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GUIDELINE AND MANAGEMENT OF PELVIC'S FRACTURES: A SISTEMATIC REVIEW

Orthopeadics

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KEYWORDS

Introduction

Pelvic ring fractures in young individuals are most commonly caused by high-energy trauma such as falls from a height or traffic accidents [1,2]. In the elderly, however, low-energy impacts often lead to fractures of the pelvic ring [2,3].

Predictors of outcomes include severity of injury, fracture type, incidence of nerve injuries, and method of treatment. For elderly patients with pelvic ring fractures, several studies have reported substantial mortality, low short-term mobility, and frequent need for community support and institutionalization after discharge from hospital [4,5,6].

Unstable pelvic ring injuries are defined as life-threatening with a loss of pelvic ring stability, which transfers axial skeletal loads to the two lower extremities. Since the first historical descriptions on the Napolean battlefieds (Larrey) and the precise description in the treaty by Joseph Franc¸ois Malgaigne (Bailliere, Paris 1847), numerous studies have clearly described these lesions [7], their mechanisms [8] and their horizontal and vertical instability as well as rotational instability on the sagittal plane [9,10].

The aim of this scientific's work is to provide an update on existing methods of management of pelvic ring injuries.
Pelvic ring injuries are known to cause a retroperitoneal haematoma, which may be life-threatening. In personal series of 2064 cases at the French Alps Trauma Centre, we identified 135 unstable lesions (6.5%) with 28% out of these were the cause of haemorrhagic shock upon arrival.

Classification of Pelvic's Fractures

Acetabular fracture displacement was defined as more than a 5-mm distraction or offset between fracture fragments at the articular surface of the acetabulum. It was classified using the Judet-Letournel classification system (Fig.1), a widely used classification system that describes acetabular fractures based on five simple and five combined (associated) fracture patterns.

The fracture classification described by Judet et al. and Letournel [8] was developed from radiographic observations, and some authors suggest that the role of CT scan for fracture classification is limited. They recommend CT only to collect ancillary information such as fracture comminution, fragment rotation, articular impaction, or femoral head injuries. Subtle fractures may be overlooked with both CT and radiography; using both procedures while classifying fractures may lead to fewer errors and better interobserver agreement. CT also may serve as a partial substitute for suboptimal oblique radiography.

The system developed by Judet et al and Letournel [8] is a morphologic classification based on observations from radiography using anteroposterior and oblique radiographs (Judet views).
This classification is important for several reasons. First, it is the universally accepted system for communicating acetabular fracture information, accepted internationally. Second, it guides the surgical approach for reduction. Third it provides an elegant anatomic framework for describing these fractures.However limitations to this system exist.

An ideal classification typically proceeds from simple to complex injuries but the fracture types in the classification of Judet et al. and Letournel do not relate either to complexity or directly to prognosis. In addition the inter observer and intraohserver agreement of this system has not been widely tested and on the basis of experience with other complex classification systems, this system may have low interobserver agreement.

Finally some acetabular fractures are difficult or confusing to classify, such as the anterior column with posterior hemitransverse fracture or the extended varieties of posterior wall fractures that resemble column fractures. Fortunately the extremely difficult cases are uncommon and for most fractures accurate classification should be possible.

In the classification of Judet et al and Letournel fractures are divided into elementary and associated patterns. The elementary fractures consist of a single main fracture line whereas associated fractures involve combinations of elementary fractures. The elementary fractures include anterior wall, posterior wall, anterior column, posterior column, and transverse fractures.

We first discuss the two acetabular fracture types (both-column and T-shaped) associated with obturator ring disruption. Next we discuss the three acetabular fractures types that spare the obturator ring (transverse, transverse with posterior wall, and isolated posterior wall).

A both-column acetabular fracture involves both anterior and posterior columns with extension into the obturator ring and iliac wing, and is one of the most common acetabular fractures. On radiographs, fracture involvement of the anterior and posterior columns is characterized by disruption of the iliopectineal line and ilioischial line, respectively. However, disruption of these lines may also be seen with other fracture patterns, such as a transverse fracture. Obturator ring and iliac wing involvement must also be present for classification as a both-column acetabular fracture. Fracture extension into the iliac wing is not always obvious on the anteroposterior radiograph; oblique Judet views or CT often reveal this finding.

