# Management of hemorrhage in patients with pelvic fracture and hemodynamically unstable

## *Tratamento da hemorragia da fratura pélvica em doente instável hemodinamicamente*

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## INTRODUCTION

During the twentieth century, the mortality of trauma victims with pelvic fractures decreased significantly and is currently between 5% and 17% [1-3]. However, these rates increase to 25% to 35% when considering patients with unstable pelvic fractures, despite the organized use of various measures for early diagnosis of the focus of bleeding, blood transfusions, treatment of coagulation and hemostasis precoce[1-3].

Most pelvic fractures do not bring specific challenges to their treatment, are stable and do not pose a greater chance of retroperitoneal bleeding. The prognosis of these patients is mainly related to the presence and severity of associated injuries [1]. However, in patients with complex and unstable fractures, retroperitoneal hemorrhage may be lethal [4].

In most cases, the retroperitoneal hemorrhage due to pelvic fractures has a venous or bone origin, but can also be secondary to arterial lesions [5, 6]. Arterial lesions are uncommon in pelvic fractures, but are associated with refractory hemorrhagic shock and high mortality and require specific treatment such as angiographic embolization, which few hospitals have available 24 hours a day.

The hemodynamically unstable patient with pelvic fractures is a challenge for the surgeon who must decide between several treatment options that include: laparotomy (for control of intra-abdominal hemorrhage), external fixation of pelvic fracture, pelvic angiography and embolization, extra-peritoneal pelvic packing as well as control of bleeding in other locations such as in open fractures and the thorax [6-9].

The TBE-CiTE group participants conducted a critical review of current literature and generated recommendations "based on evidence" for the treatment of pelvic fractures in hemodynamically unstable patients. The focus was on the preperitoneal pelvic packing and the importance of the protocols for the treatment of these patients.

## STUDY 1

Preperitoneal pelvic packing and external fixation with secondary angioembolization: optimal care for life-threatening hemorrhage from unstable pelvic fractures.

### Rationale

The angioembolization (AE) is a method frequently recommended for controlling pelvic hemorrhage of arterial origin in unstable patients. However, few hospitals around the world have AE available 24 hours per day, angiography requires the transfer of an unstable patient to radiology and in most cases (85%) the hemorrhage is not arterial, but from veins and/or bone. Another option to control bleeding in pelvic fractures with hemodynamic instability is the preperitoneal pelvic packing (PPP). PPP is different from packing through a laparotomy and is used by few trauma centers. PPP consists of a median incision from 6 to 8 cm from the pubic symphysis followed by preperitoneal packing with surgical compresses located

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together by the pelvic ring, on either side of the bladder. The authors of this study, who are probably the ones that use this technique in the United States, suggest that PPP associated with external fixation (EF) of the pelvis is a tactical option to stop the bleeding and make AE more effective in selected patients.

### Question

PPP, associated with EF of the pelvis as initial treatment for patients with hip fractures and hemodynamic instability, rapidly stops bleeding of pelvic origin, allowing other emergency surgical procedures. Does this make the use of angioembolization more effective?

### Main Findings of this Study

· The study is a review of the experience of a single trauma center with 75 patients with pelvic fractures and hemodynamic instability, who underwent PPP + EF over a period of $5^{1/2}$ years.

· Patients took an average of 66 ± 7 minutes to be taken to the operating room where they were subjected to PPP + EF, a long time considering that all were hemodynamically unstable and with evidence of active bleeding.

· Blood transfusion before surgery (10 ± 0.8 units) was much higher than during the 24 hours after surgery (4 ± 0.5 units, $p < 0.005$) suggesting that PPP + EF controlled the bleeding.

· The average time between admission and AE was 10 ± 2 hours, suggesting that the surgical procedure greatly delayed the implementation of this intervention.

· The pelvic re-packing was needed for 20% of the patients.

· The infection rate in the retroperitoneal space associated with PPP was 6%, and increased to 47% in those patients who required repeated re-packing.

· None of the patients with pelvic fractures and hemodynamic instability subjected to PPP + EF died of pelvic bleeding.

· This study suggests that the PPP + EF is an effective technique in controlling hemorrhage from pelvic fractures, and should be especially considered in institutions that do not have angioembolization available 24 hours a day.

### Strengths

· The institution has (and continues with) a protocol for the treatment of patients with pelvic fractures and hemodynamic instability.

· Homogeneity of the groups studied regarding age, Injury Severity Score (ISS), systolic blood pressure (SBP), gasometric base deficit and use of blood and associated products.

