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An assessment of pelvic binder placement at a UK major trauma centre

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ABSTRACT

INTRODUCTION Pelvic binders are used to reduce the haemorrhage associated with pelvic ring injuries. Application at the level of the greater trochanters is required. We assessed the frequency of their use in patients with pelvic ring injuries and their positioning in patients presenting to a single major trauma centre.

METHODS A retrospective review of our trauma database was performed to randomly select 1000 patients for study from April 2012 to December 2016. Patients with a pelvic binder or a pelvic ring injury defined by the Young and Burgess classification were included. Computed tomography was used to identify and measure pelvic binder placement.

RESULTS 140 patients were identified: 110/140 had a binder placed. Of the total, 54 (49.1%) patients had satisfactory placement and 56 (50.9%) had unsatisfactory placement; 30/67 (44.8%) patients with a pelvic ring injury had no binder applied, of whom 6 (20%) had an unstable injury; 9/67 patients died.

DISCUSSION This is the first study assessing pelvic binder placement in patients at a UK major trauma centre. Unsatisfactory positioning of the pelvic binder is a common problem and it was not used in a large proportion of patients with pelvic ring injuries. This demonstrates that there is a need for continuing education for teams dealing with major trauma.

KEYWORDS

Advanced trauma life support care – Haemorrhage – Multiple trauma – Pelvis – Trauma centres

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Introduction

Unstable pelvic ring injuries may lead to loss of life through haemorrhage. Bleeding most commonly occurs from the posterior pelvic venous plexus but may also arise from fracture ends, arterial sources and associated injuries.[1] Early appropriate management is important to prevent haemorrhage and its associated morbidity and mortality.

Pelvic binders or, more broadly, pelvic circumferential compression devices (PCCDs) are an important part of the management of pelvic ring injuries. They are available in both the pre-hospital and emergency department setting and are advantageous in their ability to be applied expediently without the need for an operating theatre or specialist surgical training. They encourage clot formation by stabilising the injury and reduce the size of the intrapelvic volume in which haemorrhage can accumulate.[1]

Studies have shown that PCCDs are required to be placed at the level of the greater trochanters to function correctly. This position effectively stabilises the pelvic injury,[2] carries physiological benefits for the patient[5] and is the best position in which to reduce a symphyseal diastasis.[4] Despite this knowledge and its incorporation into Advanced Trauma Life Support guidelines,[5] a previous military study has shown that only 50% of binders were positioned correctly[4] and a study in the US has demonstrated that PCCDs were absent in 53% of unstable pelvic injuries.[6]

The aims of this study were to assess the frequency of application of pelvic binders in patients presenting to a single UK major trauma centre with a pelvic ring injury and to assess the position of the pelvic binder in patients presenting as a major trauma, irrespective of whether a pelvic ring injury was found.

Methods

Patient selection

From the major trauma database at Salford Royal Hospital, we randomly selected 1000 patients for retrospective review. These were patients coded as sustaining either a 'polytrauma' or 'orthopaedic trauma' who presented between April 2012 (approximate date of activation of major trauma centres in the UK) and December 2016. The electronic case records of these patients were used to identify those with either an injury to the pelvic ring defined by the Young and Burgess classification[7] (lateral compression I–III, anterior–posterior compression I–III or vertical shear) or any patient

with a pelvic binder applied, irrespective of whether a pelvic ring injury was later found to be present.

Assessment of binder position and presence

The computed tomography (CT) scans for these patients were reviewed to identify the presence of a pelvic binder (by virtue of the metal buckle, see Fig 1). The electronic case notes were used to confirm that no alternative PCCD was applied (including bed sheets) that could not be visualised radiologically.

The position of the binder was quantified by finding the mid-point between the greater and lesser trochanters (mid-trochanteric point) and the midpoint of the metal binder buckle. The distance between these two points (dotted line, Fig 1) was then measured at 90 degrees to the plane of the trochanters. In addition, if the midpoint of the buckle was within the intertrochanteric space (intertrochanteric region, Fig 1), this was considered to be a satisfactory position. If it was outside this area it was considered to be high or low. Radiological assessments were performed electronically using the Centricity™ picture archiving and communication system.

Pubic symphysis measurement

In a subgroup of patients with an anterior–posterior compression injury, we measured pubic symphysis diastasis to assess the efficacy of the pelvic binder. We measured the gap at the superior-most and inferior most parts of the symphysis and averaged the two to give a single reading. This method was previously used by Bonner *et al.*[4] to measure pubic symphysis diastasis on plain radiographs of the pelvis in a military population.

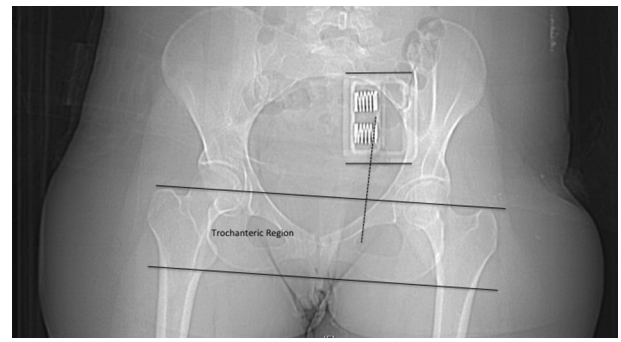

Figure 1 Measuring the position of the pelvic binder

Results

Patient group

Of the 1000 patients, 140 met the criteria for inclusion in the study (Fig 2); 112 (80%) were male and 28 (20%) were female. Mean age was 41.5 years (range 16–84 years). The mechanism of injury was a road traffic collision in 92 (65.7%), falls from height in 45 (32.1%), crush injury in 2 (1.6%) and unknown in 1 (0.8%).