On CT, fracture involvement of the anterior and posterior columns is seen, and the fracture may be comminuted. Fracture disruption of the obturator ring has a variable appearance; fracture of the superior pubic ramus may occur at the puboacetabular junction. In addition, fracture of the inferior pubic ramus may be difficult to identify if nondisplaced. The principal fracture line, which extends superiorly from the acetabulum into the iliac wing, is characteristically in the coronal plane.

If present, a pathognomonic sign of a both-column fracture is the spur sign.This sign represents posterior displacement of the sciatic buttress of the iliac wing fracture, which essentially disconnects the roof of the acetabulum from the axial skeleton. When this occurs, weight from the torso and upper body can no longer be supported by the acetabulum. On radiographs and CT, the spur sign appears as a shard of bone extending posteriorly at the level of the superior acetabulum. Evaluation of sequential CT images shows the fracture, which separates the sciatic buttress from the acetabular roof.

A T-shaped acetabular fracture is a combination of a transverse acetabular fracture with extension inferiorly into the obturator ring. It is similar to a both-column fracture in that it disrupts the obturator ring. Another similarity is disruption of both the iliopectineal and ilioischial lines.

However, the superior extension of the fracture does not involve the iliac wing, which allows differentiation from the both-column fracture. The transverse fracture of the acetabulum is limited to the acetabulum, without involvement of the obturator ring. A transverse fracture must involve both the anterior and posterior aspects of the acetabulum, so the iliopectineal and ilioischial lines are disrupted on radiography. Similar to the transverse component of the T-shaped fracture described previously, this fracture line extends superiorly and medially from the acetabulum. On CT, the characteristic sagittally oriented fracture line can be seen moving laterally to medially on subsequent CT images when scrolling from inferior to superior. Although not anatomically transverse, the fracture plane is transverse relative to the acetabulum, which is relatively tilted inferiorly and anteriorly.

The transverse with posterior wall fracture is a transverse fracture, described previously, with the addition of a comminuted posterior wall fracture that is often displaced. As with an isolated transverse fracture, the key is recognizing that the obturator ring is not disrupted, as this excludes both-column and T-shaped fractures. As with the simple transverse fracture, this fracture type does not extend into the iliac wing.

On radiographs, disruption of both iliopectineal and ilioischial lines is seen as with the isolated transverse fracture. Unlike an isolated transverse fracture, however, additional comminution of the posterior wall is seen. In the absence of displacement, comminution of the posterior wall may be difficult to identify on anteroposterior radiographs because the fragments are superimposed on the femoral head. Oblique Judet radiographs and CT are helpful in showing the comminuted posterior wall component.

The isolated posterior wall fracture is one of the most common types of acetabular fracture, with a prevalence of 27%. An isolated posterior wall fracture does not have a complete transverse acetabular component. Therefore, the iliopectineal line is not disrupted, which excludes classification of the transverse with posterior wall fracture. However, disruption of the ilioischial line may or may not be present as an extension of the comminuted posterior wall component. Oblique (Judet) radiographs and CT are helpful in showing the isolated posterior wall fracture.

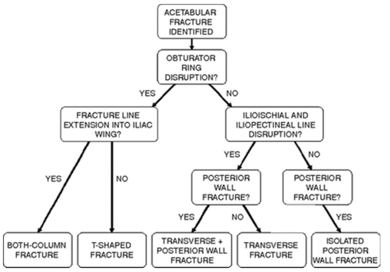

Fig 1

Initial management

The principles of Advance Trauma Life Support (ATLS) place the control of hemorrhage in third place (C) after freeing the airways (A) and restoring ventilation (B) [9]. There are numerous causes of bleeding: venous, osseous and arterial.

Management should begin at the scene of the accident. All high energy trauma or falls from a height should suggest pelvic injury. Larrey's maneuver (pushing on both iliac spinous processes), causes lower lateral lumbar pain and suggests a diagnosis.

Pre-hospital management should therefore include compression of the retroperitoneal space by pulling together the two coxal bones. A belt or a sheet wrap using the Seattle technique [10] prevents expansion of the retroperitoneal haematoma, and the loss of several precious hemoglobin grams.

Upon admission into a regional reference center, external compression should be continued until the patient undergoes a general and morphological examination. A simple AP X-ray of the pelvis should be performed, which shows displacement and clearly shows anterior and posterior injuries. All injuries to the pelvic ring are potential causes of haemorrhagic shock.