· The same technique for PPP + EF was used in all patients.

· PPP is a simple technique and can be quickly learned.

### Limitations

· The study is descriptive (a series of cases), carried out in a single center and therefore only analyzes patients submitted to PPP + EF.

· Patients with associated lesions were subjected to various procedures that have not been standardized.

· The protocol used by the Trauma Center and presented in the study determines that those patients with negative FAST received two units of packed red blood cells, and from then on hemodynamic presentation is used to define behavior. However, those patients with positive FAST are referred for exploratory laparotomy in addition to PPP/EF. The study algorithm starts the management of patients with hip fracture by FAST and not by hemodynamic presentation. During discussions of this study, it became clear that the majority of those present did not adopt this protocol in their hospitals.

· The authors did not compare PPP with the transperitoneal pelvic packing, which is used by most trauma centers around the world, or with angioembolization, used as the first line of treatment and followed by surgery.

## STUDY 2

Guidelines for conduct of the Eastern Association for the Surgery of Trauma (EAST) for bleeding from pelvic fractures: update and systematic review[6].

### Rationale

Hemorrhage caused by pelvic fracture by blunt trauma is associated with high mortality and morbidity rates. EAST, which had previously defined the guidelines for conduct for this type of trauma in 2001, decided to update and revise its recommendations through a systematic review of the literature of the period between 1999 and 2010. The study specifically answered six questions about the treatment of bleeding in pelvic trauma. This paper was discussed at TBE-CiTE as an example of the appropriate manner of generating evidence-based recommendations. To align the discussions with the other two papers presented, only two of the six issues were discussed: which patients benefit from preperitoneal pelvic packing (PPP) and which from angioembolization (AE).

### Question

Which patients, with bleeding due to pelvic fracture by blunt trauma, benefit from PPP? And which benefit from AE?

### Main Findings of this Study

· Preperitoneal packing is effective in controlling pelvic bleeding when used:

o After angioembolization, when the bleeding is not controlled (level III recommendation).

o As part of a multidiscipline procedure for the treatment of these patients (level III recommendation).

· The systematic review also commented on evidence that PPP:

o Could be used as initial treatment.

o Has a high success rate in controlling pelvic bleeding.

o Appears to reduce the need for blood transfusions.

o May be useful where neither angiography nor AE is readily available.

· For patients with hip fractures, AE is indicated:

o When there is more hemodynamic instability after excluding extra-pelvic causes of bleeding (level I recommendation).

o When there is further evidence of arterial bleeding (as in a CT scan) (level I recommendation).

o In patients over 60 years, provided they have a severe pelvic fracture without evidence of arterial bleeding (level II recommendation).

### Strengths

· Systematic literature review based on scientific evidence. The authors were chosen by a well-established institution, EAST, and follow well defined rules to generate their recommendations.

· The recommendations were classified according to "levels". For example, the "Level I" recommendations are based on strong scientific evidence, while the "level III" recommendations have no scientific evidence to support them.

· The update and review are part of the search for answers to six specific questions regarding the treatment of pelvic trauma with hemodynamic instability. The questions were:

1. Which patient should be subjected to early external mechanical stabilization?

2. Which patients require emergency angiography?

3. What is the best method to exclude extra-pelvic bleeding?

4. What radiographic findings predict a hemorrhage?

5. What is the role of temporary external non-invasive devices?

6. Which patients should be submitted to PPP?

· TBE-CiTE's discussion focused on questions 2 and 6.

### Limitations

· Despite advances in knowledge of pelvic trauma, many recommendations for its treatment still had to be made without scientific evidence to support them.

· The authors only found scientific evidence to warrant level I or II recommendations for questions 1 through 4.

· The article sought answers to conflicting issues of practice in the treatment of patients with hemorrhages due to pelvic fracture, however it did not define a procedural algorithm (or protocol).

## STUDY 3

The treatment of pelvic fracture with hemodynamic instability according to *Advanced Trauma Life Support* (ATLS®) results in high mortality[8].

### Rationale

Patients with pelvic fractures and hemodynamic instability have high mortality rates. It is believed that pre-established treatment protocols, such as ATLS, could reduce this mortality rate. This paper was discussed by TBE-CiTE with the idea of contrasting recommendations based on evidence and systematic literature review (as in the previous study) with recommendations based solely on the experience of a single service.

