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Is pubic ramus fracture a benign injury?

Hill et al.[2] performed an epidemiological study on 286 patients with a pubic rami fracture. This study included all age groups and mechanisms with a mean age of 74.7 years; a quarter of the patients suffered from dementia. Incidence was less than neck of femur fractures (25.6/100,000; 164.6/100,000)[12]. Mortality was high in the first 3 months. Survival at 1 year (86.7%) was greater than patients suffering from neck of femur fractures; however, 5-year mortality (45.6%) was similar. They highlighted that dementia increased the mortality rate.

Koval et al.[13] reviewed 63 patients aged over 55 years with pubic rami fractures. This paper is commonly cited by other sources, suggesting that rami fractures are relatively benign, as it concluded that 95% patients returned to their pre-fracture level of dependency and daily living activities. It highlighted that comorbid patients or those requiring aids for ambulation were likely to stay over the average duration of stay of 14 days. About 95% were discharged home with half requiring home care and physiotherapy. One-year mortality was 9.5%.

All 63 patients were community dwelling pre-operatively, suggesting a higher functioning cohort than other series. They included 11 undisplaced fractures, incidentally found on further imaging due to undiagnosed pain. The last patient was included in the study in December 1990, 6 years prior to publication in 1997. Recall bias maybe a factor, particularly in an elderly population alongside a low follow-up rate of only 60%. Their results are in contrast to a number of recent papers discussed below.

In a similar series, in which all patients were living in their home and 84% were fully independent pre-fall, a pubic ramus fracture resulted in greater short- and long-term morbidity[14]. Inpatient complications were 52.5% including urine infections, chest infections and pressure sores. About 31% returned to their home on discharge and at a follow-up of 29 months, three quarter of the patients had returned to their home, whilst 60% required additional assistance with daily living activities. Mortality was 22%.

Taillandier et al.[15] performed a retrospective case note review on 60 patients with pelvic insufficiency fractures. Mean duration of stay was reported to be 45 days, with an inpatient complication rate of 40%. About 25% became institutionalised as a result of the fracture, and 1-year mortality was 14.3%.

There is great variation in terms of which medical specialty manages low energy pelvic fractures in the elderly. As conservative management predominates, many recommend management under physicians once the orthopaedic decision for conservative management has been made because of the predominantly medical complication profile. The availability of rehabilitation units and community care will affect the duration of stay, inpatient complication rates and mortality. Morris et al.[5] investigated 148 closed pelvic fracture inpatients aged >65 years admitted to medical or geriatric wards (mean age = 83 years). The series was almost exclusively following low energy mechanisms, with 123 confirmed falling from standing height and 24 did not remember. Only one was high energy following a road traffic accident. Mean duration of stay was 21.3 days. The fractures were not classified in detail, with 47.2% single rami fractures and 47.9% in combination with other pelvic fractures. Inpatient and 1-year mortality was 7.6% and 27%, respectively. Excluding the 10 patients who died and 10 already in a nursing home, 80% (26/128) dropped their level of care on discharge. At a mean follow up of 52.3 months, 41.5% of the 53 surviving patients required residential or nursing home care.

Rapp et al.[16], in a retrospective cohort study, calculated mortality in 1154 pelvic fractures in nursing home residents exclusively and compared it to a matched non-fracture group of 5770. This study demonstrated that the mortality was high when compared with controls. The hazard risk ratio (HRR) was high in the first and second months when compared with the matched controls (1st month: HRR 1.83 in females and 2.95 in males, 2nd month: HRR 1.52 in females and 2.22 in males).

Similar findings were shown by Hill et al.[2] where there was no significant HRR compared with controls after 2 months. The mortality risk of pelvic fractures was approximately half the risk of proximal femur fractures in the matched populations. The authors attributed the higher risk of hip fractures to the physiological impact of surgery. The duration of inpatient stay was not included, but the authors noted that 26% died as inpatients. They suggested that mortality in this group, which included a high proportion of patients with multiple medical, physical and mental comorbidities, should focus on ensuring that they are receiving appropriate analgesia, physiotherapy and throm boprophylaxis with in the nursing home environment.