The clinical symptoms which should alert the surgeon and the intensive care specialist are pulse acceleration, which occurs after a loss of 750 mL of blood, then an increase in diastolic pressure and anxiety after 1500 mL of blood loss. Hemostasis and filling maneuvers should be begun in the presence of these symptoms.

There are no anatomo-pathological lesions that provide a prognosis for bleeding. Only iliac wing and transforaminal sacral fractures may cause more bleeding.

In haemodynamically unstable patient, fast-echo ultrasound identifies the importance of retroperitoneal or intraperitoneal bleeding. If the patient is haemodynamically stable enough, a body scan will identify active arterial bleeding and angiography with embolization may be indicated.

The use of a compression belt for more than 6 hours is difficult due to compression of the greater trochanters and the risk of bedsores. This should be replaced by transcondylar traction to reduce elevation of the hemi-pelvis and place a pelvic clamp using the Ganz technique [11] Capsular avulsions from the femur extending to the anterosuperior portions are common in these injuries, and it may not allow a typical capsulotomy

and repair of the capsule as described by Ganz et al. Anterosuperior capsular avulsions should be considered, and the capsulotomy modifi ed as necessary to get access to the femoral head. Repair of the capsular avulsions can be performed by drill holes in to the proximal femur The ligamentum teres if still attached was removed, and all debris from the joint was cleared. Small osteochondral fragments and free cartilage fl aps were removed. Fixation was done with 2.4-mm headless screws (Synthes-India). Associated labral tears if present were repaired with 3-mm suture anchors (Smith & Nephew- India). The osteotomy was fixed with three 3.5-mm cortical screws.

Patients were allowed toe touch weight-bearing for 8 weeks followed by full weight bearing. Immediate hip range of motion exercises was initiated. Thromboembolic prophylaxis with low-molecular-weight heparin was administered for 2 weeks[12]. This is only effective if the iliac wing is intact. It is effective in sacroiliac disruptions and sacral fractures. It also allows access to the abdomen and the groin (arteriography). These external reduction maneuvers should be performed in a shock control unit and should not interfere with rapid multidisciplinary management with CT scan, angiography or surgery.

This compression maneuver and stabilization of the posterior bone lesion is nevertheless the pre-requisite before performing interventional vascular X-ray The indication for clamping is not an osteoarticular injury but hemodynamic instability.

During angiography the terminal branches of the internal iliac artery are explored: ilio lumbar artery, lateral sacral artery, superior gluteal artery, internal pudendal artery [13]. Embolization is performed with material that is resorbable after 6-12 hours.

Guideline review

Weight

Prospective studies have reported an independent association between weight loss and an increased risk of clinical fractures at the hip, spine, and pelvis (central body fractures [CBFs]) in postmenopausal and older women, [14–19] but less is known about weight loss late in life and fracture risk in men.

Longitudinal studies [20–23] in older men that have measured concurrent changes in weight and hip bone mineral density (BMD) have reported higher rates of bone loss in men losing weight. One study that investigated the association between weight change since middle adulthood and risk of hip fracture in older men [24] noted that weight loss of 10% of more increased hip fracture risk, whereas weight gain of 10% or more decreased the risk of hip fracture.

Previous studies examining the association of weight loss with fracture outcomes in older adults have used traditional Cox proportional hazards regression models to analyze the association of weight change with fracture. These approaches treat mortality as an uninformative censoring event and assume that subjects censored because of death are representative of those still at risk of fracture at that point in time and have the same distribution of time-to-fracture as subjects who experience fracture. However, ignoring mortality may not provide accurate estimates of risk of fracture because weight loss in older adults strongly predicts death, [25-28] making mortality a competing risk[29].

Finally a recent study examining the impact of the competing risk of death on absolute probability and adjusted risk of CBFs in older men with weight loss late in life.

The result of this scientific work has determinated that fracture risk increas in a graded manner with increasing degree of weight loss, whereas weight gain appear to have no effect on fracture risk[30].

