



A Study on Mode of Injury, Types of Fractures and Associated Trauma in Unstable Pelvic Fractures

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The present study was aimed to analyze the mode of injury, different type of fractures and associated injuries in patients with unstable pelvic fractures who are later managed by surgical interventions.

Materials and Methods: The study involved 21 cases of unstable pelvic injuries (Tile type B and C) managed surgically patients.

Results: The result showed that out of 21 patients, 6 patients (28.6%) had associated skeletal and/or soft tissue injuries. Of which 9.4% (n=2) patients had nerve injury. Despite aggressive resuscitation including application of external fixators, the mortality of 10-20% remain unchanged.

Conclusion: Anatomic reduction and internal fixation of unstable pelvic injuries gives excellent stability, allows for early mobility with good functional outcome.

Keywords: Fracture; injury; soft tissue; pelvic ring.

1. INTRODUCTION

Fractures and injuries of the pelvic ring, which may or may not be associated with severe trauma, are infrequent and account for only 2 to 8% of all fractures encountered in orthopaedic trauma. However, in the poly-traumatized patients with other system injuries, the occurrence of pelvic ring injury is much higher, being observed in as frequently as 20 to 25% of cases [1].

Fractures of the pelvic ring in the young individuals most often occur as a consequence of high-energy trauma; such as car or motorcycle accident and from falls from great heights. In the elderly, they are usually caused by a low-energy trauma, and are most commonly due to a fall from standing height, comprising mainly due to bone porosity.

All the young patients with pelvic ring fractures or injuries due to the high-energy trauma, should be initially assessed by a multi-disciplinary team, because they often have multiple organ injuries and are subject to major internal bleeding. Bleeding in this type of injury is more severe when associated with unstable pelvic fractures. In turn, elderly patients with fractures due to minor trauma generally do not develop these many lethal complications [2].

Of late, a considerable number of studies related to the care and immediate or late complications of this type of injuries have been published [3]. These increasingly inform and guide the professionals involved in protocol management of such care, characterizing the importance and severity of the injury, especially in the poly-traumatized.

Understanding the anatomy of the pelvic ring is essential for accurate diagnosis and treatment. A systemic approach taking into account the mechanism of injury, physical examination and radiographic assessment is important to quickly identify unstable pelvic disruptions and their associated injuries. The pelvis is a ring like structure, isolated pubic rami fracture on plain radiographs are unusual and should warrant careful evaluation for posterior pelvic disruption with 3D CT imaging. Computed tomographic scanning is thus an effective method of examining the pelvis. Hemorrhagic shock can occur in about 10% of pelvic ring injuries [4]. Immediate recognition and treatment of this life threatening condition is critical in emergency

management. In addition to fluid resuscitation and blood transfusion, circumferential wrapping, angiographic embolization, laparotomy with pelvic packing, and external fixation are all a part of an important life saving adjuncts in the setting of such hemo-dynamic instability [5].

Stability is achieved by the ability of the osseoligamentous structures of the pelvis to withstand physiologic stresses without abnormal deformation. The supporting pelvic ligaments, including the posterior and anterior sacroiliac, ilio-lumbar, sacro-spinous, and sacro-tuberous ligaments, play a very crucial role in pelvic stabilization. One need to be familiar with the ligamentous anatomy and the bio-mechanics relevant to understanding pelvic ring disruptions. The Young and Burgess classification system is a systematic approach for interpreting pelvic ring disruptions and assessing stability on the basis of fundamental force vectors that create predictable patterns [6]. This system also provides for an algorithmic approach to interpreting images and categorizes injuries as antero-posterior compression, lateral compression (stable and unstable variant), vertical shear or any such combined. Opening and closing of the pelvis from rotational forces result in antero-posterior and lateral compression injuries. In the vertical shear injuries, there is a cephalad displacement of the hemipelvis. Knowledge of these injury patterns leads to prompt identification and diagnosis of other subtle injuries and their associated complications by appropriate imaging, so that the orthopedic surgeon can apply corrective forces for prompt pelvic stabilization.

