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PELVIC FRACTURES, EPIDEMIOLOGY, ANATOMY, MECHANISM OF INJURY, CLASSIFICATION, IMAGING PRESENTATION, CLINICAL PRESENTATION, MANAGEMENT AND COMPLICATIONS

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SUMMARY

Introduction: *Open fractures of the pelvis represent one of the most fatal injuries within musculoskeletal trauma so they must be treated correctly, adjusting to a multidisciplinary approach to achieve the well-being of the affected person, in addition to restoring homeostasis and normal pathophysiology related to the mechanical stability of the pelvic ring.*
Objective: *to detail current information related to pelvic fractures, epidemiology, anatomy, mechanism of injury, classification, imaging presentation, clinical presentation, management and complications.*
Methodology: *a total of 27 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 20 bibliographies were used because the other articles were not relevant for this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: fracturas de pelvis, fraturas do anel pelvico, anatomy of the pelvis, fractures of the pelvis.*
Results: *Most cases of pelvic fractures occur in young people due to high-energy mechanisms, although injuries can also be generated by low-energy mechanisms and can cause fractures of individual bones. Mortality is higher in individuals with hemodynamic instability. The standard imaging examinations in trauma are anteroposterior projections of the thorax, lateral cervical spine and anteroposterior projections of the pelvis; special projections of the pelvis include the oblique alar and obturator projections. The severity of pelvic fractures is closely related to the associated injuries.*
Conclusions: *Knowledge of anatomy is a fundamental piece in the treatment of pelvic fractures and associated injuries. There are several systems for classifying pelvic fractures, according to anatomical patterns, mechanisms of injury, resulting instability requiring surgery. The most frequently used is that of Young and Burgess. For evaluation, one should start with the ABCDE, airway, breathing, circulation, disability, and exposure and integrate a complete traumatologic evaluation. To determine whether there is pelvic instability, the anteroposterior and lateral compression test is performed*

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for one occasion, generating internal and external rotation of the pelvis. The spine and extremities should be well assessed with an adequate neurovascular examination and a thorough neurological examination. In pelvic fractures, management and treatment begins with ABCDE. Followed by stabilization of the patient, a multidisciplinary approach is required. External or internal fixation can be performed to stabilize the pelvis, its use and recommendation usually vary according to the characteristics of each fracture, the associated injuries and the instability of the pelvic ring. Pelvic trauma with involvement of the acetabulum and injuries to the genitourinary system should not be underestimated. Complications include infection, thromboembolism, malunion and pseudarthrosis.

KEY WORDS: *fracture, pelvis, pelvic ring, pelvic trauma.*

INTRODUCTION

Open fractures of the pelvis represent one of the most fatal injuries within musculoskeletal trauma and must be treated correctly, following a multidisciplinary approach. Traumatic injuries can present themselves in different ways, both as small wounds and as severe and difficult to manage injuries that can lead to shock, as well as organic damage or multisystemic dysfunction, so adequate management and timely treatment should be provided, focused on the prevention of bleeding and infections that can trigger sepsis. Some fracture traces or subtypes of pelvic fractures do not generate rupture of the ring, as is the case of fractures of the iliac wing, which in most cases can be treated conservatively. It should be taken into account that pelvic fractures can be linked to other types of injuries, hip dislocations, fractures of the acetabulum, which can appear together with high-energy trauma. For all patients with pelvic trauma, management has to take a multidisciplinary approach, focusing on the well-being of the affected person, in addition to restoring homeostasis and normal pathophysiology related to the mechanical stability of the pelvic ring; therefore anatomy and physiology are cornerstones in the management of patients with this condition. Management of associated soft tissue injuries should be effective, using broad spectrum antibiotic therapy, proper debridement and wound irrigation. Selective fecal detour, based on the location of the wound, is mandatory and safe, which reduces the risk of infection and sepsis, in addition to reducing the mortality rate(1-4).

METHODOLOGY

A total of 27 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 20 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: fracturas de pelvis, fraturas do anel pelvico, anatomy of the pelvis, fractures of the pelvis.

The choice of the bibliography presents elements related to pelvic fractures, including epidemiology, anatomy, mechanism of injury, classification, imaging presentation, clinical presentation, management and complications.

DEVELOPMENT

Epidemiology

Most cases of pelvic fractures occur in young people from high-energy mechanisms; however, the elderly often present with these fractures with milder trauma, such as a fall from a minimal height. Pelvic trauma is usually dangerous and can be life-threatening. Pelvic trauma occurs in 3% of skeletal injuries and has a high mortality rate, especially in individuals with hemodynamic instability. Some authors show that the average incidence is between 15 and 28 years of age, with males under 35 years of age being generally affected, and in the case of females, those older than 35 years(1-3,5-8).

