before radiological imaging and when repeated radiological imaging should be done. The use of this algorithm in trauma centers will help to reduce the number of missed injuries, and the number of late diagnoses as well as will increase the patient survival rates.

Key Words:

Pelvic fracture, Trauma, Missed injuries, Pelvic binder.

Introduction

Pelvic fractures are indicators of high-energy trauma and important energy transfer, as can be encountered in traffic accidents, falls from heights as well as crush injuries. During the initial assessment of patients with major trauma, pelvic fractures are one of the potentially life-threatening injuries encountered¹.

Pelvic fractures have a mortality rate that reaches 30% and even raises to 60% if associated with significant pelvic bleeding². To limit the pel-

vic space favoring internal bleeding, as well as the bleeding from the fracture fragments, the use of pelvic binders is now a standard practice^{3,4}.

Computed tomography (CT) of the pelvis is reported to have a sensitivity and specificity of almost 100% in the diagnosis of pelvic injuries⁵. However, in case of external pelvic binder placement with adequately approximated symphyseal and sacroiliac joints^{6,7}, delayed diagnosis and missed injuries could occur^{7,8}. Nonetheless, pelvic binders are routinely used also during early imaging evaluation to avoid the risk of major bleeding. In this context, in polytrauma patients, it remains controversial when the pelvic binder should be released prior to radiological imaging and when repeated radiographs or CT scans should be done.

Thus, the aim of this report is to document the risk of missed diagnosis, as well as to identify a possible algorithm for optimal management of traumatized patients with pelvic binders, in order to reach an early diagnosis of pelvic fractures without additional risks.

Clinical Presentations

Case Report 1

A 59-year-old patient fell on a steep snowy slope in the mountains. He slipped for about 80-100 meters until he hit the rocks hitting roughly his pelvis. On the arrival of the helicopter and the emergency medical personnel, the patient was found in a dangerous position with a risk of falling further. He was immediately accompanied away from the site, and the Advanced Trauma Life Support (ATLS) protocol was applied. The patient had no respiratory distress but showed signs of haemodynamic instability with a blood pressure of 90/70 mmHg, and thus 500 ml of crystalloid isotonic solution were administered by the emergency medical personnel as well as 1g of tranexamic acid. Suspecting a pelvic fracture, the pelvic binder was applied.

Upon arrival of the patient at the regional trauma center, the primary and secondary surveys demonstrated a blood pressure of 120/80 mmHg, multiple abrasions of the left arm, a 3 cm laceration of the palmar surface of the right wrist, a hematoma of the right gluteus as well as painful palpation of the sacrum. Due to the mechanism of injury and the suspicion of lumbar and pelvic fractures, a computed tomography scan was performed (Figure 1) with the pelvic binder in place. The radiologist on call referred a fracture of the transverse process of L5. As for the pelvis, apart from a fracture of the right iliac crest, no other injuries were detected. The pelvic binder was therefore removed.

Due to the persistence of pelvic pain, which was attributed to the fracture of the transverse process of L5, after 6 weeks a conventional radiograph (Figure 1) of the pelvis was performed, documenting a widening of the symphysis of approximately 12 mm. Consequently, the patient underwent a surgical pelvic stabilization with no complications, and the patient was discharged on the 8th postoperative day.

Case Report 2

A 34 year-old-male fell from approximately 6 meters from the window of his apartment. On arrival of the helicopter and the emergency medical personnel, the ATLS protocol was applied. The patient had an evident head injury with a Glasgow Coma Scale (GCS) of 4. Because of the GCS below 8 associated with respiratory distress, the patient was sedated and intubated. No haemodynamic instability was detected. Due to the mechanism of injury, the emergency medical personnel applied the pelvic binder.

