Fractures of the hip joint include fractures of the proximal femur and acetabulum. Pelvic fractures also can be included in the category of hip fractures, because pain attributed to the hip region (ie, buttock, groin, thigh) can emanate from an injury to the pelvic ring. Hip fractures can affect both young and elderly populations. Usually, younger patients sustain pelvic or acetabular fractures as a result of significant trauma, whereas elderly patients can sustain such fractures as a result of more trivial events. A pathologic fracture can occur at any age but is most often seen with low-energy injuries and may present with unusual fracture patterns. Whatever the etiology, however, hip fractures can lead to substantial morbidity and mortality.

In younger patients, hip fractures generally are the result of high-energy events in which life-threatening injuries can occur. Initial orthopaedic concerns should focus on stabilizing the fracture to allow complete evaluation of the affected patient. Although pelvic and acetabular fractures in younger patients are often accompanied by other injuries, treatment of the fracture usually is emergent and often involves surgery. In contrast, in elderly patients, treatment of fractures of the pelvis and acetabulum is largely nonsurgical. Management of these injuries is more dependent on precise diagnostic evaluation, pain management, and rehabilitation. The medical, social, and economic issues that must be addressed in regard to elderly patients with pelvic and acetabular fractures extend beyond orthopaedic management and involve many different facets of the health care system.

A previous article published in the April 2002 issue of Hospital Physician discussed fractures of the proximal femur.1 This review focuses on the epidemiology, classification, and treatment of pelvic and acetabular fractures. Pathologic fractures related to primary or metastatic neoplasms require specialized evaluation and treatment and are beyond the scope of this article.

EPIDEMIOLOGY AND EVALUATION OF PELVIC AND ACETABULAR FRACTURES

High-Energy Fractures

Pelvic and acetabular fractures can occur either with high-energy trauma or with low-energy or repetitive trauma. High-energy pelvic and acetabular fractures are rare. Two-thirds of patients with this diagnosis also have other musculoskeletal injuries, and more than half have multiple system injuries. There is associated hemorrhage in 75% of cases, urogenital injury in 12%, and lumbosacral plexus injury in 8%. In a large study reviewing the epidemiology of these fractures, pelvic ring injuries were classified as stable in 55% of cases, as rotationally unstable in 25%, and as unstable in translation in 21%; concomitant acetabular fractures were present in 16% of cases.

The rate of surgical fixation of high-energy fractures was examined in a study and varied by type; results showed that the least complex pelvic fractures are treated surgically less than 5% of the time, whereas the most complex are treated surgically more than half of the time. In isolated acetabular fractures, internal fixation was performed 39% of the time. Total mortality after high-energy fractures is approximately 10%, with a 3-fold increase in patients with complex pelvic trauma, compared with patients without peripelvic injuries. Risk factors for high-energy pelvic fractures are similar to those for blunt trauma in general (eg, motor vehicle use while under the influence of alcohol or drugs, driving with excessive speed, driving recklessly, not using seat belts when in an automobile, being in an automobile without air bags).

The evaluation of a high-energy fracture of the pelvis or acetabulum requires a thorough medical history, physical examination, and radiographic studies. The best approach is to assess the patient in 2 stages with an interdisciplinary team, including a general surgeon, an emergency department physician, an anesthesiologist, and an orthopaedic surgeon. The first stage of the evaluation is an assessment of the affected patient for immediate

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life-threatening problems associated with pelvic and acetabular fractures (Figure 1). Because these fractures should be considered a sign of other potential serious injuries, head, chest, and abdominal injuries should be eliminated as possibilities. Retroperitoneal hemorrhage caused by the fracture must be ruled out as well; if such hemorrhage is present, urgent fracture stabilization is mandatory. After the acutely injured patient is hemodynamically stable, the second stage of evaluation should take place, which involves reassessment of the fracture in preparation for definitive treatment. This step should include determination of the fracture pattern and location and assessment of pelvic stability. An evaluation to determine soft-tissue involvement, sacroiliac joint integrity, and nerve injury is also necessary.

Although a complete history is often not available in cases of multitrauma, every effort should be made to ascertain the mechanism and magnitude of the injury. Physical examination must include an evaluation of pelvic deformity, leg-length discrepancy, and rotational abnormalities; soft-tissue assessment is also necessary. Pelvic stability is assessed by push-pull and rotatory test maneuvers, which sometimes can require sedation or even anesthesia. Radiographic examination may vary, depending on whether a pelvic or acetabular fracture is suspected, but a complete examination includes pelvic inlet and outlet views, an anteroposterior view of the pelvis, and 45-degree oblique (Judet) views of the affected hip. A thin-cut (3-mm) computed tomography (CT) scan of the bony pelvis and acetabulum may be necessary, if warranted by plain radiographs (eg, if the films raise suspicion of sacroiliac or acetabular joint involvement).

