

## REVIEW ARTICLE

# Patients with hemodynamic unstable pelvic fractures *in extremis*: Pelvic packing or angiography? ☆

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### KEYWORDS

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Pelvic packing;  
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### PALABRAS CLAVE

Fractura pelvis;  
Packing pélvico;  
Angiografía

**Abstract** The multidisciplinary management of patients with pelvic trauma has improved prognosis, but mortality is still very high. The appropriate treatment strategy remains controversial, especially regarding the control of bleeding in patients whose clinical situation is extreme by using angiography or pelvic packing.

We propose using a tool of evidence-based medicine (CAT) the benefit of the completion of pelvic packing in relation to a specific clinical question from a specific situation. What is best for the management of bleeding, extraperitoneal pelvic packing or angiography, in patients with hemodynamically unstable pelvic fracture *in extremis*?

From this study we can conclude that angiography may improve control of bleeding in patients with arterial bleeding and hemodynamically stable but the packing has priority in patients with pelvic fractures and hemodynamic instability.

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### Pacientes con fractura de pelvis inestables hemodinámicamente *in extremis* ¿packing pélvico o arteriografía?

**Resumen** El manejo multidisciplinar de los pacientes con traumatismo pélvico ha mejorado su pronóstico, sin embargo la mortalidad sigue siendo muy elevada. La estrategia de un tratamiento adecuado es aún controvertida, sobre todo respecto al control de la hemorragia en pacientes cuya situación clínica es extrema mediante el uso de arteriografía o *packing* pélvico.

Planteamos mediante una herramienta de medicina basada en evidencia (CAT) el beneficio de la realización del *packing* pélvico en relación a una pregunta clínica específica desde una situación concreta, ¿qué es mejor para el manejo del sangrado, *packing* pélvico extraperitoneal o arteriografía, en pacientes con fractura de pelvis inestables hemodinámicamente *in extremis*?

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De este estudio podemos concluir que la arteriografía puede mejorar el control de la hemorragia en los pacientes con sangrado arterial y hemodinámicamente estables, pero el *packing* tiene prioridad en los pacientes con fracturas de pelvis e inestabilidad hemodinámica.

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## Introduction

The Critical Appraisal Topic (CAT) tool was developed by McMaster University (Canada) based on the methodology of evidence-based medicine (EBM). Its aim is to develop a method which enables sharing of clinical learning and helps to improve skills such as clinical practice instructions conducted according to EBM principles. CAT is a brief summary of the most relevant scientific evidence related to a specific clinical issue from a specific standpoint. It is based on fast literature searches of at least 1 relevant article rather than an exhaustive exploration of all the available literature.

Despite the implementation of multidisciplinary management for patients suffering hemodynamic instability due to pelvic fractures, their mortality rate exceeds 40%<sup>1-5</sup> and in one third of cases is secondary to a failure of hemorrhage control.<sup>6</sup>

Angiography (or arteriography) has been proven to be a safe and effective technique for the control of pelvic hemorrhaging.<sup>7,8</sup> However, the question of whether angiography is better than pelvic packing to control bleeding in hemodynamically unstable patients has not yet been definitively resolved. Over 80% of hemorrhage cases in pelvic fractures originate at the presacral venous plexus and bone surfaces, whereas arterial bleeding only accounts for 10%.<sup>9</sup> The success rate of angiography for the detection and arrest of arterial bleeding is between 80% and 100%. Nevertheless, this procedure cannot control the main potential for venous bleeding associated to instability of pelvic fractures.<sup>10</sup>

We propose using CAT to investigate the existence of scientific evidence on the greater adequacy of angiography or pelvic packing in patients whose clinical situation is extreme.

## Material and Method

### Clinical Question

Which is the best option for the management of bleeding in *in extremis* hemodynamically unstable patients with pelvic fractures, extraperitoneal pelvic packing or angiography?

- Problem patients: hemodynamically unstable patients with pelvic fractures.
- Intervention to consider: extraperitoneal pelvic packing vs angiography-embolization.

Results to consider: hemorrhage control, mortality.

### Search Pattern

MeSH terms "pelvic fracture" AND "pelvic packing" AND "angiography" AND "traumatic haemorrhage".

### Search Strategy

Search in CATs banks (BMJ Groups POEMs, ATs of NeLM National electronic Library for Medicine, Center for Clinical Effectiveness, CCE, Monash University): 0 results

- PubMed: 39 results, 4 adequate.
- Cochrane: 0 results.
- TRIPdatabase: 0 results.
- Bandolier: 0 results.

## Critical Assessment of Articles

*Critical appraisal of relevant articles:* conducted based on methodology, internal validity and applicability (according to CASPe critical reading skills program; <http://www.redcaspe.org>).