The patient arrived at the regional trauma center sedated, intubated, haemodynamically stable and with a Cerebral Perfusion Pressure of 56 mmHg. A right gluteal hematoma was noted. The total-body CT scan showed an occipital cranial fracture with subdural hemorrhage, minimal frontal subarachnoid hemorrhage, a pulmonary contusion with associated pneumothorax, mul-

multiple rib fractures, a scapular fracture, multiple fractures of the transverse processes as well as a renal contusion. No pelvic fractures were observed (Figure 2). During the patient's hospitalization, the pain at the right gluteus was in gradual regression, and the patient started full weight-bearing with the help of crutches. He was transferred after 18 days to a rehabilitation clinic.

At the follow-up 6 weeks later, a pelvic radiograph was done because of the persistence of pain at the right gluteus. A dislocation with a vertical shift of the pelvis was shown (Figure 2). An open reduction and internal fixation of the pelvic ring were refused by the patient. At the 6-month follow up, the patient reported complete resolution of the symptoms and resumption of his work and sports activities. The control pelvic radiograph showed no further dislocations.

Case Report 3

A 53-year-old male had a motor vehicle collision in which he had a frontal accident against a car while driving his motor scooter. On arrival of the emergency medical personnel, the ATLS protocol was applied. Because of extreme pain and compromised haemodynamics, the patient was sedated and intubated. Further 1500 ml of crystalloid isotonic solution were administered by the emergency medical personnel. Due to the mechanism of injury, the emergency medical personnel applied the pelvic binder.

The patient arrived at the regional trauma center sedated, intubated, with a blood pressure of 80/50 mmHg and a heart rate of 130 bpm. After fluid resuscitation, haemodynamically stable. Clinically, the patient presented an open fracture of the left femur, a subamputation of the left foot and suspicion of fractures of the left wrist and right leg. A total-body CT scan was performed, which excluded thoracic or abdominal injuries but showed multiple limb fractures without signs of pelvic fracture (Figure 3).

On the 1st day of recovery, during the revision of the leg amputation, a pelvic instability was detected by fluoroscopy (Figure 3). Open reduction

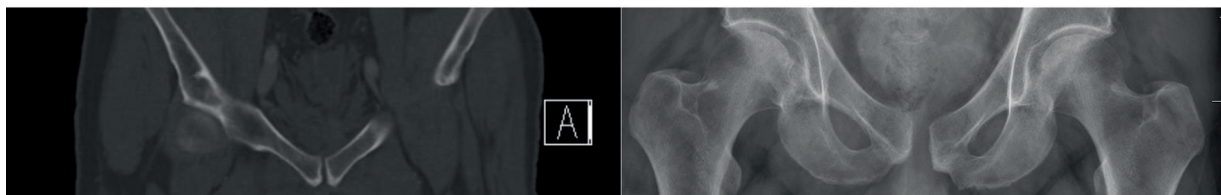


Figure 1. Case report no. 1

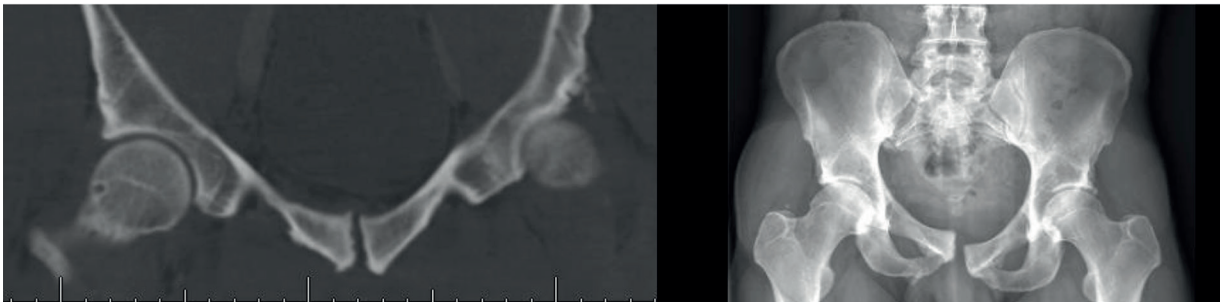


Figure 2. Case report no.2.

and internal fixation of the symphysis pubis was thus performed in the following days. During his hospital stay, the patient developed pneumonia and deep venous thrombosis which were treated with antibiotics and anticoagulants respectively. He was discharged on the 33rd postoperative day.