After the diagnosis is made and the fracture classified, the goal of treatment is to limit pain and deformity and to return patients to the same level of activity they had prior to the fracture. Although obtaining this goal often involves surgery, the goal sometimes can be achieved without surgery. A nonoperative approach is usually reserved for stable or nondisplaced fractures. For many acetabular and pelvic fractures, however, operative treatment is appropriate. Prior to surgery, patients with multiple comorbidities need to be medically evaluated so that surgical risks are minimized.

Low-Energy Fractures

Low-energy and insufficiency pelvic and acetabular fractures are more common than are high-energy fractures. Women are more commonly affected, and most patients with this type of injury are not multiply injured. In a retrospective study examining the epidemiology of pelvic fractures in patients age 60 years and older, pelvic ring injuries were classified as stable in 45 of 48 patients; 87% of these patients were women. In three fourths of cases, the cause of injury was a low-energy fall. Concomitant acetabular fractures occurred in approximately 25% of cases, almost always involving the low anterior column. The rate of surgical fixation is very low for low-energy injuries. Acetabular fracture fixation is advocated, however, when there is significant displacement and satisfactory bone stock is present. Mortality in patients who sustained a low-energy fracture was reported to be approximately 10% at 1 year, 20% at 2 years, and 50% at 5 years. Unlike high-energy pelvic and acetabular fractures, however, the mortality was rarely related to the trauma itself; instead, there was a high incidence of associated cardiovascular disorders. Risk factors for low-energy pelvic and acetabular fractures are similar to risk factors for proximal femoral fractures.

As with high-energy fractures, the evaluation of low-energy pelvic or acetabular fractures involves a combination of a thorough medical history, physical examination, and radiographic studies. Because these injuries are usually isolated, the use of an interdisciplinary team is not necessary. However, the evaluation should include a determination of fracture pattern and location, pelvic stability, and acetabular joint involvement. A complete history, including the cause of the injury in cases of acute injury, is essential; for example, syncope is a common cause of falls in elderly persons and requires further work-up. Physical examination must include an evaluation of both ecchymoses and the condition of the soft tissues, palpation of the anterior and posterior pelvis and greater trochanter, determination of range of motion of the hip and lumbosacral spine, and neurovascular examination. Radiographic examination should include an anteroposterior view of the pelvis and a lateral view of the affected hip. Concomitant femoral fracture should be ruled out; if acetabular extension of the fracture is suspected, 45-degree oblique (Judet) views of the affected hip should be considered. Unlike high-energy injuries, low-energy fractures of the pelvis and acetabulum rarely require obtaining a CT scan. Technetium Tc 99m bone scanning 48 hours or more after the injury occurs may be helpful if results of standard radiographs are negative.

Insufficiency fractures of the acetabulum, pelvis, and sacrum are rare and occur primarily in postmenopausal women. Such fractures have also been described in osteoporotic women with seropositive rheumatoid arthritis. Whereas typical fractures occur with abnormal forces on normal bone, these fractures occur with normal forces on abnormal bone. Sacral insufficiency fractures present with marked sacral tenderness on
Injury

Check airway
Oxygen suction, position; intubation; cervical spine control

Check breathing
Chest tubes; oxygen

Check circulation
IV lines, crystalloid, blood; control external loss; abdominal assessment; pelvic assessment; assess for instability

Hemodynamically stable, with a stable pelvis
Continue assessment and treatment

Hemodynamically unstable, with a stable pelvis
Blood replacement; cervical spine, chest, AP pelvic radiographs

Hemodynamically unstable, with an unstable pelvis
Continue assessment and treatment

Hemodynamically stable, with an unstable pelvis

Medical antishock trousers in ED
Urgent transport to OR
External fixation of pelvis
Peritoneal lavage

Positive for blood
Laparotomy

Patient stable

Pelvic packing; no coagulopathy
Negative for blood
Patient stable

Patient still unstable
No coagulopathy

Angiography

Large vessel bleeding source
Surgical control

Small vessel bleeding source
Embolization

Positive for blood
Laparotomy

Patient still unstable
Rule out coagulopathy, other injury; continue with replacement