Patients who sustain these injuries fall into two categories, viz; survivors and non-survivors. In non-survivors, mortality is of a bimodal distribution. Early death is common due to haemorrhage or associated traumatic brain injury. Late death is usually because of overwhelming sepsis and or multi-organ failure. Survivors frequently experience long-term medical and socio-economic implications of fractures of the pelvic fractures. These include mental health issues, chronic pain, pelvic obliquity, leg length or rotational discrepancy, abnormalities of the gait, urological and sexual dysfunction and long-term unemployment.

Among patients with multiple injuries, because of blunt trauma, up to 5 to 16% sustain injuries to the pelvic ring, resulting in a mortality rate as high as 11 to 54% that is primarily due to

hemorrhagic shock. Therefore, it is important to control the associated hemorrhage while managing these complex pelvic fractures. In most trauma units, the initial management of a pelvic fracture is based on the guidelines of Advanced Trauma Life Support (ATLS) system developed by the American College of Surgeons (ACS) Committee on Trauma. These guidelines do not contain data or a consensus on a definitive pelvic stabilization methodology [7]. In theory, the reduction and stabilization of the pelvic ring can decrease bleeding from the fracture site as a reduction of pelvic volume has been shown to reduce the extent of hemorrhage from such injuries by their tamponade effect. The sooner that the bleeding is brought under control, the greater is the chance of avoiding the "lethal triad" of hypothermia, coagulopathy and acidosis secondary to the hypotension or hypoperfusion of tissues. Early pelvic stabilization by external mechanical compression (EMC) with different devices, such as C-clamps, external fixators, and sheets, can definitely reduce pelvic volume and control hemorrhage. However, the use of C-clamps and external fixators are invasive, requires orthopedic expertise and prompt availability, but this limits access to the abdomen for exploration, subsequent nursing care, patient positioning and skin protection. Common non-invasive methods for pelvic stabilization include sheet wrapping and pelvic binders [8].

The present short term study shall aim to analyse the clinical, radiological and functional outcomes in patients with unstable pelvic fractures (Tile classification B and C based on fracture pattern), treated by surgical stabilization. The results shall be summarized by evaluating them by the Cole et al; pelvic outcome scale at the end of 7 months.

1.1 Aim and Objectives of the Study

The aim of this study is to analyze the mode of injury, different type of fractures and associated injuries in patients with unstable pelvic fractures who are later managed by surgical interventions for a better functional outcome.

2. MATERIALS AND METHODS

Ours is a prospective study involving 21 cases of unstable pelvic injuries (Tile type B and C) managed surgically patients who were hemodynamically stable were primarily take up for definitive procedures. A protocol was elaborated

with data obtained from patients/relatives and medical records, which included the following items: age, sex, color, mechanism of injury.

These patients presented in the Casualty of SREE BALAJI MEDICAL COLLEGE AND HOSPITAL, Chromepet, Chennai, during the period from March 2017 to Feb 2018 (duration 12 months).

2.1 Inclusion Criteria

- i) Both male and female patients in the age group 21 to 35 years were included.
- ii) Pelvic injuries only conforming to Tile Type B and C alone were included.
- iii) Cases with other major associated closed injuries were included.

2.2 Exclusion Criteria

- i) Patients not conforming to the above age group were excluded.
- ii) Patients with open abdominal and crush injuries of the pelvis were excluded.
- iii) Patient failing anaesthetic fitness and those with life threatening head and chest injuries were excluded.
- iv) Tile type A fractures.

Student's *t*-test was used for sex, and multivariate analysis of variance supplemented by the Tukey test was used for the variables injury mechanism and pelvic ring fracture/injury classification.

3. RESULTS

From our study series we found that majority of patients suffered road traffic accidents followed by fall from height and railway accidents were comparatively less constituting only 4.8% of total number of cases.

61.90% (n=13) of cases were of tile type B and 38.10% (n=8) number of cases were tile type C. Two patients suffered open fractures in our series and the rest were closed injuries.

3.1 Fracture Pattern Distribution

In our case series out of 21 patients, 6 patients (28.6%) had associated skeletal and/or soft tissue injuries. Of which 9.4% (n=2) patients had nerve injury.

