



## Review

## Pelvic fracture in multiple trauma: Are we still up-to-date with massive fluid resuscitation?



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## ABSTRACT

Until today the mortality of complex pelvic trauma remains unacceptably high. On the one hand this could be attributed to a biological limit of the survivable trauma load, on the other hand side an ongoing inadequate treatment might be conceivable too. For the management of multiple trauma patients with life-threatening pelvic fractures, there is ongoing international debate on the adequate therapeutic strategy, e.g. arterial embolization or pelvic packing, as well as aggressive or restrained volume therapy. Whereas traditional pelvis-specific trauma algorithms still recommend massive fluid resuscitation, there is upcoming evidence that a restrained volume therapy in the preclinical setting may improve trauma outcomes. Less intravenous fluid administration may also reduce haemodilution and concomitant trauma-associated coagulopathy. After linking the data of the TraumaRegister DGU<sup>®</sup> and the German Pelvic Injury Register, for the first time, the initial fluid management for complex pelvic traumas as well as for different Tile/OTA types of pelvic ring fractures could be addressed. Unfortunately, the results could not answer the question of the adequate fluid resuscitation but confirmed the actuality of massive fluid resuscitation in the prehospital and emergency room setting. Low-volume resuscitation seems not yet accepted in practice in managing multiple trauma patients with pelvic fractures at least in Germany. Nevertheless, prevention of exsanguination and of complications like multiple organ dysfunction syndrome still poses a major challenge in the management of complex pelvic ring injuries. Even nowadays, fluid management for trauma, not only for pelvic fractures, remains a controversial area and further research is mandatory.

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**Introduction**

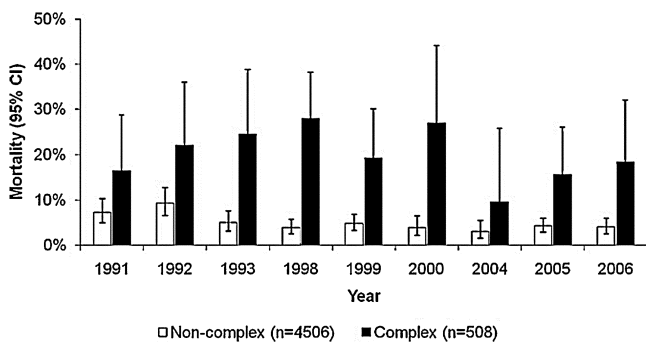
Pelvic fractures are relatively uncommon with a reported incidence of only 2–8% of all fractures, but in multiple trauma patients, the frequency can rise up to more than 25% [1–4]. The risk of haemorrhage makes pelvic fractures the most serious skeletal injury resulting in substantial mortality that ranges from 5% to 50% in the literature and is dependent not only on the type of pelvic ring fracture but also on the severity of associated injuries involving the abdomen, chest, and central nervous system [5–12]. Even if actual studies found out a distinct decrease over the time, until today, the mortality rate of multiple trauma patients with so called “complex pelvic traumas” remains unacceptably high, approximately 18% [11,12] (Fig. 1). Thereby, the definition for “complex pelvic trauma” is the association with pelvic soft tissue injuries, e.g. open fracture including Morel-Lavallée lesion, disruption of pelvic vessels including retroperitoneal haematoma, urogenital injuries, hollow viscous injuries or neurologic deficits directly caused by the pelvic fracture [5]. On the one hand this stagnation of mortality could be attributed to a biological limit of the survivable trauma load, on the other hand side an ongoing inadequate treatment might be conceivable too.

**Pelvic anatomy and sources of bleeding**

The pelvic ring comprises of a three-element bony ring, formed by the ligamentous juncture of the sacrum and both innominate bones. With its tight sacra-iliac, sacra-tuberous, and sacra-spinous ligaments, normally, the pelvic ring provides a stable compartment for the neurovascular and visceral structures of the pelvis. In case of pelvic fractures haemorrhage can be generated from iliac arterial branches, the presacral venous plexus, or the large bulk of cancellous bone, whereby the blood loss typically is retroperitoneal. Unfortunately, it is difficult to know the proportional contributions of venous and arterial bleeding to the overall pelvic haemorrhage. In contrast to the self-limiting fracture bleeding at the extremities, the bleeding of the pelvic fractures follows the “chimney effect”. Because of the disrupted compartments in the retroperitoneal area, there is no self-tamponade and the patient is at high risk to bleed to death [5–7]. Thus, to stop the intrapelvic bleeding represents the most important step in the emergency management of this fracture entity followed by optimizing the patient’s ability to coagulate the bleeding vessels [13].