Negative for blood
Patient stable

Patient still unstable

Figure 1. Algorithm of pelvic fracture resuscitation. (Adapted with permission from Browner BD, Levine AM, Jupiter JB, et al. Skeletal trauma: fractures, dislocations, ligamentous injuries. Vol 1. 2nd ed. Philadelphia: WB Saunders; 1998:1135.) AP = anteroposterior; ED = emergency department; IV = intravenous; OR = operating room.
physical examination, and rami fractures present with pain in the low back, groin, or hip. Some patients, however, are asymptomatic. Radiographs often show no abnormalities, but results of technetium Tc 99m bone scan evaluation are positive for fracture (Figure 2). A characteristic H pattern may be seen with a sacral insufficiency fracture. Confirmation of the fracture is often made with a magnetic resonance image or CT scan.

After the diagnosis of a low-energy pelvic or acetabular fracture is made and the fracture is classified, the goal of treatment is again to limit pain and maximize patient function. Surgery is almost never indicated, so a nonoperative approach is standard to treat these injuries. Repeat radiographic evaluation 1 to 2 weeks after patient mobilization is very important not only to document stability of the fracture pattern but also to confirm lack of fracture displacement. For rare low-energy acetabular and pelvic fractures, operative treatment is appropriate.10 Prior to surgery, patients with multiple comorbidities should be medically evaluated so that surgical risks are minimized. This approach is similar to that used for elderly patients with proximal femoral fractures.1

**PELVIC RING FRACTURES**

Fractures of the pelvis involve 1 or more bones of the pelvic ring (ie, the sacrum and the 2 innominate bones) and may involve the ligamentous structures between these bones. Because the pelvis represents the link between the axial and appendicular skeleton, injuries to the pelvis are debilitating. Understanding pelvic fractures and their care necessitates understanding pelvic stability. A stable pelvic injury can be defined as one that will withstand normal physiologic forces without abnormal deformation.

There are several classification systems for pelvic ring disruptions. According to the frequently used system proposed by Tile (Figure 3), type A pelvic injuries are stable with insignificant displacement, type B fractures are rotationally unstable or displaced in the axial plane but are vertically stable, and type C injuries are vertically (coronally), posteriorly, and rotationally unstable.12

The treatment of pelvic fractures depends on the mechanism of injury, the presence of any associated injuries, and the fracture type. High-energy fractures, especially those with associated injuries, can be of any type but most often are type B and C injuries; this type of fracture requires immediate assessment of the patient and appropriate resuscitation (Figure 1). Treatment of hemodynamic instability may require immediate pelvic stabilization with an external fixation device. After the patient is stabilized and associated injuries prioritized, treatment of the pelvic ring fracture will vary depending on the type of fracture. For unstable fractures, reduction and fixation are indicated. Postoperative early mobilization is a goal of treatment but must be tempered by the surgeon’s ability to achieve stable fixation of the fracture. The patient’s weight-bearing status progresses from only touch-down initially to partial weight bearing at approximately 6 weeks. If this progression is tolerated, full weight bearing without gait aids by 3 months can be expected.

Low-energy pelvic fractures are almost always type A injuries. These are treated symptomatically with pain management and weight bearing as tolerated. Prophylactic anticoagulation appears to be unwarranted among elderly patients with minor pelvic fractures,13 although this conclusion is somewhat controversial.

In our practice, we have seen several patients with apparent type A fractures of the pelvis sustained in low-energy injuries who later were found to have marked displacement of the fracture after weight bearing was initiated. It is therefore advisable to obtain a surveillance radiograph of the pelvis 1 to 2 weeks after the initial injury; such a study confirms stability in most cases but allows proper intervention if instability is discovered.

Low-energy or insufficiency fractures of the pelvic ring are uncommon. Sacral insufficiency fractures, first described by Laurie in 1982 and occurring primarily in
postmenopausal women, are classified as type A (or stable) pelvic ring fractures. With early rehabilitation, including early ambulation, good functional results can be achieved.

**ACETABULAR FRACTURES**

Acetabular fractures occur primarily in young adults as a result of high-energy trauma. These fractures, by definition, involve the hip joint and may be displaced or nondisplaced. Displaced intra-articular fractures that are allowed to heal in an abnormal position may lead to posttraumatic arthritis.