### Question

Does the treatment of pelvic fracture with hemodynamic instability, using the principles of ATLS and AE, result in an unacceptably high mortality rate?

### Main Findings of this Study

This study is a review of the files of 48 patients with pelvic fractures and hemodynamic instability admitted to a single hospital over a period of five years. According to the authors, all patients were treated according to the principles of ATLS, and 14 patients underwent AE soon after admission. The mortality rate in this study was 41.7% and the most common causes of death were pelvic bleeding and head trauma. The mortality rate observed in this study is higher than that reported in other studies published between 1990 and 2009.

Despite many limitations, the study concluded that ATLS and AE are not adequate for the treatment of patients with pelvic fractures and hemodynamic instability, and recommends the development of new protocols. These conclusions were questioned by the majority of TBE-CiTE participants, who agreed that the evidence presented, along with the limitations of the study, do not indicate that ATLS should not be used to guide the resuscitation of these patients.

### Strengths

· The study suggests that treatment protocols for patients with trauma, massive transfusion, etc. can help reduce mortality in hip fractures.

· The authors comment that different types of intervention (FE, AE and packing) plus the participation of a multidisciplinary team (orthopedist and trauma surgeon) could reduce the mortality rate.

### Limitations

· The study is retrospective and included a small number of patients (n = 48) treated over five years.

· There is no explanation of how the 11 publications used for comparison were selected.

· This study suffers from the same (and many) limitations typical of retrospective studies.

· Patients may have died for reasons that were not considered in this study (known as "unmeasured confounders"). For example, there is no information on pre-hospital care, time between injury and hospital admission, the qualifications of the team responsible for the initial care, resources available in the hospital, etc.

· It is not possible to know with certainty:

o if the care provided to patients was uniform and similar across the five years of the study and did not vary with the staff on duty, the experience of the surgeon, the day of the week, etc;

o the rigor with which the principles of ATLS were followed;

o the quality of the hospital and its resources.

· The service did not have protocols for pelvic trauma nor massive transfusion.

· The mortality rate of those patients who underwent angiography was 28%, lower than the overall mortality of 41%, which questions the study's conclusion that AE is not effective in the treatment of those patients.

## FINAL CONCLUSIONS

The conclusions are based on the three publications above. In the treatment of patients with pelvic fracture and hemodynamic instability:

1. There is evidence suggesting that preperitoneal pelvic packing (PPP) can:

- be effective in controlling pelvic bleeding,
- reduce the necessity of blood transfusions,
- be useful where there is no angiography or where it is not readily available.

However, further PPP studies are needed (evidence) before being recommended as "standard of care" for patients with pelvic fracture and hemodynamic instability.

2. There is solid evidence that angioembolization is effective in controlling the bleeding of arterial origin in pelvic trauma. Therefore AE is indicated as the treatment for patients with pelvic fracture and hemodynamic instability where arterial bleeding is suspected (level I recommendation).

3. Few recommendations are based on solid scientific evidence (as in prospective and randomized studies). Probably the best evidence-based recommendations are published by EAST.

4. There is evidence that protocols for the evaluation and treatment of these patients can reduce the high mortality rate associated with pelvic fracture with hemodynamic instability.

## RECOMMENDATIONS

1. Surgeons should consider learning the technique of preperitoneal pelvic packing, since:

a. it can be effective in containing pelvic bleeding, and

b. it can be useful in hospitals where angiography is not available.

2. When available, angioembolization is to be used to control the bleeding of arterial origin caused by pelvic fracture.

3. Every institution that receives patients with hip fractures should have a multidisciplinary care protocol for the care of these patients. We suggest that such a protocol should include:

a. Methods for the rapid identification of the source of the bleeding (X-ray of the thorax, X-ray of the pelvis and FAST/LPD).

b. A method of pelvic immobilization early in the emergency room such as water or binders.

c. A method of blood transfusion that includes well-defined "triggers" for the transfusion of packed red blood cells, fresh plasma and tranexamic acid (see TBE-CiTE publication of January, 2012[10]).

d. An algorithmfor the control of retroperitoneal hemorrhage involving early external fixation, angioembolization and preperitoneal packing. The order of procedures and their indications should be decided based on local resources.

e. A periodical review of the protocol and any associated problems, to be discussed in groups, with the aim of providing improvements in care.

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**Disclaimer**
The recommendations and conclusions of this paper represent the OPINION of the participants of the TBE-CiTE journal meeting, and not necessarily the views of the institutions to which they belong.

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