Assessment of evidence levels (I, II, III) and strength of recommendation (A, B, C) (The Center of Evidence-Based Medicine in Oxford).

## Results

We assessed the following information from the 4 articles retrieved:

1. Control of severe hemorrhage using C-clamp and pelvic packing in multiply injured patients with pelvic ring disruption. Ertel W, Keell M, Eid K, Platz A, Trentz O. Zurich 2001.<sup>11</sup>

This was a prospective, III-B cohort study. *Intervention:* 20 patients between January 1, 1997 and July 31, 1999. C-clamp was used as the primary stabilization method in pelvic fractures. Packing was used in patients who presented persistent or massive hemorrhage. Serial measurements of blood lactate were conducted during the initial hours. *Inclusion criteria:* multiple trauma, injury severity score (ISS) greater than or equal to 20, unstable pelvic fracture (Tile B or C), hemorrhagic shock ( $p < 90$  mmHg after administration of over 2 l iv crystalloids). *Results:* serial measurements of lactate levels were performed in the initial hours in order to obtain quick and accurate information about the severity of bleeding (patients who died presented higher blood lactate levels in the initial hours than those who survived; 8.6 mmol/l vs 4.2 mmol/l). Pelvic packing associated to fracture fixation with C-clamp enabled an adequate control of hemorrhaging in multiple trauma

patients with pelvic ring disruption. *Weakness*: observational study which did not compare both techniques and had a small population.

2. Extraperitoneal pelvic packing: A salvage procedure to control massive traumatic hemorrhage. Tötterman A, Madsen JE, Skaga NO, Røise O. *Noruega* 2007.<sup>12</sup>

This was a retrospective, III-B cohort study. *Intervention*: 661 patients treated for pelvic trauma; 18 underwent extraperitoneal packing as a protocol for the control of massive bleeding following pelvic trauma (grade III-IV hemodynamic instability according to Advanced Trauma Life Support [ATLS]) between August 1, 2000 and March 31, 2004. *Inclusion criteria*: patients undergoing extraperitoneal packing to control massive bleeding following pelvic fracture. All presented at least one of the following clinical signs:  $p < 90$  mmHg, central venous pressure (CVP)  $< 5$  cm H<sub>2</sub>O, heart rate (HR)  $> 100$  bpm. *Results*: following an extraperitoneal pelvic packing protocol in patients with pelvic fracture and bleeding may increase survival (patients present a mean mortality rate of 28% at 30 days). The high number of arterial lesions found after packing suggests it should be supplemented with angiography once patients are stable (80% of patients in the cohort presented arterial bleeding lesion after packing). *Weakness*: retrospective observational study which did not compare both techniques and had a small population.

3. Preperitoneal pelvic packing/external fixation with secondary angioembolization: Optimal care for life-threatening hemorrhage from unstable pelvic fractures. Burlew CC, Moore EE, Smith WR, Johnson JL, Biffl WL, Barnett CC, et al. *Denver* 2011.<sup>13</sup>

This was a prospective, III-B cohort study. *Intervention*: a total of 1245 patients with pelvic fractures were treated between September 2004 and March 2010. Of these, 75 presented fracture and hemodynamic instability and underwent pelvic packing and external fixation. *Inclusion criteria*: pelvic fracture associated to hemodynamic instability (pressure  $p < 90$  mmHg despite transfusion of 2 units of packed red blood cells). *Results*: packing is a rapid method for the control of hemorrhage associated to pelvic fractures (mean time from admission until surgery was 66 min). Decreased transfusion requirements after packing (mean transfusion after pelvic packing was 4 packed red blood cells in the first 24h, compared to a mean 10 units before surgery). Packing seems to decrease mortality in high risk patients (these present a mortality rate of 21%, which is lower than that found in the literature for patients with similar characteristics). *Weakness*: observational study which did not compare both techniques and had a small population.

4. Direct retroperitoneal pelvic packing versus pelvic angiography: A comparison of two management protocols for haemodynamically unstable pelvic fractures. Osborn PM, Smith WR, Moore EE, Cothren CC, Morgan SF, Williams AE, et al. *Denver* 2009.<sup>10</sup>

This was a prospective, III-B cohort study. *Intervention*: a total of 40 patients with pelvic fractures and hemodynamic instability from November 1998 to September 2004, divided into 2 groups (packing,  $n=20$  and angiography,  $n=20$ ). *Inclusion criteria*: pelvic fracture associated to hemodynamic instability ( $p < 90$  mm Hg despite administration of over 2 l

of iv crystalloid). *Results*: packing is a faster method than angiography for the control of hemorrhage associated with pelvic fracture (mean 45 min from reception of patient until the completion of packing versus mean 130 min for angiography). There is a decrease in transfusion requirements after performing pelvic packing in the first 24h (the group which underwent angiography received a mean 10.1 units of packed red blood cells, whereas the packing group received 6.9 units). Packing reduces the need for embolization of arterial lesions (only 3 patients required embolization after packing, compared to 10 embolized patients in the angiography group). Packing seems to reduce mortality in high-risk patients. *Weakness*: observational study with a small population.