A clinical article shows that the incidence of urological trauma in pelvic fractures with acetabular involvement was 2.4%, with a mean age of 45 years; the male-female ratio was 2.1:1. It also showed that the most frequent associated injuries were urethral injuries with 43%, followed by bladder injuries with 32%, followed by the combined injuries of these 2 previous ones with 11%, related to high energy pelvic trauma and renal injuries with 14%, the latter being associated with isolated acetabular fractures. On the other hand, other trials present different results, detailing that open pelvic fractures are infrequent, but with a significant morbidity, with a high survival rate, and without significant difference in survival between individuals with closed or open pelvic fractures, presenting 14% and 4% mortality respectively. The attached bibliography reports mortality between 4 and 45%. Associated risk factors are being over 50 years old and coagulopathy(9-11).

Anatomy

The pelvic ring is formed by 2 innominate bones and the sacrum, linked anteriorly at the symphysis pubis and posteriorly at the 2 sacroiliac joints. An innominate bone is formed by the union of three ossification sites: ilium, ischium and pubis, connected by the triradiate cartilage at the dome of the acetabulum. The true or minor pelvis holds the pelvic viscera. The false or greater pelvis, formed by the lower part of the abdominal cavity. The stability of the pelvis is provided by the ligamentous complexes, which are classified into 2 according to their insertions:

- Sacro-ilion union: the ligamentous components on the posterior aspect of the pelvis are the most resistant, the most stabilizing, joining the sacrum with the innominate bones. The sacroiliac ligamentous complex fragments into the anterior ligaments and the posterior ligaments including the long and short ligaments. The sacrotuberous ligament and the posterior sacroiliac ligaments maintain the vertical stability of the pelvis. The sacrospinous ligament supports rotational control of the pelvis.
- Pubis-pubic junction: there are the ligaments of the symphysis.

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The ligaments that run from the lumbar spine to the pelvic ring provide complementary stability:

- Iliolumbar ligaments.
- Lumbosacral ligaments.

Ligaments that are located transversely and resist rotational forces.

- Short posterior sacroiliac.
- Anterior sacroiliac.
- Iliolumbar.
- Sacrospinous.

Ligaments that are located vertically and resist shear forces:

- Long posterior sacroiliac.
- Sacrotuberous.
- Lateral lumbosacral ligaments(4-6).

In summary, on the anterior aspect of the pelvic ring, the ligaments of the symphysis hold against external rotation through the sacroiliac joints posteriorly. Posteriorly the posterior sacroiliac complex and the ligaments of the pelvic floor stabilize the pelvic ring. The posterior sacroiliac complex is the most important ligamentous structure for the stability of the ring. Because of the high soft tissue damage associated with pelvic ring injuries, injuries should be ruled out:

- Vascular.
- Neurological.
- Visceral.

The venous plexus in the posterior pelvis shows most of the related hemorrhages. The corona mortis is an anastomosis between the obturator artery and the external iliac artery, its damage in surgery can cause the death of the patient due to hemorrhage(3,4).

Stability of the pelvis

It is called a stable lesion when it can withstand physiological forces without generating a pathological deformity. Infrequently, perforating traumas cause destabilization of the pelvic ring. Unstable injuries are usually grouped according to the type of displacement:

- Rotational instability: open pelvis accompanied by external rotation or compressed pelvis plus internal rotation.
- Vertical instability: anatomical studies with successive section of the pelvic ligaments establish the apparent participation of each of these to the stability of the pelvis:
  - Isolated symphysis: diastasis pubis 2.5 cm.
  - Symphysis and sacrospinous ligaments: diastasis pubis > 2.5 cm; rotation and not of a vertical or posterior displacement.
  - Sacrotuberous, sacrospinous and posterior sacroiliac symphysis and ligaments; vertical, rotational and posterior instability(5,6).

Mechanism of injury

It can be divided into high and low energy mechanisms:

- High energy: these are usually generated in traffic accidents, falls from great heights, run over, crushing, motorcycle accidents; they are associated with pelvic ring ruptures.
- Low energy: these are usually generated in trauma with mild impact, avulsion injury by intense muscle contraction, straddle falls; and are associated with fractures of individual bones.

In addition, injuries may occur due to:

- Crushing: entrapment between injurious forces. The duration, position and type of force applied must be taken into account.
- Impact: impact of a moving object against a stationary object. The type of fracture varies according to the magnitude, direction and nature of the force.