**Pelvic ring fracture classification**

The two most commonly utilized classifications are those described by Tile [14] and by Young and Burgess [15]. While the

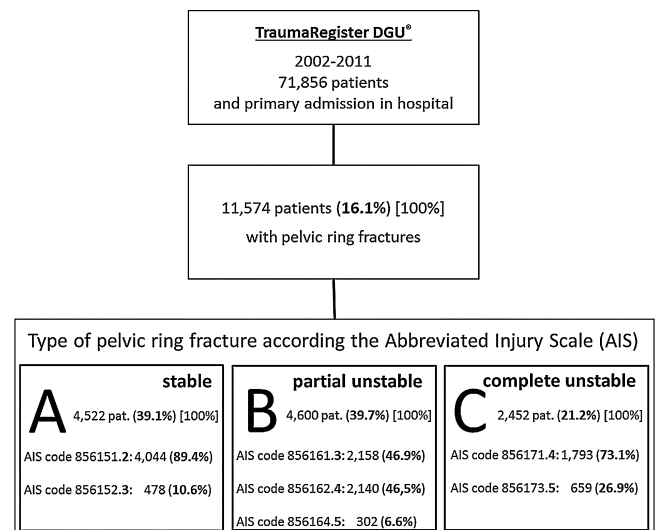


**Fig. 1.** Stratified risk of mortality in patients with non-complex and complex pelvic trauma. Source: Data from the German Pelvic Injury Register. Modified from Pohlemann et al. [11].

classification system by Tile primarily focuses on the stability of the posterior pelvic ring, Young and Burgess, in addition, brought the concept of the underlying trauma mechanism into the focus. In contrast to the Anglo-American world, in Germany, the Tile classification adopted by the Orthopaedic Trauma Association (OTA) is used most widely [16], e.g. in the German Pelvic Injury Register and indirectly in TraumaRegister DGU®. The latter uses for all injuries the Abbreviated Injury Scale (AIS), but for pelvic ring fractures, the AIS<sub>pelvis</sub> bases to some extent on the Tile/OTA classification that differs between 3 types of injuries: Type A: Stable injuries of the iliac wing, sacrum and coccyx, and anterior pelvic ring. Type B: Rotationally unstable, but vertically stable injuries of the anterior and posterior pelvic ring. And Type C: Rotationally and vertically unstable injuries with complete disruption of the posterior arch [16,17] (Fig. 2).

**Prehospital trauma care**

The prehospital management of multiple trauma patients with pelvic fractures used to include a physical examination of the pelvic ring for mechanical instability. But, Pehle et al. found out that a clinical examination only has a sensitivity of 44% and a specificity of 99% for detecting pelvic fractures [19]. This means that even mechanically unstable pelvic ring fractures Type B/C according Tile/OTA can be missed already on scene. Nowadays, however, it is accepted that early application of a pelvic binder provides mechanical stability of the pelvic ring and allows clot formation. This may prevent ongoing pelvic derived haemorrhage and the often-lethal trauma-induced coagulopathy. Thus, actual consensus statements propose that pelvic immobilization should be used routinely if there is any suspicion of pelvic fracture based on the mechanism of injury, symptoms and clinical findings [20,21]. Looking for the administration of fluids in the prehospital setting, in the actual literature, there is upcoming evidence that limiting the amount of fluids given by following a strategy of permissive hypotension during the initial resuscitation period may improve trauma outcomes [22–24]. In 2011, Hussmann et al. showed by TraumaRegister DGU® data, that increasingly preclinical volume led to a slight elevation of lethality as well as of transfused packed red blood cells concentrates (PRBCs) in multiply injured patients after severe pelvic trauma. As a result, they



**Fig. 2.** Overview of the frequency, types, and severity of pelvic ring fractures according to the Abbreviated Injury Scale (AIS) of TraumaRegister DGU® from 2002 to 2011. Source: Modified from Burkhardt et al. [18].

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