In terms of considering the impact of intervention, outcome measures included the duration of stay in hospital, inpatient complications, social care level, use of mobility aids and mortality. In a low functioning cohort, the duration of acute hospital stay and mortality rate were the main outcome measures to be assessed, as morbidity and social care level are maximal.

Does fracture severity affect the outcome? Is the presence of posterior ring involvement worth identifying?

Mears et al.[17] investigated 181 low energy elderly pelvic and sacral fractures with the aim of identifying whether fracture type affected the outcome. Outcomes were analysed relative to four groups: undisplaced

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sacral insufficiency and undisplaced, displaced and bilateral displaced pubic rami fractures. The authors concluded that morbidity and mortality were similar regardless of displacement or fracture type and this has, in accordance with Koval et al.[13], served to limit interest in considering aggressive management in certain fracture types and patients. However, detailed analysis of their results revealed higher odds ratios in the displaced fractures for likelihood of hospitalisation, complications and 1- and 2-year mortality. More support in living situation and ambulatory aids was required for all fracture types. The duration of stay in hospital (5.9 days) was shorter than that in other studies, and no information was available on whether the patients returned home or were discharged to rehabilitation facilities. About 26% patients had complications of immobility, and mortality at 30 days, 1 year and 2 years was 7%, 23% and 47%, respectively. The main weakness of the paper was that their primary aim was to compare mortality and morbidity with fracture classification, and no radiographic images were available for review but were classified using written radiology reports alone. The presence and extent of sacral involvement radiologically or by examination in either the undisplaced or displaced fractures was unknown.

Alnaib et al.[6] prospectively investigated the association and outcomes between pubic rami fractures, sacral osteoporotic fractures and combination of both in 67 patients with low energy pelvic fractures (nine isolated sacral fractures and 58 pubic rami or in combination; 54.1% of pubic rami fractures included a sacral fracture). The likelihood of a sacral fracture was greater (60.6%) than an isolated rami fracture (39.4%) if two or more rami fractures were present. Magnetic resonance imaging (MRI) and bone scan were used to confirm sacral involvement, but they demonstrated that on clinical diagnosis alone, the presence of low back pain showed a significant relationship. Mean duration of stay was 45 days, inpatient mortality was 10.4% and the proportion of patients returning to their home dropped from 89.6% to 53.7%. Only 9% were fully independent on discharge. Subgroup analysis revealed that the duration of stay was greater in combined (52.8 days) than in isolated (36.3 days) pubic rami fractures. The destination on discharge and mobility were not significantly different.

Van Dijk et al.[18] highlighted that even when excluding pubic rami fractures with an associated sacral fracture, there was a high level of morbidity. About 20% of 99 patients had complications including urinary tract infections, pneumonia, cardiac failure and side effects of analgesia. Mean duration of stay was 10 days (range 2–57), with 33% requiring increased level of care after discharge. Mortality at 1, 5 and 10 years was 24.7%, 64.4% and 93.8%, respectively.

Scheyerer et al.[19] highlighted that in a retrospective series of 233 pubic rami fractures, at least 73% had evidence of a posterior pelvic ring injury. Although this series was not exclusive to the elderly or low energy trauma patients, it included a greater proportion of female patients (56.5%; median age = 74 years). Unfortunately, there was no subgroup analysis of the elderly low energy group.

In a study by Cosker et al.[20], non-selective MRI scans of 50 consecutive elderly patients with pubic rami fractures demonstrated that 90% patients had an associated sacral fracture. Posterior pain remained in 93% patients at 5-month follow-up and 77% patients rated their pain as severe enough to limit their daily living activities.

