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The role of angio-embolization in the acute treatment concept of severe pelvic ring injuries

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KEYWORDS

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ABSTRACT

Background: In recent years a wide variety of strategies to treat the haemodynamically unstable patient with pelvic ring fractures have been proposed. This study evaluates our institutional management of patients with severe pelvic fractures and analyses their outcomes.
Methods: Retrospective review of all severely injured trauma patients with pelvic ring injuries admitted to a level I trauma centre from 2007 to 2012. Patient records were documented prospectively in a trauma database and evaluation was performed by SPSS.
Results: During the study period, a total of 173 patients with pelvic ring fractures were admitted and formed the basis of this study. Overall, 46% of the patients had suffered a type A fracture, 25% a type B fracture and the remaining 29% a type C pelvic ring fracture. Surgical treatment was required in 21% of the patients (pelvic C-clamp, n = 6; supra-acetabular external fixator, n = 32; pelvic packing, n = 12; definitive plate osteosynthesis of the pubis symphysis, n = 6). Angio-embolization was performed in 16 patients (9%); in 8 patients it was the only specific treatment for the pelvic injury on day 0 and in 8 patients it was performed immediately post-operatively. The overall mortality rate was 12.7% (n = 22), with the type C pelvic fractures having the highest mortality (30.0%). Four patients died immediately after admission in the shock room.
Conclusions: Angiographic embolization as a first-line treatment was only performed in haemodynamically stable patients or in patients responding to fluid resuscitation with the finding of an arterial blush in the CT scan. In haemodynamically unstable patients, pre-peritoneal pelvic packing in combination with mechanical pelvic stabilization was immediately carried out, followed by angio-embolization post-operatively if signs of persistent bleeding remained present.

Introduction

Pelvic fractures represent a significant challenge for the trauma surgeon in terms of life-threat and functional outcome. An increased recognition of pelvic fractures as a marker of injury severity, as well as improved algorithms for resuscitation, skeletal fixation, and critical care monitoring, have done much to advance the care of these often severely injured patients [1]. However, mortality still remains significantly high; the overall mortality rate of patients with any pelvic fracture ranges between 5-10% [2-6], in haemodynamically unstable pelvic ring fractures it is up to 60% [7-9] and in patients with open pelvic fracture as high as 70% [10,11].

While in recent years a wide variety of strategies to treat the haemodynamically unstable patient with pelvic fractures have been proposed [2,12-20], there is still no clear consensus as to the best management strategy for these patients. Basically, two different fundamental treatment modalities have been advocated to address persistent haemodynamic instability due to pelvic fractures: angiography with sequential embolization controlling arterial hemorrhage versus pelvic packing, which mainly controls venous bleeding and bleeding from the fracture sites. However, the establishment of gold standard treatment guidelines is difficult due to the associated multisystem injury pattern in these patients. Recently, our group published our institutional management algorithm for patients with severe pelvic fractures, basically describing the integration of angio-embolization into the early clinical treatment protocol based on the contrast media extravasation in the initial CT-scan [18]. This study evaluates our management decisions in patients with severe pelvic fractures, in particular in the light of the current controversy with regards to the optimal emergent treatment, and analyses their outcomes.

Patients and methods

After approval by the Institutional Review Board, we retrospectively reviewed all severely injured trauma patients with pelvic ring injuries admitted to the Hospital of the J. W. Goethe University Frankfurt/Main from January 2007 through December

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2012. Further inclusion criteria were: acute blunt trauma, primary admission and age ≥18 years. Data was prospectively documented using a computer-based online documentation tool [21,22].

The exact pelvic fracture pattern according to the Tile classification (type A/B/C) and the acute (day 0) management of the pelvic injury was extracted from the database and the electronic patient file (X-rays/CT scan, operation report, discharge summary). Patient variables abstracted included age, gender, mechanism of injury, blood pressure and Glasgow Coma Scale (GCS) score on admission, Injury Severity Score (ISS), Abbreviated Injury Score (AIS) for each body region (head, chest, abdomen, extremity), and outcome (intensive care unit [ICU] and hospital length of stay, sepsis, multiple organ failure [MOF], mortality). Continuous variables were converted into dichotomous variables using clinically relevant cut-points (Age ≥ 55 years, systolic blood pressure < 90mmHg, GCS ≤ 8, ISS ≥ 25, AIS ≥ 3).