Table 1. Mode of injury

Mode of injury	Number of patients	% age
R.T.A	18	85.7%
Fall from height	02	9.5%
Railway accidents	01	4.8%
Total	21	100%

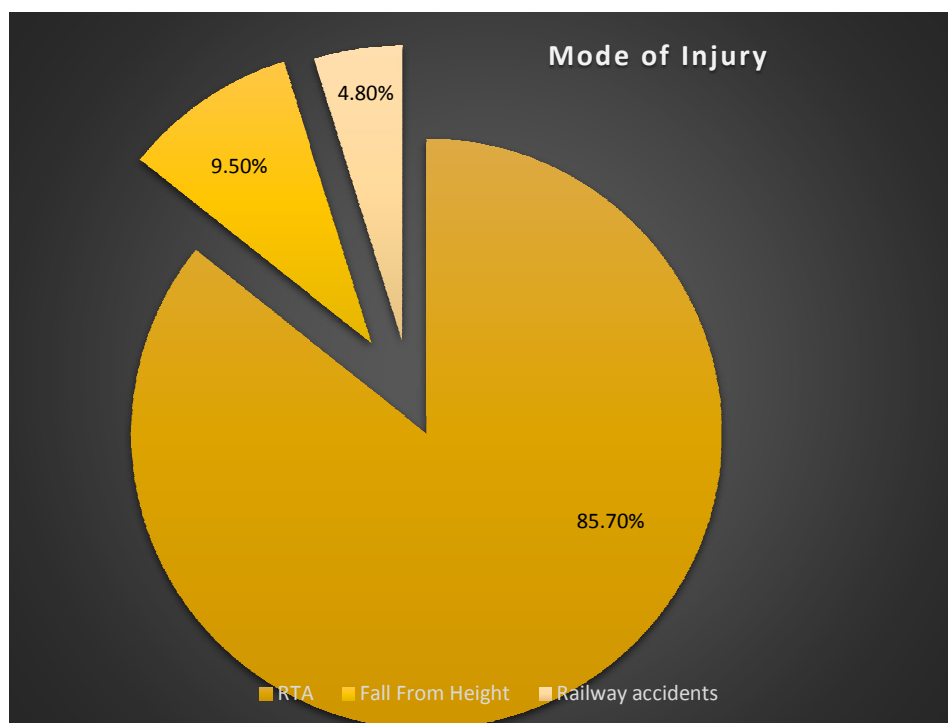


Fig. 1. Mode of injury

Table 2. Fracture pattern distribution

Tile's type	Number of patients (n)	% age
B1	6	28.60%
B2	6	28.60%
B3	1	4.75%
C1	5	23.80%
C2	2	9.50%
C3	1	4.75%
Total	21	100%

Table 3. Associated injuries

Associated non skeltal injuries	Number of patients (n)	% age
Nerve injury (L4-L5)	2	9.4%
Injury to urethra	1	4.8%
Injury to urinary bladder	1	4.8%
Injury to external iliac artery	1	4.8%
Head injury	1	4.8%
Total	6	28.6%