Bruce et al.[21] reviewed 117 lateral compression 1 (LC1) fractures, reporting that some subtypes of these typically stable fractures were unstable with displacement at follow-up, with 33% and 68% of complete sacral fractures with unilateral and bilateral rami displaced fractures, respectively. However, they did not show whether patients with displaced fractures had a worse clinical outcome than those with undisplaced fractures. However, in this case (unlike acetabular fractures), the outcomes of pelvic ring injuries were not shown to correlate with fracture displacement. This series comprised younger patients following high-energy mechanisms, and there were no comparable studies in elderly low energy fractures. However, it potentially highlights the spectrum within LC1 fractures and it maybe relevant to the elderly, particularly those who are mentally or physically unable to protect weight bearing.

Lefaivre et al.[22] similarly concluded that LC1 fractures represent a spectrum of injury, with 98% of rami fractures having an associated sacral fracture.

Operative versus non-operative

Two papers retrospectively analysed the outcomes of operative and conservatively managed patients.

Lau et al.[23] retrospectively compared 37 osteoporotic pubic rami fractures in an elderly population with amean age 85 years. They noted that 57% of pubic rami fractures had additional posterior ring fractures. Three groups were classified: pubic rami alone (15), LC1 (13) and LC2 (9). They reported morbidity and mortality with an average follow-up of 1 year in both groups. Seven of the nine LC2 fractures were operatively managed; the remaining 30 were conservatively managed. Non-operative management included bed rest and those operatively managed underwent internal fixation with plates and/or screws. Specific surgical approach was not discussed. There was no difference in walking status at 3 months based on fracture classification (pubic rami 53%, LC1 62% and LC2 56%). The walking status deteriorated in all operatively managed and all but six conservatively managed patients at 1year. Mortality at 1 year was less for operative than non-operative

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management (operative 1/7, 14%; non-operative 8/30, 2 6.7%); however, sample sizes were too small to be significant. All mortalities were between 3 months and 1 year. Overall, they concluded that functional outcome was not affected by the involvement of the posterior pelvic ring but that it should be managed operatively if they are unstable or reduce pain.

Dechert et al.[24] retrospectively reported on 157 pelvic fractures admitted to a Level 1 trauma centre in patients with a minimum age of 65 years (mean = 75.7 years). Outcomes were compared against their series of pelvic fractures aged under 65 years and a matched control of over 65 years with blunt trauma without fracture. The mechanism was low energy falls in 30% patients; the remainder were high energy. One hundred and thirty-seven patients were non-operatively managed, with bed rest alone. No further details on duration of bed rest or other movement restrictions, such as traction, were included. The authors demonstrated that 75% patients required increased levels of care as a result of their injury. They did not clarify whether this pertained to purely non-operatively managed patients or their operatively managed cohort too. Overall mortality was 22.3% (31/139) and 5.5% (1/18) in the non-operative versus operative group, respectively. Eighteen patients were operatively managed, but no details on surgical procedure or the approach used were described. The authors did not describe the indication for operative management, patient fitness for surgery, specific patient comorbidities, fracture classification or fracture stability. The authors concluded that elderly patients, irrespective of treatment, have worse outcomes and poorer functional outcomes following pelvic fractures than younger patients and elderly patients without pelvic fractures. Unfortunately, outcomes were not analysed by mechanism or fracture type; therefore, it is difficult to make any specific conclusions regarding the fragility fractures in a series with a relatively high proportion of high energy injuries than other series.

Operative management

The evidence on surgical stabilization is predominantly limited to small retrospective case series with no controls. There is some controversy, but most authors regard pubic rami fractures even in the presence of sacral impaction following low energy falls in the elderly to be classified as stable type A or LC1 fractures.

Tosounidis et al.[25] investigated 183 pelvic fractures in the elderly and identified seven rotationally unstable fractures on computed tomography (CT) scanning initially treated as stable type A fractures. An anterior external fixator was advocated on these seven patients for an average of 3 weeks with an associated improvement in the outcome score.

Tsiridis et al.[26] published a case series of three patients with sacral insufficiency fractures treated with percutaneous sacroiliac screws, resulting in immediate pain relief, uncomplicated rehabilitation and uneventful healing.

Vanderschot et al.[27] published a significant reduction in pain and early discharge in 17 patients who had trans-sacral iliac screws for chronic sacral insufficiency fractures, of which 12 patients had osteoporosis.