## Discussion

The CAT tool, supported by evidence-based medicine (EBM), helps professionals to find answers to clinical questions and seek the best evidence to put it into practice, providing a response to specific clinical problems and facilitating the decision making process. It has been established that CAT are valid for gathering evidence about treatment, diagnosis, etiology and systematic reviews.

Given their nature, they generally start as drafts which must be amended by critical review. This feature is one of the most important limitations. There are currently various databases with developed CAT (CATbank) and IT applications (CATmaker). These first drafts may contain miscalculations and interpretation errors or may be based on improvable evidence.

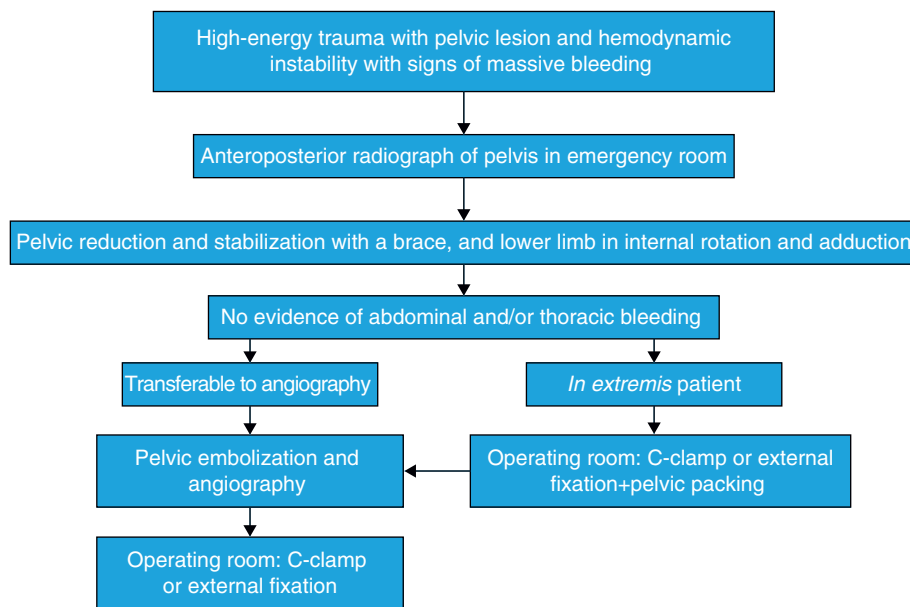
They may have a short life span and be rendered obsolete by new and better evidence. Therefore, CAT banks can be used as a starting point for updated searches for new and better evidence.

The management of patients with pelvic fractures and hemodynamic instability represents a challenge for orthopedic surgeons and the rest of the medical team.

Performing an angiography requires, firstly, having trained human and technical resources, and also involves a relatively long time period which many of these patients cannot afford. Furthermore, this method can only control arterial bleeding, but not that originating from the presacral venous plexus and that from the fracture, which according to some studies reaches 80% of the total blood loss in these patients.<sup>9,14</sup>

The conclusions obtained from this CAT were the following:

- Pelvic packing is a rapid method for the control of hemorrhage secondary to a pelvic fracture.
- Performing pelvic packing can reduce the need for transfusion in patients.
- Pelvic packing can reduce mortality due to hemorrhage.
- Performing pelvic packing may control bleeding lesions and reduce the need for angiographic embolization.
- Packing is a faster technique and is more available than angiography to control hemorrhage.
- Packing and angiography are 2 useful and complementary tools for the management of patients with pelvic fractures associated with hemodynamic instability.



**Figure 1** Action protocol for patients with pelvic fractures associated to hemodynamic instability.

- Angiography may improve hemorrhage control in hemodynamically stable patients with arterial bleeding, while packing takes priority in patients with hemodynamic instability.
- Serial measurements of lactate levels during the initial period after trauma may serve to more accurately estimate the true severity of bleeding.
- The existence of high levels of lactate and base deficit are important predictors of mortality in pelvic trauma.

These conclusions lead to the proposal of the following algorithm for patients suffering pelvic lesions associated to hemodynamic instability (Fig. 1).

## Level of Evidence

Level of evidence IV.

## Ethical Responsibilities

**Protection of people and animals.** The authors declare that this investigation did not require experiments on humans or animals.

**Confidentiality of data.** The authors declare that this work does not reflect any patient data.

**Right to privacy and informed consent.** The authors declare that this work does not reflect any patient data.

## Conflict of Interests

The authors have no conflict of interests to declare.

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