Point patterns of injury differ according to the direction of force application:

- Anteroposterior force: external rotation of the hemipelvis. generates opening of the pelvis, by rotating over intact posterior ligaments.
- Lateral compression force: associated with impaction of the cancellous bone. The pattern of injury depends on the site of force application:
  - Posterior half of ilium: generally stable with minimal soft tissue injury.
  - Anterior half of the iliac wing: internal rotation of the hemipelvis. It breaks the posterior sacroiliac ligament complex. May cause displacement of the contralateral hemipelvis in external rotation, forming an ipsilateral lateral compression injury, in addition to a contralateral external rotation injury.
  - Greater trochanter region: related to transverse acetabulum fractures.
- Abduction and external rotation force: can split the sacral hemipelvis when energy passes through the diaphysis and femoral head, with the leg undergoing external rotation and abduction.
- Shear force: usually results in a fracture with triplanar instability subsequent to impairment of the sacrotuberous, sacroiliac and sacrospinous ligaments.

In older individuals, bone resistance in the great majority of cases is diminished in comparison with ligaments, generating bone deterioration before ligamentous deterioration. On the other hand, in young individuals, bone resistance is greater, generating ligament deterioration before bone deterioration(2,4-6,12).

Clinical Evaluation

In these cases, the ABCDE, airway, breathing, circulation, disability, and exposure should be started and a complete traumatological evaluation should be integrated. Correct and early resuscitation is important, as well as treating life-threatening injuries, evaluating and identifying head, thoracic, abdominal and spinal injuries, without forgetting injuries to the limbs and pelvis,

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focusing on the distal neurovascular condition. To find out if there is pelvic instability, the anteroposterior and lateral compression test is performed for one occasion generating internal and external rotation of the pelvis. A dysmetry plus shortening on the affected side can be observed, as well as an alteration of the lower limb in internal or external rotation. When the first clot formed in a retroperitoneal hemorrhage is destructured, the elaboration of a subsequent one is relatively complex due to the hemodilution generated by the administration of intravenous fluids added to the depletion of the previous coagulation factors, for which reason it is traditionally said that the first clot is the best. Bruising in the region alerts us that a major hemorrhage has occurred. We should also assess for defects that indicate a sacroiliac fracture, sacroiliac dislocation or alterations in the symphysis, with emphasis on looking for signs of an open fracture. As far as possible, rectal and vaginal examination should be performed in polytraumatized individuals with fracture with rupture of the pelvic ring, since an undiagnosed perforation of any of these increases mortality. The spine and extremities should be well assessed accompanied by an adequate neurovascular examination and a thorough neurological examination(3-6,11).

Figure 1. X-ray showing fracture of the pelvis with external fixator placement.

Source: the authors.

Hemodynamic Status

The most common origin of retroperitoneal bleeding secondary to pelvic fracture is rupture of the venous plexus in the posterior pelvis. Retroperitoneal bleeding can be massive. Bleeding may also come from external or internal iliac impairment, leading to heavy bleeding with loss of distal pulses and hemodynamic instability. It is advisable to control bleeding proximally prior to surgical repair. Superior gluteal artery injury can be managed with rapid fluid replacement, pelvic stabilization and embolization. In addition to abdominal bleeding, intrathoracic, retroperitoneal and compartment bleeding should be ruled out(3,5,6).

For timely management and control of bleeding are available:

- MAST, military anti-shock trouser.
- Anterior external fixator.
- Pelvic girdle or hammock around the pelvis.
- Vacuum stabilizing support or bean bag.
- Posterior pelvic clamp or C-clamp.
- Open reduction and internal fixation.
- Open packing of the retroperitoneum.
- Angiography and embolization if bleeding remains after closing the pelvic diameter.

Pelvic bleeding is related to 50% of individuals who die after a pelvic fracture(3,5,6,13,14).

Neurological Injury

There are usually alterations in the nerve roots and the lumbosacral plexus; the more medial the sacral fracture is, the more the incidence of neurological lesions increases. In the patient with loss of consciousness it is more complex to demonstrate the previously mentioned lesions(5).

Genitourinary and gastrointestinal injuries.