Discussion

Our report demonstrates that delayed diagnoses and missed injuries of open book fractures of the pelvis could occur in optimally placed pelvic binders resulting in reduced and stabilized pelvic injuries. Occurrences of 1.3 up to 47% of delayed diagnoses and missed injuries have been reported in patients with multiple injuries after trauma⁹.

Recent reports by Fletcher et al¹⁰ and Bayer et al¹¹ have also reported initially missed pelvic injuries as a result of the anatomical reduction by the pelvic binder. A review article by Chesser et al¹² has highlighted some controversial issues regarding the use of pelvic binders as well. Missed diagnosis of pelvic instability on primary survey radiographs is one of those.

Since unstable pelvic fractures occur in up to 20% of all pelvic fractures¹³, the ATLS guidelines¹⁴ advise placing a pelvic binder in the pre-clinical setup before transporting the patients. Studies¹⁵ have demonstrated that bleeding from

pelvic fractures is responsible for up to 23% of deaths due to haemorrhage as a consequence of trauma. Hemorrhage originates from the presacral venous plexus, the iliac vessels, as well as from cancellous bone surfaces. Mortality rates could reach up to 60% if associated with significant pelvic bleeding². By reducing and stabilizing the fractures, pelvic binders limit the potential space for pelvic bleeding as well as the bleeding from the fracture fragments^{3,4}. Consequently, mortality rates associated with pelvic injuries are also reduced¹⁶. Even though pelvic binders are an excellent mean of stabilizing pelvic-ring injuries, they are a temporary measure awaiting permanent stabilization. Trauma centers are encountering an increasing number of patients with pelvic binders. While in the past physical pelvic examination was crucial to detect tenderness or instability as a sign of pelvic injury⁹, recent studies^{1,14} recommend deliberately omitting physical examination in unresponsive or haemodynamically unstable trauma patients with signs of pelvic trauma in the pre-clinical stage and instead placing the pelvic binder.

The 24-hour availability as well as the high sensitivity and specificity of CT scans render it an essential tool in the emergency department. CT scans allow an easier assessment of the spatial fragments and allow reformatting of three-dimensional images¹⁷. Beside the use of these images in pre-operative planning, CT scans put in eviden-



Figure 3. Case report no.3.