Injuries Osteo-Ligamentous

Multiple trauma patients present with a systemic inflammatory response syndrome (SIRS), which begins after the first day and ends after approximately 4 days. After 10 days the Compensatory Anti-inflammatory Response Syndrome (CARS) develops, reducing the patient's immune defenses against surgery [31]. Thus the patient should undergo surgery either before the first day or between the 4th and 10th days. The decision should be based on systemic stability of the patient based on a temperature of above 34◦, an absence of acidosis with a PH of above 7.2 (normal lactate) and the absence of coagulopathy with fibrinogenemia above 1 g/L. [32]. These stable patients may benefit from early definitive osteo-ligamentous treatment ("early total care") immediately following admission into a reference center.

Injuries Urogenital

Posterior urethral injury is usually associated with pelvic fractures. Shear mechanisms resulting in pelvic fracture may tear through the bulbomembranous urethra and lead to urethral disruption and displacement. Treatment options vary as a consequence of these differences. More traditional therapies for urethral stricture disease include urethral dilation, direct visual internal urethrotomy (DVIU) and a variety of open urethroplasty techniques. Treatment options are selected based on the severity (length and density), location, patient comorbidities, and surgeon preference.

The urethral stricture and pelvic fracture urethral injury (PFUI) literature recognizes an association between erectile dysfunction (ED) and ejaculatory dysfunction (Feng et al., 2008; Erickson et al., 2010a). It is postulated that surgical treatment of urethral stricture itself might affect sexual function.

A multivariate analysis documented that diastasis of the pubic symphysis, lateral prostatic displacement, and a long urethral gap at surgery (all of which occur with more severe pelvic traumas) are the predictors of ED after pelvic fracture urethral injuries with an odds ratios (OR) of 15.9, 6.9, and 2.0, respectively (Koraitim, 2013).

Injuries Neurological

Initial neurological lesions are present in 52% of these cases[33-34]. At the 20 month follow-up, there are severe neurological lesions in only 14% with a motor deficit in less than 3/5. They result in neuropathic pain in L4-L5 (lumbosacral trunk) and S1. Sacro-iliac pain must be distinguished from incomplete reduction.

During the acute phase, neurolysis of the lumbosacral trunk by ilio-inguinal approach is only proposed to relieve compression of a bone fragment. Usually there is no visible compression and treatment is symptomatic with an antiepileptic such as Pregabaline (Lyrica). The prognosis of these lesions is poor when they involve deficits that arebsecondary to sacro-iliac disruption causing nerve root avulsions. During sacral trauma the lumbosacral plexus branches are injured.The prognosis is better in these cases with spontaneous recovery [34]. A spinal stimulation implant may be a solution for debilitating nerve root avulsion.

Moreover about 30% of patients with a sacral fracture will present with a neurological deficit. Most patients with a translated transverse fracture will present with a deficit, so a high index of suspicion and thorough evaluation is necessary, especially in patients with multiple body injuries. Although most motor nerve roots innervating the muscles of the lower extremities originate craniad to the sacrum, some sacral fractures may be associated with superior gluteal nerve injuries, causing weakness of hip abduction and internal rotation. The Denis classification is useful for estimating the risk of neurological deficit to evaluate the sciatic nerve or the L-5 root only and the bladder dysfunction or sciatic nerve injuries (L-5, S-1 or S-2).

Malunion/Nonunion

Malunion and nonunion of the pelvis usually occur in unstable injury patterns that were initially managed without surgery or solely by external fixation because of delay in definitive treatment of pelvic trauma due to associated severe injury. These conditions result in chronic residual pain, deformity, and progressive functional disability. Treatment is sometimes difficult because of inexperience and lack of understanding of the injury on the part of the surgeon and inability to apply force to the vectors necessary for reduction. It is difficult to discuss malunion and nonunion separately because they commonly occur together.

Hemipelvic displacement of >1 cm and/or rotation of 15° to 20° may represent malunion because a lack of healing encompassing these parameters has been associated with diminished clinical results, although it is not always symptomatic.

Diagnosing nonunion may be difficult. It is difficult to visualize the fracture site because it is obscured by hardware on radiographs. Therefore, it is important that the surgeon monitors the patient over time to detect continued pain and instability and a broken or altered internal fixator. Nonunion is usually symptomatic.

Pain is the most common symptom reported after fracture of the pelvic ring. It is usually perceived posteriorly in the sacroiliac joint because of instability. The pain usually worsens with weight-bearing and decreases with rest, but the anterior lesion is relatively less painful. It is important to ascertain whether the symptoms are related to pelvic malunion and nonunion rather than to other clinical conditions such as mechanical low back pain, an old neurologic injury, or dysesthetic pain of neurogenic origin. Nonunion of the pelvic ring is not well tolerated.