Bladder injuries are present in 20% of pelvic trauma and urethral injuries are present in 10%, the latter with a higher incidence in men compared to women. Intraperitoneal injuries require surgical repair; in extraperitoneal injuries when the urethra is not permeable, a Foley catheter or a suprapubic size is placed, care should be taken to find bleeding on catheterization or in the urethral meatus. When there is suspicion, retrograde urethrography should be performed. Individuals with hematuria and an intact urethra should be referred for cystography, under suspicion of bladder injury. Rectal examination should be evaluated for the possibility of having a floating or high prostate. Perforations in the rectum or anus by bone fragments should be

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treated as open fractures. If intestinal entrapment is generated causing obstruction related to the fracture, a discharge colostomy is recommended. Rectal laceration points out the importance of injury to the individual and the increased risk of death(3,5,15).

Figure 2. Intraoperative pelvic fracture stabilized with external fixator, showing bladder injury.

Source: the authors.

Imaging Assessment

The standard imaging tests in trauma are the anteroposterior projections of the thorax, lateral cervical spine and anteroposterior projection of the pelvis.

Anteroposterior projection of the pelvis: this can evaluate previous injuries such as fractures of the pubic branches and displacement of the symphysis; in addition to injuries of the sacroiliac joint, sacral fractures, iliac fractures and fractures of the transverse process of L5.

Among the special projections of the pelvis are the oblique alar and obturator projections, the latter frequently used when an acetabular fracture is to be ruled out.

Entrance projection of the pelvis: it is performed with the individual in the supine position and the X-ray beam at 60° in a caudal direction, perpendicular to the pelvic rim. It is used to determine the anterior or posterior displacement of the sacroiliac joint, as well as the sacrum and the iliac wing. It can identify deformities in internal rotation of the iliac and sacral alterations by impact.

Exit projection of the pelvis: it is performed with the individual in the supine position and the X-ray beam at 45° to the cephalic direction. It can be used to identify the vertical displacement of the hemipelvis, it can also show some delicate signs of pelvic ring rupture, such as a small expansion of the sacroiliac joint, an interruption of the sacral ridges, the existence of non-displaced sacral fractures or the deterioration of the sacral foramina(5,6).

The abdominopelvic CT scan will provide a broad visualization of the pelvic anatomy, being able to recognize pelvic, intraperitoneal or retroperitoneal bleeding, in addition to showing the presence of hip dislocation, with associated acetabulum fracture. It is also optimal to evaluate the posterior pelvis, both sacrum and sacroiliac joints. MRI has limitations due to the difficult access to the individual with polytrauma, the time delay in the technique and limitations of the equipment itself, however, it usually provides images of excellent quality in the vascular and genitourinary structures(3,5,9,16,17).

To assess vertical stability, traction and compression maneuvers can be used with the patient under anesthesia, the so-called stress projections.

Some authors differ in terms of instability, Tile says that instability is a displacement ≥ 0.5 cm, Bulcholz, Kellam and Browner say that instability exists when a vertical displacement ≥ 1 cm is generated. Some of the radiographic signs of instability are:

- Posterior fracture line with separation.
- Sacroiliac displacement of 5 mm in any plane.
- Fracture-avulsion of the transverse process of L5.

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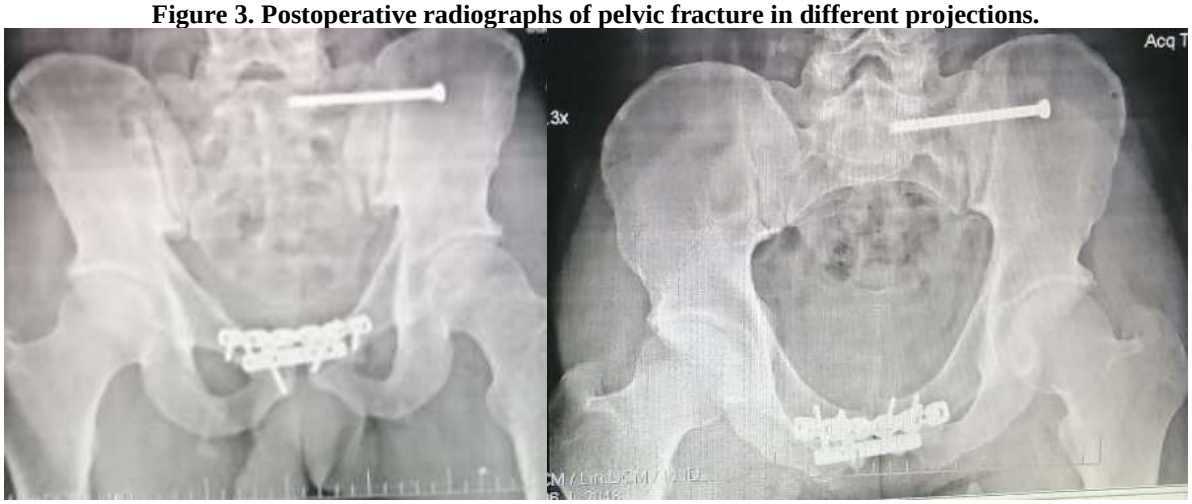
- Fracture-avulsion of the lateral border of the sacrum involving the sacrotuberous ligament.
- Fracture-avulsion of the ischial spine involving the sacrospinous ligament(5,6).