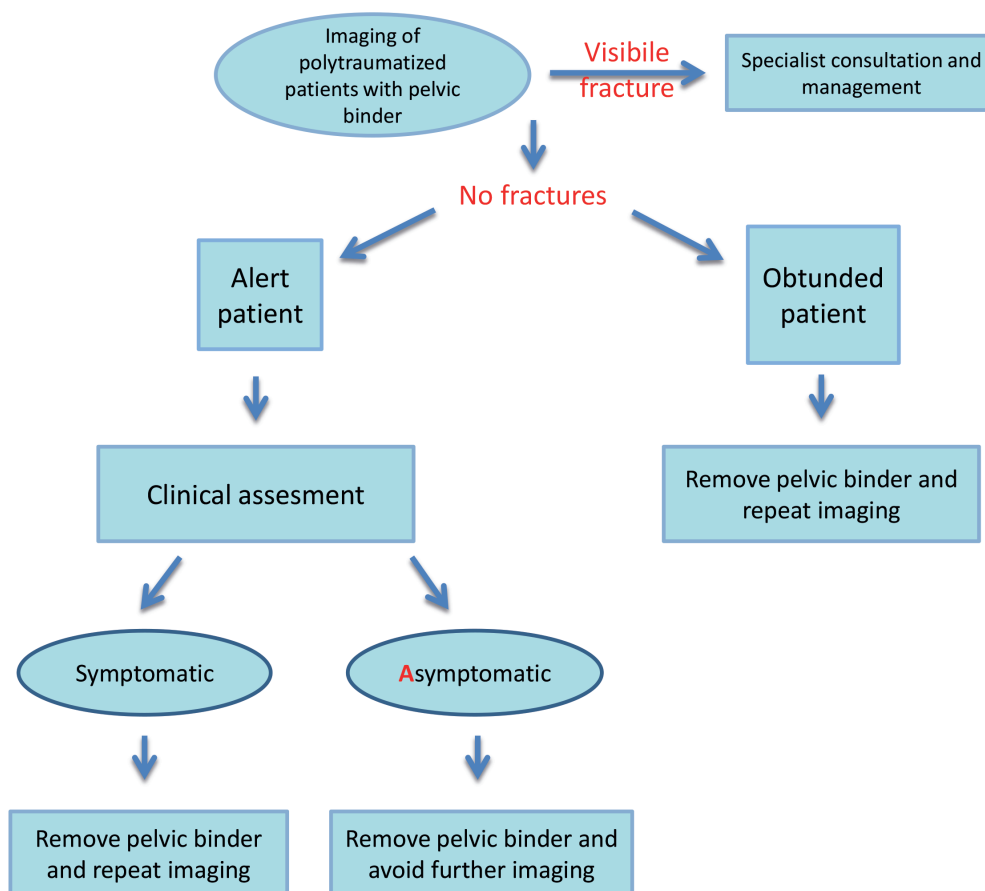
ce subtle fractures and displacements not easily noticed on plain radiographs thus finally contribute in reducing the number of pelvic injuries missed¹⁸. However, even though CT of the pelvis is reported to have a sensitivity and specificity of almost 100% in the diagnosis of pelvic injuries⁵, in case of external pelvic binder placement, if it has adequately approximated the symphyseal and sacroiliac joints^{6,7}, delayed diagnosis and missed injuries could occur^{7,8}.

Due to fear of disturbing initial clot formation and the high mortality associated with haemorrhage in pelvic fractures¹⁹, the emergency department staff and orthopedic surgeons show an appropriate reluctance to remove a pelvic binder before primary survey radiography is performed even though there are no reports that demonstrate that its removal could cause haemodynamic instability. Taking in consideration the few numbers of cases encountered in the report, one can sum this data with the other studies in the field to obtain substantial information and deductions.

As above mentioned – even though the CT scans were initially reported as normal – such cases could have been diagnosed earlier by systematic evaluation and clinical suspicion. Clearly, clinical examination is sometimes limited in polytraumatized patients (intubation, reduced consciousness, etc.). However, if clinical suspicion remains, repeated radiographs or CT scans should be performed after removal of the pelvic binder, due to the possibility of masking an open-book fracture with a correctly applied external stabilizer, resulting in anatomical reduction. The management algorithm for such patients should, therefore, consider this aspect and adopt the proper measures to optimize their treatment.

Conclusions

We have created an algorithm for polytrauma patients to determine when the pelvic binder should be released prior to radiological imaging and when repeated radiological imaging should be done (Flow chart).



Flowchart

Since haemodynamic stability is our premier concern, it is safer to keep the pelvic binder in place until radiographic analysis or until operative intervention. In alert, oriented and collaborative patients, clinical assessment is what guides our management. If the patient refers pain in the pelvic area under physical examination, we recommend repeating the imaging technique after removing the pelvic binder. If the patient is asymptomatic, we remove the pelvic binder and avoid further pelvic imaging. In cases of obtunded patients though, our advice is to remove the pelvic binder and repeat imaging (x-Ray or CT scan) to exclude missed sacroiliac joint or symphyseal widening.

The use of this algorithm in trauma centers will help to reduce the number of missed injuries and the number of late diagnoses without additional risks, in the end improving patient management and survival rates of open-book pelvic fractures.

Conflict of Interest

The Authors declare that they have no conflict of interest.

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