It may occur due to insufficient fixation or premature mechanical loading. A history of comorbidities and tobacco use also favor this outcome. Surgical revision may be necessary, usually without attempting reduction if nonunion is associated with malunion [35,36]. In that case, fixation must be reinforced, usually with plates, and especially in the anterior arch.

In case of sacro-iliac pain because of non-healing of the sacro-iliac and ilio-lumbar ligaments, arthrodesis is proposed. The results of these arthrodeses, whatever the technique are disappointing. The best treatment of nonunion is preventive and based on the quality of management of initial fixation [36].

Malunion is usually due to insufficient reduction of sacral lesions. It is fairly well tolerated. Vertical displacement of less than 1 cm of the sacrum does not lead to functional deficits. Reduction of a sacro-iliac malunion is dangerous for the lumbosacral plexus. Arthrodesis without displacement reduction is preferable [35].

Hemostatic strategy

For patients with suspected pelvic fractures, medial and posterior compression of the anterosuperior iliac spines (Larrey's maneuver) must be routinely performed. If this maneuver is painful, the pelvic ring must be routinely immobilized by a specifically designed pelvic belt, or, if unavailable, be wrapped compressively with a sheet.

This results in approximation of the bony fracture margins and minimizes the bony component of bleeding. The Antishock garment is not indicated in this situation because its adverse effects (reduced thoracic compliance, increased digestive fluid regurgitation, enhanced thoracic bleeding, compartment syndrome) outweigh the moderate benefits [37]. When the patient is at risk of entering the vicious hemorrhagic circle, damage control principles should prevail [38,39]. This consists of temporary control of bleeding and sepsis followed by definitive surgical repair once the patient is stabilized. This type of management, consisting of a well-defined series of surgical maneuvers [39], becomes necessary when the following criteria are present: persistent hemodynamic instability, acidosis, hypothermia (T≤34°), transfusion of five units or more of packed red blood cells.

When multiple hemorrhagic injuries co-exist, particularly at different anatomic sites, a hemostatic strategy should be set up with a scrupulous flow-sheet based on the bleeding sites and the therapeutic possibilities. While control of intra-abdominal bleeding is of first priority, multisite embolization can also be life-saving in severely injured patients [40]. External bleeding from the extremities calls for temporary control by crude, makeshift ligations before treating the thoracoabdominal injuries. The other hemorrhagic injuries of the extremities can be treated later, except when they are ischemic.

For patients with isolated pelvic and perineal trauma, in hemorrhagic shock upon admission, most authors now agree that bilateral ligation of the internal iliac arteries should be abandoned [41].

Postoperative Management

The postoperative course depends upon the time necessary to obtain bone union and ligament repair before weight bearing can begin.

A 90° seated position solicits the posterior arch of the pelvic ring and should be avoided for at least 45 days.

We prefer the seated in bed position at 45°, for 45 days. Once the incision has healed the patient can be moved during hydrotherapy.

One hundred percent full weight bearing on both legs is not allowed until 3 months after surgery. Unilateral weight bearing does not protect the pelvic arch because it creates asymmetric loads, which tend to deform the pelvic ring.

Recommended times until weight bearing are approximate and depend upon the patient's physical condition.They can be reduced when the patient is young and increased in older patients, smokers or patients with comorbidities.

Imaging Evaluation

Following the Advanced Trauma Life Support (ATLS) guidelines, every patient with high energy trauma should undergo anteroposterior radiography of the pelvis. However, this imaging modality may not adequately show sacral fractures, with an overall detection rate as low as 30%. For this reason, thin-cut CT scans with coronal and sagittal reconstructions have become the gold standard for the evaluation and diagnosis of sacral fractures.

MRI can additionally be helpful in demonstrating areas of neural compression and displacement of fracture fragments. Elderly patients with suspected insufficiency fractures

should be initially evaluated with a technetium-99 bone scan (instead of plain radiography) which will show activity according to the fracture pattern; the standard projections are anterior and posterior. Nonetheless, bone scanning is not specific, and a CT scan should still be obtained.