Figure 3. Postoperative radiographs of pelvic fracture in different projections.



Source: the authors.

Classification

Currently there are different systems for classifying pelvic fractures, based on different categories such as anatomical patterns, mechanisms of injury, resulting instability requiring surgery. In addition to classification, for treatment it is important to remember: the patient's hemodynamics, associated injuries and anatomical damage that impairs pelvic ring function. ATLS considers as hemodynamic instability the individual with: blood pressure less than 90 mmHg and heart rate greater than 120 bpm, in addition to evidence of skin vasoconstriction, decreased consciousness and/or shortened respiration(2,5,6).

Some of the most commonly used classifications are described below.

Young and Burgess classification.

This classification algorithm is based on the mechanism of injury and is currently the most commonly used system for the evaluation of pelvic ring injuries(3).

- Lateral compression: this is an implosion of the pelvis following a laterally imposed force which reduces the anterior sacroiliac, sacrotuberous and sacrospinous ligaments. It can cause oblique fractures of the pubic branches. It presents 3 types.
  - Type I: Impaction of the sacrum on the side of impact. Transverse fractures of the pubic branches are stable.
  - Type II: Posterior fracture of the iliac wing in the form of a crescent on the side of impact, with rupture of the posterior ligamentous structures, generating displacement of the anterior fragment. It maintains vertical stability and is related to crush fractures of the anterior part of the sacrum.
  - Type III: Type I or II lateral compression fracture on the side of impact; force continues into the contralateral hemipelvis to produce an external rotation injury (windswept pelvis) due to rupture of the sacroiliac, sacrotuberous and sacrospinous ligaments. Instability can result in hemorrhage and neurological injury secondary to traction injury on the side of the sacroiliac injury.
- Anteroposterior compression: generated by a direct impact force or by transfer forces in the anterior region of the pelvis, leading to external rotation injuries, longitudinal fractures of the branches or symphysis diastasis. It presents 3 types.
  - Type I: vertical fracture of one or two branches of the pubis, with maintenance of the posterior ligaments; symphysis pubis diastasis 2.5 cm.
  - Type II: diastasis of the symphysis pubis more than 2.5 cm; widening of the sacroiliac joints formed by the rupture of the anterior sacroiliac ligaments. The rupture of the sacrospinous and sacrotuberous ligaments and of the symphysis, without injury to the posterior sacroiliac ligaments, generates the so-called open book injury presenting instability in both external and internal rotation and maintaining vertical stability.
  - Type III: total rupture of the ligaments of the symphysis, sacrospinous, sacrotuberous and sacroiliac, which gives extreme rotational instability plus lateral displacement; without posterior cephalic displacement. It is a completely unstable injury, with the highest rate of vascular injury and bleeding.
- Vertical shear: generated by vertical or longitudinal forces associated with complete rupture of the

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symphysis, sacrotuberous, sacrospinous and sacroiliac ligaments. High instability and usually has neurovascular lesions and related bleeding.

- Combined mechanism: as crushing causes vertical shearing and lateral compression(4-6).

Tile Classification

They are classified into several types:(5,6).

A. Stable. Fractures of the pelvis that do not affect the annulus.
   A1. Avulsion.
   A2. Minimally displaced fractures of the annulus, stable.
B. Vertical stability, rotational instability.
   B1. External rotation instability; open book injury.
   B2. Lateral compression injury; ipsilateral only injuries; internal rotation instability.
   B3. Lateral compression injury; bilateral rotational instability.
C. Vertical and rotational instability.
   C1. Unilateral injury.
   C2. Bilateral injury, vertical instability on one side and rotatory instability on the other.
   C3. Bilateral injury, on both sides vertical and rotational instability, associated with fractures of the acetabulum.

WSES classification.

It categorizes pelvic ring injuries into 3:

Minor, WSES grade I: hemodynamically and mechanically stable lesions.

Moderate, WSES grade II and III: hemodynamically stable and mechanically unstable lesions.