The most often used classification of acetabular fractures is a modification of the anatomic classification published by Judet and colleagues in 1964. Fractures are divided into 5 simple and 5 associated fracture types. The simple types are fractures of the posterior wall, posterior column, anterior wall, and anterior column and transverse fractures (Figure 4), whereas the associated types are formed by a combination of the simple types.

The mainstay of treatment of displaced acetabular fractures is operative management. The primary reason for surgery is to allow early ambulatory function and to decrease the chance of posttraumatic arthritis. The accepted treatment is surgical reduction of the fracture and internal fixation with metallic screws and plates. Hardware is placed outside of the hip joint and acts as an “internal cast” until the bone heals (Figure 5). The plates and screws are not routinely removed.

Nonoperative treatment can be successful for a small number of displaced acetabular fractures and for the majority of nondisplaced fractures. Indications for nonoperative treatment are derived from analysis of fracture configuration, as seen on CT scan and 45-degree oblique (Judet) radiographs. Nonsurgical treatment is indicated when there is tolerable incongruity noted on radiographic analysis or if there are contraindications to surgery. Tolerable incongruity would include incongruity in a non–weight-bearing position of the acetabulum or incongruity of less than 1 mm. Contraindications might include ongoing local or systemic infection, severe osteoporosis, associated soft-tissue and visceral injuries, and critical medical comorbidities. Advanced age is a relative contraindication to surgery, but many elderly patients benefit from surgical fixation of acetabular fractures.

The most common complications associated with surgical treatment of acetabular fractures include iatrogenic nerve palsy, heterotopic bone formation, and thromboembolic complications. We suggest routine prophylaxis to avoid deep venous thrombosis in patients with high-energy acetabular fractures who are treated surgically (and even patients treated nonoperatively). After
internal fixation, patients are encouraged to ambulate with protected weight bearing until radiographic healing is shown, at which point weight bearing is increased.

PROGNOSIS AND PREVENTION

The prognosis of pelvic and acetabular fractures also depends on the energy of the injury and the stability of the fracture pattern. As indicated previously, a mortality rate of approximately 10% for high-energy pelvic fractures has been reported, with a rate as high as 30% in complex pelvic trauma. Pain at intermediate follow-up has been observed in all types of fractures but is correlated with fracture pattern. Reports indicate that approximately 55% of patients with type A pelvic ring fractures are completely free of pain; 41% of patients with type B fractures and only 27% of patients with type C fractures report no pain. Malfunction of micturition has been reported in 8% of patients, and sexual dysfunction occurs in 12% of men (erectile dysfunction) and 2% of women (dyspareunia). Anatomic healing is evident on radiographs in 91% of type B and 75% of type C pelvic ring fractures. Clinical results are good or excellent in 70% of type B and 54% of type C fractures.

Prognosis is guarded in low-energy stable fractures. For the average patient who is older and infirm, the mortality of this type of fracture is 12% at 1 year. In contrast to what occurs with high-energy fractures, mortality in low-energy fractures generally results from pre-existing medical conditions. In a large study, age and presence of dementia were independent significant factors predictive of mortality in patients with low-energy fractures. Elderly patients with pelvic fractures have been shown to use substantial health care resources, with prolonged length of hospital stay and a high need for health care services. Thromboembolic disease is a controversial cause of mortality in this age group.

A year after sustaining pelvic ramus fractures, patients have a good prognosis with regard to complete pain relief and fracture outcome. In one study, 92% of patients were living at home, 84% had no or mild complaints of hip or groin pain, and 92% had returned to their prefracture ambulatory status. Pre-existing medical conditions and acetabular involvement of the fracture, however, are important adverse factors affecting postinjury ambulatory status.

Patients with sacral insufficiency fractures who
undergo early rehabilitation can do well and have good outcomes. Most report improvement 1 to 2 weeks after the fracture and complete resolution of symptoms 6 to 12 months after treatment of their injury.14

Prevention strategies for pelvic and acetabular fractures are as different as the fractures themselves. Education, safety, and law enforcement appear to be the most important issues in preventing high-energy fractures. For low-energy fractures, prevention and treatment of osteoporosis may be the most effective intervention.1

CONCLUSION

Hip fracture is among the most common and most devastating maladies necessitating hospital admission. These fractures include not only fractures of the proximal femur but also fracture of the pelvis and acetabulum. Physicians should have a clear understanding of the scope of this problem as well as the basic types of fractures and types of treatments. The clear distinction between high-energy and low-energy fractures should be understood in the classification and treatment of these injuries. This article has summarized these issues and gives visual examples to illustrate the salient points.

REFERENCES