Injury Severity Score

Injury Severity Scoring (ISS) is a process by which complex and variable patient data is reduced to a single number [42]. This value is intended to accurately represent the patient's degree of critical illness. In truth, achieving this degree of accuracy is unrealistic and information is always lost in the process of such scoring. As a result, despite a myriad of scoring systems having been proposed, all such scores have both advantages and disadvantages.

Part of the reason for such inaccuracy is the inherent anatomic and physiologic differences that exist between patients. As a result, in order to accurately estimate patient outcome, we need to be able to accurately quantify the patient's anatomic injury, physiologic injury, and any pre-existing medical problems which negatively impact on the patient's physiologic reserve and ability to respond to the stress of the injuries sustained.
Outcome = Anatomic Injury + Physiologic Injury + Patient Reserve

A recent study evaluated all consecutive open pelvic fractures in patients treated at a single Level-1 Trauma Center during a 10-years interval. Of the 30 patients, 12 (1.6%) died, 5 (16.6%) in the immediate period (during hospital resuscitation), 4 (13.3%) very early (during the first 24 hours of hospital admission), and 3 (10.0%) late (for nonrelated reasons to the pelvic ring injury). All patients that died had an ISS greater than 35, demonstrating the severity of injury in different organs and systems.

EQ-5DTM

EQ-5DTM is one of the most commonly used generic questionnaires to measure health-related quality of life (HRQOL) [43]. The conceptual basis of the EQ-5D is the holistic view of health, which includes the medical definition, as well as the fundamental importance of independent physical, emotional and social functioning. The concept of health in EQ-5D also encompasses both positive aspects (well-being) and negative aspects (illness).

The EQ-5D is short, easy to use and flexible. It has been used successfully in several different settings (scientific trials, health policies, pharmacoeconomics, clinics, etc.). It consists of a questionnaire and a visual analogue scale (EQ-VAS). The EQ-VAS is a self-rated health status using a VAS and records the subject's perceptions of their own current overall health and can be used to monitor changes with time. The self-assessment questionnaire is self-reported description of the subject's current health in 5 dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression).

The subject is asked to grade their own current level of function in each dimension into one of three degrees of disability (severe, moderate or none). The combination of these with the conditions “death” and “unconscious” enables description of 245 different health states.

Patients with higher age, complex trauma, and surgery had a higher likelihood for a reduced quality of life. Moreover EQ-5DTM scores in patients with a history of pelvic ring fractures tended to be slightly lower compared to population norms.

In conclusion, patients with higher age, complex trauma, and surgery had a higher likelihood for a reduced quality of life after pelvic ring injuries. Considering the rapidly increasing number of elderly patients with pelvic ring fractures, this finding highlights the need and challenge for the future to develop and implement novel treatment strategies for improved outcomes in these patients.

Conclusion

Pelvic ring injuries require initial multidisciplinary management whose goal is to stop or limit life-threatening bleeding.

Early pre-hospitalization compression, the use of clamps and embolization has changed the life-threatening prognosis. Before osteo-ligamentous lesions can be treated they must be evaluated, and various classifications have been published for this purpose.

Sacro-iliac screw fixation simplifies treatment. It is only possible on a pelvis that has been reduced in the early stages of management. The fixation technique should be rigorous to prevent iatrogenic lesions.

The indication for anterior stabilization should be large, especially if the chosen posterior fixation does not control horizontal instability or sagittal rotation stability. This initial treatment strategy can prevent nonunion and malunion.

Bibliography

[1] Pohlemann T, Tscherne H, Baumgartel F, Egbers HJ, Euler E, Maurer F, Fell M, Mayr E, Quirini WW, Schlickewei W, Weinberg A. Pelvic fractures: epidemiology, therapy and