Starr et al.[28] highlighted from a series of 108 surgically-repaired rami fractures that loss of reduction was common in the elderly and female patients intrinsically linked to the osteoporotic bone. They found that anterior column screws were most likely to fail in medial fractures closer to the pubic symphysis.

Analogous to stable vertebral body fractures in the elderly, there are limited studies on percutaneous sacroplasty for sacral insufficiency fractures. A prospective observational cohort study of 52 patients with a mean age of 75.9 years underwent sacroplasty[29]. A significant reduction in pain was immediately reported along with 80% reduction in visual analogue pain score at 2 weeks and 90% in 1 year from pre-procedure score. Reduced opiate requirements were also noted.

There have been a number of similar retrospective case series using fluoroscopy or CT guidance to perform sacroplasty in sacral insufficiency fractures[30–34]. They all report improved pain score, improved mobility and early discharge. All patients had attempted conservative management, but due to persisting pain, the procedure was performed.

Both percutaneous sacroplasty and insertion of sacroiliac screws carry the risk of neurovascular injury. In the severely osteoporotic bone, tactile feedback and poor hold may limit their effectiveness. In contrast to inserting bone cement, screw fixation facilitates primary bone healing, where as injecting cement can impair fracture healing. There is a risk of cement extrusion into the foramina and injury to nerve roots from either heat or space occupation. Ideal cement viscosity is currently based on vertebroplasty results. The role in acute fractures is not fully known, and potentially, the risk of cement extrusion is greater.

To date, there are no randomised comparative studies comparing operative to conservative management in fragility fractures of the pelvis.

Discussion

Differences in healthcare systems, rehabilitative provision, social support and among hospitals make comparisons between retrospective studies difficult, particularly in the absence of controls.

By excluding high energy and younger patients, this review highlights that there is great heterogeneity in low energy pelvic fractures in the elderly.

Historically, surgery has only been advocated in unstable pelvic ring injuries throughout all age groups. By comparison, proximal femoral

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fractures in the elderly carry very strong evidence that early operative management is extremely beneficial[12].

Stability and pain are intrinsically linked. Mental function and pre-operative morbidity are key indicators of greater morbidity and mortality. In younger patients, LC1 fractures can be conservatively managed because they routinely possess the mental and physical ability to follow commands and non-weight bearing on the unaffected side with or without aids. Typically, patients lacking the cognitive function to understand the cause of pain will not mobilise, and thereby, they risk the consequences of immobility. Early mortality in most studies appears to occur during the initial period when fractures are painful.

Before considering a randomised trial for internally stabilising low energy pelvic fractures in the elderly, it is appreciated that there is a spectrum of disease and that these may need to be separately classified. One suggestion is sub-classification of LC1 fractures with increasing severity into the following categories:

I Undisplaced rami only (no posterior fracture)
II Displaced rami only
III Rami fractures with anterior sacral impaction or posterior avulsion
IV Rami fractures with an associated sacral fracture that exits posteriorly

In order to identify those with sacral involvement, considering surgical management would routinely require a CT scan. NICE guidelines recommend the role of limited MRIs to rule out hip fracture, but continued pain and inability to mobilise with negative hip imaging is often a result of rami fractures with or without a missed posterior pelvic ring injury.

Surgical intervention would allow full weight bearing, and there is an expectation that pain relief gained by fixation would support early mobilisation versus the anaesthetic risk and complications of surgery itself.

Conclusion

As shown by the national hip fracture database, improved morbidity and mortality is multifactorial, and appropriate surgery is a small part of patient management. These patients should ideally be managed by a combined ortho-geriatrician service. Patient selection may not be solely based on initial diagnosis but the ability to mobilise relative to pain control over the first few days. Review by the orthopaedic team may warrant further imaging and reassess any decision for conservative management in patients with severe pain and immobility.

Performing randomised controlled trials to develop evidence-based protocols can reduce the morbidity and mortality in the elderly with fragility fractures of the pelvis.

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