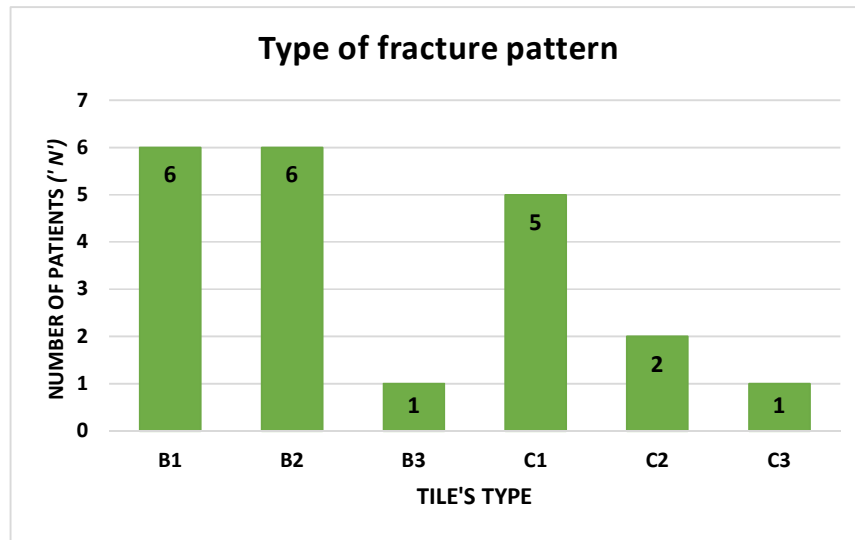


Fig. 2. Type of fracture pattern

4. DISCUSSION

Road traffic accidents were the most common mode of injury in our series, comprising of 85.7% ($n=18$) number of cases. 13 out of 21 patients suffered Tile's type B (B1-6/B2-6/B3-1) (rotationally unstable) injury, and remaining 8 patients had Tile type C injuries (C1-5/C2-2/C3-1)

Analyzing the significant associated intra-pelvic soft tissue injuries in our study, we had one case each of urethral and vascular injury. We had 2 cases of L4,L5 nerve palsy Sunil et al; reported 21.79% urogenital injuries, of which 10.25% were urethral injuries. The earlier study reported urological injury in 15 of 27.27% patients with Tile's type B and C injuries. Cole et al; had reported an incidence of 9.3% urethral injuries with Tile type C pelvic fractures [9].

However, the previous study reported 19 cases of neurological injury in his series [10]. We had one patient with L4, L5 palsy on admission and he improved to a motor power of 4+ (MRC grading) in 8 months. Another case of post-operative L5 palsy recovered to grade 4 in 6 months. Thus our incidence of lower neurological injuries (9.5%) could be attributed to the fact that in our series C2 and C3 type fractures constituted only 14.28% of all cases. Tornetta et al; reported 35% of significant neurological injury in their study of 48 unstable posterior pelvic ring disruptions [11]. Probably their higher incidence was because their series dealt only with Tile type C fractures.

Injury to the intra-pelvic vasculature is probably the single most important associated injury in pelvic trauma, since the major cause of mortality in pelvic fractures is hemorrhage. Direct injury to arteries is reported in 10-20% of patients with massive hemorrhage. The incidence of direct tear of a large bore artery like external iliac artery is rare. Metz et al; reported on 39 consecutive patients with hemo-dynamic instability who underwent pelvic angiography. In their study, bleeding from either internal iliac artery or its branches were the cause of hemorrhage in all of their patients. In our study, we came across only one patient with external iliac artery injury which was managed by the vascular surgeon and emergent pelvic external fixation. This was followed 2 weeks later with ORIF. It was a typeC3 pelvic fracture. However the outcome in this caes was poor.

The incidence of deep vein thrombosis in major pelvic fracture patients is reported at being between 10 to 80% in various studies. We used thrombo-prophylaxis in all cases and in our series we did not have any symptomatic deep vein thrombosis.

5. CONCLUSION

Conventional orthopaedic wisdom is that patients who survive disruption of the pelvic ring eventually had few late musculo-skeletal problems. But studies on the natural history of the pelvic ring injuries proved that the unstable types had high mortality in the acute stage and

chronic morbidity in the long term. Despite aggressive resuscitation including application of external fixators, the mortality of 10-20% remain unchanged. This led to clinical trials on internal fixation and several studies have shown that early open reduction and stable internal fixation improves the chances of survival and more importantly, reduces the incidence of late musculo-skeletal morbidity.

Anatomic reduction and internal fixation of unstable pelvic injuries gives excellent stability, allows for early mobility with good functional outcome. Delayed internal fixation was not associated with increased peri-operative morbidity. These cases achieve better reductions than those that are obtained with external fixation alone. Delaying the fixation, however, increased the difficulty of obtaining anatomic reduction in certain cases. Even delayed internal fixation may yield equally good functional outcome in patients where near anatomic reduction could be obtained.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

Ethical clearance was obtained from the panel committee of Sree Balaji Medical College and Hospital.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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