longtermoutcome: overview of the multicenter study of the Pelvis Study Group] 1996;99:160-167.
[2] 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;213:532-538; discussion 538-539.
[3] Culemann U, Scola A, Tosounidis G, Pohlemann T, Gebhard F. Concept for treatment of pelvic ring injuries in elderly patients: a challenge Unfallchirurg. 2010;113:258-271.
[4] Henry SM, Pollak AN, Jones AL, Boswell S, Scalea TM. Pelvic fracture in geriatric patients: a distinct clinical entity. J Trauma. 2002;53:15-20.
[5] Morris RO, Sonibare A, Green DJ, Masud T. Closed pelvic fractures: characteristics and outcomes in older patients admitted to medical and geriatric wards. Postgrad Med J. 2000;76:646-650.
[6] O'Brien D P, Luchette FA, Pereira SJ, Lim E, Seeskin CS, James L, Miller S, Davis K Jr, Hurst JM, Johannigman JA, Frame SB. Pelvic fracture in the elderly is associated with increased mortality. Surgery. 2002; 132:710-714; discussion 714-715.
[7] Tonetti J, Nordin JY. Les fractures et disjonctions de l'anneau pelvien de l'adulte. Monographie de la Sofcot. No 92. Paris: Elsevier Editeur; 2006.
[8] Judet R, Judet J, Letournel E (1964) Fractures of the acetabulum: classification and surgical approaches for open reduction. J Bone Joint Surg Am 46(8):1615-1675
[9] Tile M. Fracture of the pelvis and Acetabulaum. Baltimore: Williams and Wilkins;1984.
[10] Isler B, Ganz R.Classification of the pelvic ring injuries. Injury 1996;27(Suppl. 1):3-12.
[11] Elmarghany M, Abd El-Ghaffar TM, Seddik M, Akar A, Gad Y, Ragheb E, Aprato A, Massè A. Surgical hip dislocation in treatment of slipped capital femoral epiphysis Sicot 2017;3:10.
[12] Ganz R, Krushell RJ, Jakob RP, Küffer J. The antishock pelvic clamp. Clin Orthop Relat Res 1991;267:71-8.
[13] Martinelli T, Thony F, Decléty P, Sengel C, Broux C, Tonetti J, et al. Intra-aortic balloon occlusion to salvage patients with life-threatening hemorrhagic shocks from pelvic fractures. J Trauma 2010;68:942-8.
[14] Compston JE, Wyman A, FitzGerald G, et al. Increase in fracture risk following unintentional weight loss in postmenopausal women: The Global Longitudinal Study of Osteoporosis in Women. J Bone Miner Res. 2016 Jul;31(7):1466-72.
[15] Crandall CJ, Yildiz VO, Wactawski-Wende J, et al. Postmenopausal weight change and incidence of fracture: post hoc findings from Women's Health Initiative Observational Study and Clinical Trials. BMJ. 2015;350:h25.
[16] Ensrud KE, Cauley J, Lipschutz R, Cummings SR. Weight change and fractures in older women. Study of Osteoporotic Fractures Research Group. Arch Intern Med. 1997;157:857-63.
[17] Ensrud KE, Ewing SK, Stone KL, Cauley JA, Bowman PJ, Cummings SR. Intentional and unintentional weight loss increase bone loss and hip fracture risk in older women. J Am Geriatr Soc. 2003;51:1740-7.
[18] Langlois JA, Harris T, Looker AC, Madans J. Weight change between age 50 years and old age is associated with risk of hip fracture in white women aged 67 years and older. Arch Intern Med. 1996;156:989-94.
[19] Langlois JA, Mussolino ME, Visser M, Looker AC, Harris T, Madans J. Weight loss from maximum body weight among middle-aged and older white women and the risk of hip fracture: the NHANES I epidemiologic follow-up study. Osteoporos Int. 2001;12:763-8.
[20] Dennison E, Eastell R, Fall CH, Kellingray S, Wood PJ, Cooper C. Determinants of bone loss in elderly men and women: a prospective population-based study. Osteoporos Int. 1999;10:384-91.
[21] Ensrud KE, Fullman RL, Barrett-Connor E, et al. Voluntary weight reduction in older men increases hip bone loss: the osteoporotic fractures in men study. J Clin Endocrinol Metab. 2005;90:1998-2004.
[22] Hannan MT, Felson DT, Dawson-Hughes B, et al. Risk factors for longitudinal bone loss in elderly men and women: the Framingham Osteoporosis Study. J Bone Miner Res. 2000;15:710-20.