Severe, WSES grade IV: hemodynamically unstable lesions regardless of mechanical status(2).

Factors that increase mortality

Among the main ones we have: (5,6).

- Type III anteroposterior compression.
- Type III lateral compression.
- Vertical shear.
- Old age.
- Cranioencephalic traumas.
- Abdominal trauma.
- Hemorrhagic shock on admission.
- Requirement of large volumes of blood.
- Perineal wounds.
- Open fractures.
- High Injury Severity Score.
- Fracture associated with an infected Morel-Lavallé lesion.

Treatment

Pelvic fractures are life threatening. The management and treatment of these begins with the ABCDE, this is of essential importance for all polytrauma. It should be ensured to have double venous access, hypotension must be managed with rapid administration of fluids and if necessary blood products(2,4,18).

When there are signs of pelvic ring rupture, pelvic bandages should not be forgotten, since they reduce hemorrhage and compress bone bleeding by reducing the internal volume of the pelvis, giving a tampon effect. These are usually used only until it is time for definitive repair. To correctly place this pelvic bandage, the girdle must be placed over the greater trochanter and the pubic symphysis, achieving adduction of the legs and reducing the pelvic volume in a good way.

The recommended treatment is variable, so a systematization is required for the correct therapeutic flow. The mechanical stabilization previously mentioned, either with the pelvic girdle or a sheet, collaborates in the stabilization of the pelvic ring and also reduces the internal bleeding of the venous plexus, mainly in pelvic ring lesions of the anterior to posterior compression type; on the other hand, the bibliography does not recommend lateral compression. Skeletal traction is the suggested stabilization for a vertical shearing pelvic ring alteration. External skeletal fixation can also be performed, providing better stability in hemodynamically unstable patients, together with emergency laparotomy(3,5).

Conservative treatment is recommended for the following fractures:

- Almost all lateral compression type I fractures.
- Almost all anteroposterior compression type I fractures.
- Diastasis pubis 2.5 cm.

As far as rehabilitation is concerned, we find that weight bearing must be protected in the first instance, either with a walker or canes. After mobilization, a serial X-ray control is necessary to rule out a probable secondary displacement; if this is detected and if it is greater than 1 cm in the posterior ring, weight bearing should be interrupted, in addition to evaluating the possible surgical treatment with the existence of a clear displacement.

The absolute indications for surgery are:

- Open book fractures or with vertical instability plus hemodynamic instability.
- Open fractures of the pelvis or associated with visceral perforation.

Relative indications for surgery are:

- Symphysis symphysis diastasis greater than 2.5 cm.
- Rotational deformity.
- Sacral displacement > 1 cm.
- Dysmetria greater than 1.5 cm.
- Intractable pain.

Surgical techniques include the following:

- External fixation: it is used for resuscitation of the patient, and can be used in anterior pelvic injuries for definitive fixation; it is not recommended as a final treatment in injuries with posterior instability. Generally it is used in two ways in the first the external fixator is placed on two or three 5 mm nails, 1 cm apart, located on the anterior iliac crest, and the second way or

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Hanover's assembly with single nails installed on the supraacetabular surface and in an anteroposterior direction.

- Internal fixation: compared to the external fixator, it presents increased resistance forces in the pelvic ring.

Some special recommendations according to the type of fracture:

- For iliac wing fractures perform open reduction and stable internal fixation using compression screws and neutralization plates.
- For symphysis pubis symphysis diastasis performs plate fixation.
- For sacral fractures, fixation with trans-iliac rods is performed, although it may cause neurological injury due to compression, so fixation with plate or iliosacral screws is frequently indicated to avoid compression of the fracture site.
- For unilateral sacroiliac dislocation, direct fixation using iliosacral screws or anterior sacroiliac plate fixation is indicated.
- For bilateral posterior rupture that generates instability, fix the displaced portion of the pelvis on the body of the sacrum using posterior screws. Lumbopelvic fixation can also be used.

In exposed bladder or rectal injuries, interdisciplinary management between the orthopedic surgeon, the general surgeon and the urologist is necessary. Colostomy is recommended for any open injury that causes contact of the fracture site with fecal matter.

Sacral fractures are likely to generate neurological injury with different percentages depending on their location:

- Denis I: 6 %, lateral to the sacral foramina.
- Denis II: 28 %, crossing the sacral foramina.
- Denis III: 57 %, medial to the sacral foramina.

Decompression of the sacral foramina is recommended in case of progressive neurological deficit; recovery can take up to 3 years.