Emergency Department Algorithm in Patients with Pelvic Fractures

All patients presenting with pelvic ring injuries underwent management according to our institutional protocol for pelvic injuries, outlined in Fig. 1. The general approach is based on the patient's haemodynamic stability and the patient's response to volume resuscitation. The evaluation of the trauma pattern and the initial management follows the principles of Advanced Trauma Life Support (ATLS®). Surgeon-performed focused assessment sonography for trauma (FAST) is performed in the emergency room upon arrival. Further assessment includes plain radiographs of the chest and pelvis. In parallel, a definitive airway is obtained (liberal intubation in patients with severe pelvic trauma) and a large-bore intravenous access is established (preferably large-bore central catheters). In terms of volume resuscitation, 2 litres of crystalloid solution are administered followed by packed red blood cells (PRBC) and fresh frozen plasma (FFP) in the haemodynamically unstable patient. For temporary mechanical fracture stabilization, a pelvic binder is placed on arrival if it has not been done in the pre-hospital phase. If the patient's systolic blood pressure remains less than 90mmHg despite PRBC transfusion, the patient is considered to be a "non-responder". These patients are not amenable to further diagnostic procedures and undergo urgent exploration, pre-peritoneal pelvic packing and mechanical stabilization of the pelvic fracture (pelvic C-clamp, supra-acetabular external fixator). During pelvic packing, associated injuries that contribute to mortality, such as intra-abdominal haemorrhage, haemo-pneumothoraces and long bone fractures are simultaneously assessed and treated with damage control techniques. In the case of persistent haemodynamic instability with ongoing need of volume resuscitation following surgery, a subsequent angiography is performed. If extravasation of contrast is seen, selective embolization with coils or foam is performed. Evidence of vessel spasm or abrupt cut-offs of vessels are likewise seen as signs of injury and embolization is carried out. If the patient stabilizes after angioembolization, their trauma evaluation is completed, including CT scans and any necessary plain radiographs. Subsequently, the patient is transferred to the ICU for further resuscitation.

Patients initially responding adequately to fluid boluses and holding the systolic blood pressure >90mmHg ("responder") undergo contrast-enhanced CT scan evaluation following the primary survey. In case of contrast extravasation, a pelvic angiography with embolization is subsequently performed with the pelvic binder in place. Patients with ongoing need of volume replacement to achieve haemodynamic stability, with ongoing

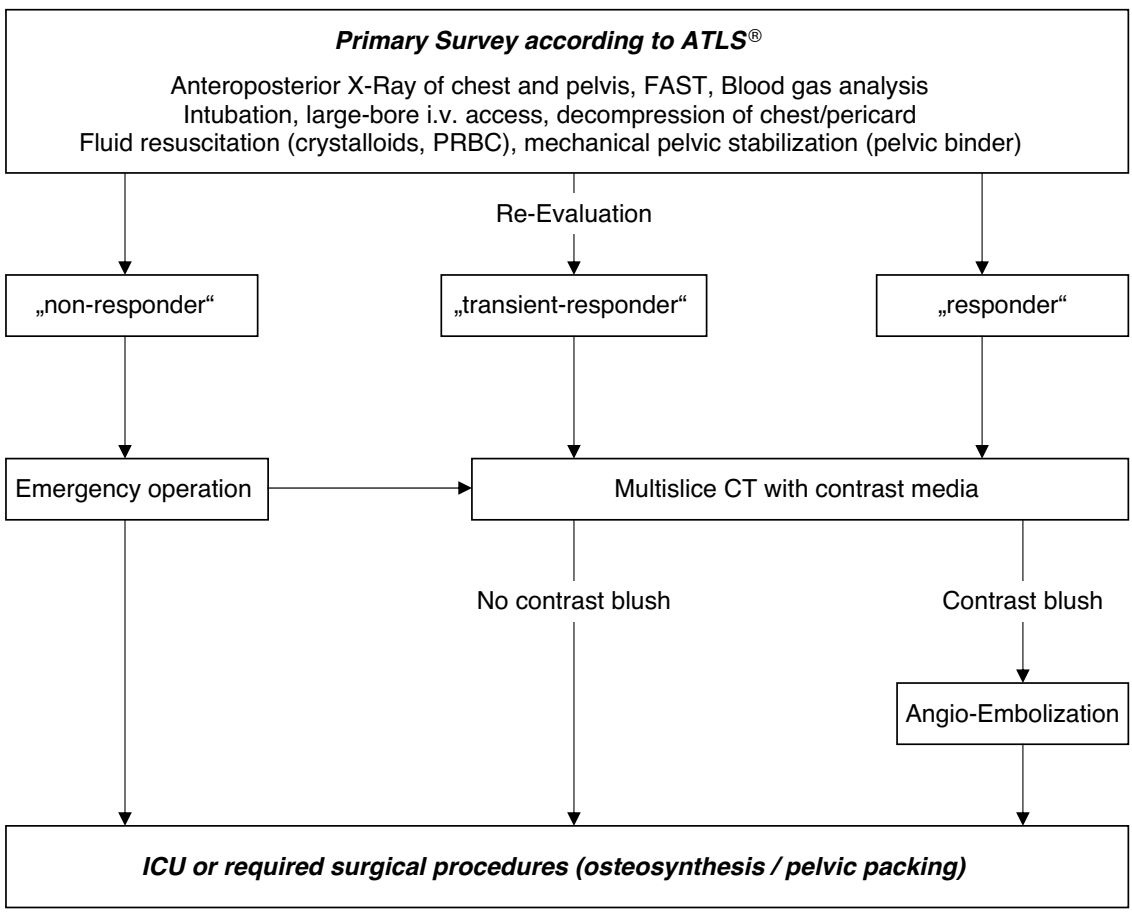

Fig. 1. Emergency department algorithm in patients with pelvic fractures.