[23] Knoke JD, Barrett-Connor E. Weight loss: a determinant of hip bone loss in older men and women. The Rancho Bernardo Study. Am J Epidemiol. 2003;158:1132-8.
[24] Langlois JA, Visser M, Davidovic LS, Maggi S, Li G, Harris TB. Hip fracture risk in older white men is associated with change in body weight fromage 50 years toold age. Arch InternMed. 1998;158:990-6.
[25] Knudtson MD, Klein BE, Klein R, Shankar A. Associations with weight loss and subsequent mortality risk. Ann Epidemiol. 2005;15:483 91.
[26] Newman AB, Yanez D, Harris T, Duxbury A, Enright PL, Fried LP. Weight change in old age and its association with mortality. J Am Geriatr Soc. 2001;49:1309-18.
[27] Nguyen ND, Center JR, Eisman JA, Nguyen TV. Bone loss, weight loss, and weight fluctuation predict mortality risk in elderly men and women. J Bone Miner Res. 2007;22:1147-54.
[28] Wedick NM, Barrett-Connor E, Knoke JD, Wingard DL. The relationship between weight loss and all-cause mortality in older men and women with and without diabetes mellitus: the Rancho Bernardo study. J Am Geriatr Soc. 2002;50:1810-5.
[29] Berry SD, Ngo L, Samelson EJ, Kiel DP. Competing risk of death: an important consideration in studies of older adults. J Am Geriatr Soc. 2010;58:783-7.
[30] Kristine E Ensrud,1,2,3 Stephanie L Harrison,4 Jane A Cauley,5 Lisa Langsetmo,2 John T Schousboe,6,7 Deborah M Kado,8 Margaret L Gourlay,9 Jennifer G Lyons,10 Lisa Fredman,10 Nicolas Napoli,11 Carolyn J Crandall,12 Cora E Lewis,13 Eric S Orwoll,14 Marcia L Stefanick,15 and Peggy M Cawthon4; for the Osteoporotic Fractures in Men (MrOS) Research Group. Impact of Competing Risk of Mortality on Association of Weight Loss With Risk of Central Body Fractures in Older Men: A Prospective Cohort Study. Journal of Bone and Mineral Research, Vol. 32, No. 3, March 2017, pp 624-632.
[31] Flierl MA, Stoneback JW, Beauchamp KM, Hak DJ, Morgan SJ, Smith WR, et al. Femur shaft fracture fixation in headinjured patients: when is the right time? J Orthop Trauma 2010;24:107-14.
[32] Pape HC, Giannoudis PV, Krettek C, Trentz O. Timing of fixation of major fractures in blunt polytrauma: role of conventional indicators in clinical decision making. J Orthop Trauma 2005;19:551-62.
[33] Tonetti J, Cazal C, Eid A, Badulescu A, Martinez T, Vouaillat H, et al. Lésions neurologiques des fractures de l'anneau pelvien. À propos d'une série prospective continue de 50 lésions pelviennes postérieures opérées par vissage ilio-sacré. Rev Chir Orthop 2004;2:122—31.
[34] Reilly MC, Zinar DM, Matta JM. Neurologic injuries in pelvic ring fractures. Clin Orthop Relat Res 1996;329:28—36.
[35] Mears DC. Management of pelvic pseudarthroses and pelvic malunion. Orthopade 1996;25:441-8.
[36] Matta JM, Dickson KF, Markovich GD. Surgical treatment of pelvic nonunions and malunions. Clin Orthop 1996;329:199-206.
[37] Palmier B, Cantais E, Meaudre E, Kaiser K. Principes des interventions d'hémostase. In: L&C ES, editor. Urgences 2005. Paris: Société Francophone de Médecine d'Urgence-SAMU de France; 2005. p. 427-42.
[38] Burch JM, Ortiz VB, Richardson RJ, et al. Abbreviated laparotomy and planned reoperation for critically injured patients. Ann Surg 1992;215:476—83 [discussion 474-83].
[39] Arvieux C, Letoublon C. La laparotomie écourtée pour le traitement des traumatismes abdominaux sévères : principes de technique et de tactique chirurgicales. EMC Techniques Chirurgicales Appareil Digestif 2005:1-13.
[40] Reche F, Badic B, Dubuisson V, et al. L'embolisation multi-site dans le traitement des traumatismes abdomino-pelviens fermés hémorragiques. J Chir Visc 2009;147:28-9.
[41] Seavers R, Lynch J, Ballard R, et al. Hypogastric artery ligation for uncontrollable hemorrhage in acute pelvic trauma. Surgery 1964;55:516-9.
[42] Baker SP, ONeill B, Haddon W Jr, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma 1974; 14(3):187-96.
[43] Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med. 2001;33:337–343.