In postoperative management it is important to eliminate or aspirate respiratory secretions, respiratory exercises, early mobilization, thromboembolic prophylaxis using elastic stockings, sequential compression device and drugs if necessary; if it is not possible to anticoagulate consider filter in the vena cava.

Recommendations for return to walking:

- In the first days, full weight bearing on the lower limb or unaffected sacral side.
- On the affected side, partial weight-bearing for at least 6 weeks.
- Full support, without crutches, on the affected side, after 12 weeks.
- Individuals with unstable bilateral pelvic fractures moving from bed to chair improves the elimination of respiratory secretions. After fracture healing, partial weight bearing on the less severe limb is allowed at approximately 12 weeks(5,6).

Prognosis

Mortality in pelvic fractures is around 8%, with higher mortality in those who present hemorrhagic shock on arrival. In those individuals who suffer an open pelvic fracture, the risk of mortality increases up to 45%, so we can say that the severity of pelvic fractures is closely related to the associated injuries. Some authors report that the risk of death from an isolated pelvic fracture is between 0.4 and 0.8%(1,4,19,20).

Other bibliographies report that hemodynamically stable patients have a mortality rate of 3%, while hemodynamically unstable patients have a mortality rate of 38%. They also report that in lateral compression, cranioencephalic trauma is the main cause of death, while in anteroposterior compression, pelvic injuries and injuries to the viscera cause death. Anteroposterior compression with posterior instability presents around 37% of mortality, while vertical shearing is around 25%(5,6).

Complications

- Thromboembolism: deep vein thrombosis may occur due to immobilization, as well as due to lesions of the pelvic venous system.
- Infection: according to studies, it usually occurs with an incidence between 0 to 25 %, nevertheless, an infection of the wound does not condition a bad result. Morel's lesion is a risk factor for infection, which is reduced by posterior percutaneous fixation of the pelvic ring.
- Consolidation in bad position: which can generate substantial disability, and trigger other complications such as:
  - Dysmetria.
  - Chronic pain.
  - Sitting difficulties.
  - Gait disturbances.
  - Lumbar pain.
  - Pelvic outlet obstruction.
- Pseudoarthrosis: infrequent, in order to achieve consolidation, stable fixation and bone grafting are sometimes required. It is usually present in individuals of an average age of 35 years, leaving sequelae such as:
  - Gait abnormalities.
  - Pain.
  - Compression and irritation of nerve roots(5,6).

CONCLUSIONS

Epidemiologically speaking, we found that most cases of pelvic fractures occur in young people due to high energy mechanisms, in these cases the pelvic ring can be broken, however, injuries can also be generated by low energy mechanisms, which can cause fractures of individual bones. Mortality is higher in individuals with hemodynamic instability. Knowledge of the anatomy is fundamental for the treatment of pelvic fractures and associated injuries. There are several systems for classifying pelvic fractures, according to anatomical patterns, mechanisms of injury, resulting instability requiring surgery. The most frequently used is that of Young and Burgess. The standard imaging examinations in

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trauma are the anteroposterior projections of the thorax, lateral of the cervical spine and anteroposterior of the pelvis; within the special projections of the pelvis are the oblique alar and obturator projections. The evaluation should begin with the ABCDE, airway, breathing, circulation, disability, and exposure and integrate a complete trauma assessment. To determine whether there is pelvic instability, the anteroposterior and lateral compression test is performed for one occasion, generating internal and external rotation of the pelvis. The spine and extremities should be well assessed accompanied by an adequate neurovascular examination and a thorough neurological examination.in pelvic fractures, management and treatment begins with the ABCDE. Followed by stabilization of the patient, a multidisciplinary approach is required. External or internal fixation can be performed to stabilize the pelvis, its use and recommendation usually vary according to the characteristics of each fracture, the associated injuries and the instability of the pelvic ring. Pelvic trauma with involvement of the acetabulum and injuries to the genitourinary system should not be underestimated. The severity of pelvic fractures is closely related to the associated injuries. Complications include infection, thromboembolism, malunion and pseudarthrosis.

BIBLIOGRAPHY

1. *Grotz MRW, Allami MK, Harwood P, Pape HC, Krettek C, Giannoudis PV. Open pelvic fractures: epidemiology, current concepts of management and outcome. Injury. 2005 Jan;36(1):1–13.*
2. *Coccolini F, Stahel PF, Montori G, Biffl W, Horer TM, Catena F, et al. Pelvic trauma: WSES classification and guidelines. World J Emerg Surg. 2017 Dec;12(1):5.*
3. *Davis DD, Foris LA, Kane SM, Waseem M. Pelvic Fracture. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Apr 23]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK430734/*
4. *Tullington JE, Blecker N. Pelvic Trauma. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Apr 23]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK556070/*
5. *Koval KJ, Zuckerman JD. Fracturas y luxaciones. 2 ed. Madrid: Marban; 2003.*
6. *Bucholz RW, Heckman JD, Rockwood CA, Green DP. Rockwood & Green's fracturas en el adulto. Madrid: Marbán; 2003.*
7. *Arvieux C, Thony F, Broux C, Ageron FX, Rancurel E, Abba J, et al. Current management of severe pelvic and perineal trauma. J Visc Surg. 2012 Aug;149(4):e227-238.*
8. *Magnone S, Coccolini F, Manfredi R, Piazzalunga D, Agazzi R, Arici C, et al. Management of hemodynamically unstable pelvic trauma: results of the first Italian consensus conference (cooperative guidelines of the Italian Society of Surgery, the Italian Association of Hospital Surgeons, the Multi-specialist Italian Society of Young Surgeons, the Italian Society of Emergency Surgery and Trauma, the Italian Society of Anesthesia, Analgesia, Resuscitation and Intensive Care, the Italian Society of Orthopaedics and Traumatology, the Italian Society of Emergency Medicine, the Italian Society of Medical Radiology -Section of Vascular and Interventional Radiology- and the World Society of Emergency Surgery). World J Emerg Surg WJES. 2014 Mar 7;9(1):18.*
9. *Bhatt NR, Merchant R, Davis NF, Leonard M, O'Daly BJ, Manecksha RP, et al. Incidence and immediate management of genitourinary injuries in pelvic and acetabular trauma: a 10-year retrospective study. BJU Int. 2018 Jul;122(1):126–32.*
10. *Hermans E, Edwards MJR, Goslings JC, Biert J. Open pelvic fracture: the killing fracture? J Orthop Surg. 2018 Apr 13;13(1):83.*
11. *Corrêa WO, Batista VGR, Cavalcante Júnior EF, Fernandes MP, Fortes R, Ruiz GZL, et al. Preditores de mortalidade em pacientes com fratura de pelve por trauma contuso. Rev Colégio Bras Cir. 2017 Jun;44(3):222–30.*
12. *Rossaint R, Bouillon B, Cerny V, Coats TJ, Duranteau J, Fernández-Mondéjar E, et al. Management of bleeding following major trauma: an updated European guideline. Crit Care Lond Engl. 2010;14(2):R52.*
13. *Dente CJ, Feliciano DV, Rozycki GS, Wyrzykowski AD, Nicholas JM, Salomone JP, et al. The outcome of open pelvic fractures in the modern era. Am J Surg. 2005 Dec;190(6):831–7.*
14. *Poole GV, Ward EF, Muakkassa FF, Hsu HS, Griswold JA, Rhodes RS. Pelvic fracture from major blunt trauma. Outcome is determined by associated injuries. Ann Surg. 1991 Jun;213(6):532–8; discussion 538-539.*
15. *Cannada LK, Taylor RM, Reddix R, Mullis B, Moghadamian E, Erickson M, et al. The Jones-Powell Classification of open pelvic fractures: a multicenter study evaluating mortality rates. J Trauma Acute Care Surg. 2013 Mar;74(3):901–6.*
16. *Tang J, Shi Z, Hu J, Wu H, Yang C, Le G, et al. Optimal sequence of surgical procedures for hemodynamically unstable patients with pelvic fracture: A network meta-analysis. Am J Emerg Med. 2019 Apr;37(4):571–8.*
17. *Chotai N, Alazzawi S, Zehra SS, Barry M. Paediatric pelvic fractures: A review of 2 cohorts over 22 years. Injury. 2018 Mar;49(3):613–7.*
18. *Ben-Menachem Y, Coldwell DM, Young JW, Burgess AR. Hemorrhage associated with pelvic fractures: causes, diagnosis, and emergent management. AJR Am J Roentgenol. 1991 Nov;157(5):1005–14.*
19. *Yoshihara H, Yoneoka D. Demographic epidemiology of unstable pelvic fracture in the United States from 2000 to 2009: trends and in-hospital mortality. J Trauma Acute Care Surg. 2014 Feb;76(2):380–5.*
20. *Vaidya R, Scott AN, Tonnos F, Hudson I, Martin AJ, Sethi A. Patients with pelvic fractures from blunt trauma. What is the cause of mortality and when? Am J Surg. 2016 Mar;211(3):495–500.*

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