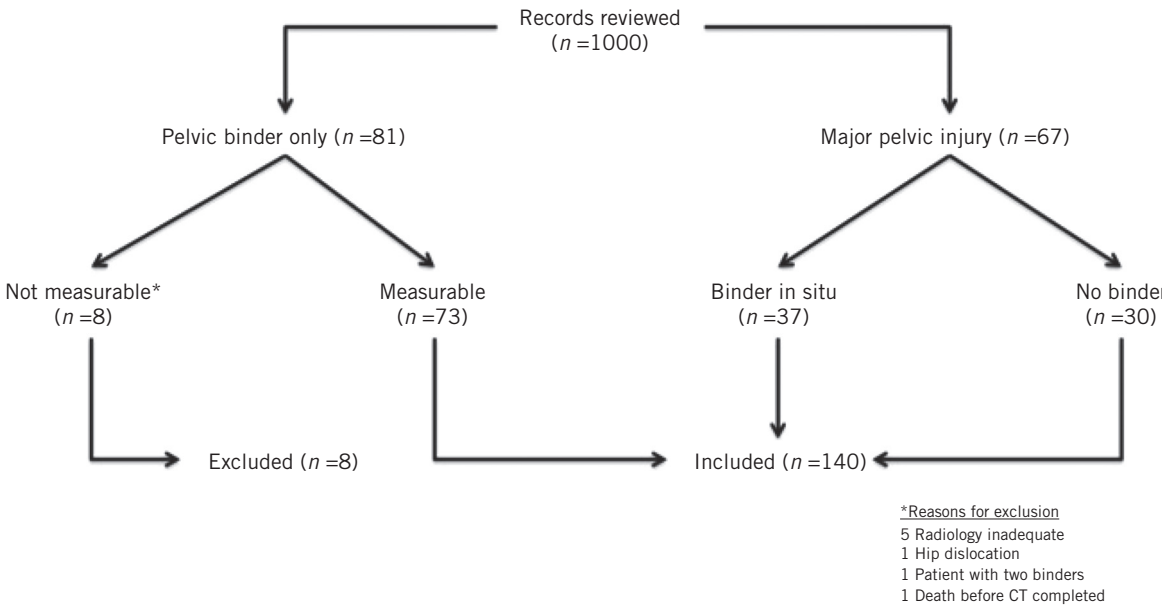

Figure 2 Flowchart demonstrating the patient selection process

Assessment of binder position

In the 110 patients with pelvic binders, 54 (49.1%) were in a satisfactory position, 45 (40.9%) were high and 11 (10%) were in a low position. The average distance of the midpoint of the buckle to the mid-trochanteric point was 40.6 mm (range 142.3 mm high to 73.7 mm low). In 30 of 67 (44.8%) patients with a pelvic ring injury, there was no attempt to apply any PCCD.

Pelvic injury group

A pelvic ring injury was observed in 67 patients (Table 1). A binder was applied in 37 cases, with 16 being in a satisfactory position. There were 9 fatalities in the 67 patients (Table 2). There were unstable injuries requiring definitive fixation in 13 patients: 4 had a binder applied satisfactorily, 3 had a binder positioned unsatisfactorily (high or low) and there was no attempt to apply a binder in 6.

An anterior–posterior compression-type injury had been sustained in 9 patients: 2 had a binder applied satisfactorily, 2 had a binder positioned unsatisfactorily (high or low) and in 5 no attempt had been made to apply a binder. A pubic symphysis diastasis was observed in of the 5 of the patients with no binder. A full breakdown of this group of patients is shown in Table 3, including mortality and whether definitive fixation was performed.

Discussion

This is the first study in the published literature to date assessing pelvic binder placement in patients at a UK major trauma centre. Unsatisfactory placement of PCCDs and recognition of serious pelvic injury remain common problems in the management of pelvic trauma and are clearly demonstrated by our results.

Table 1 Characteristics of patients with a pelvic ring injury

Injury pattern	Incidence	PCCD fitted	Placement			Mortality
			Accurate	High	Low	
Lateral compression						
I	44	21	11	8	2	4
II	7	6	1	4	1	1
III	5	5	2	1	2	1
Anterior–posterior compression						
I	1	0	–	–	–	1
II	5	1	1	0	0	1
III	3	2	1	0	1	1
Vertical shear	2	2	0	2	0	0
Total	67	37	16	15	6	9

PCCD, pelvic circumferential compression device.

Table 2 Fatalities in the pelvic ring injury group

Patient	PCCD fitted	Binder placement	Injury pattern
1	Yes	Satisfactory	LC I
2	Yes	Satisfactory	LC I
3	Yes	High	LC I
4	No	–	LC I
5	Yes	Satisfactory	LC II
6	Yes	Low	LC III
7	No	–	APC I
8	Yes	Satisfactory	APC II
9	No	–	APC III

APC, Anterior–posterior compression; LC, lateral compression.

Table 3 Patients with an anterior–posterior compression (APC) injury

Binder placement	APC injury pattern	Pubic symphysis measurement (mm)	Definitive fixation required	Mortality
Satisfactory	II	3.23	–	Died
Satisfactory	III	18.5	Yes	–
Low	III	2.89	Yes	–
Absent	II	1.8	Yes	–
Absent	III	19.51	–	Died
Absent	I	2.5	–	Died
Absent	II	6.47	Yes	–
Absent	II	26.66	Yes	–
Absent	II	35.21	Yes	–

Our results of pelvic binder positioning demonstrate incorrect placement in over 50% of patients and are very similar to those of a previous military study (current study, satisfactory 49.1%, high 40.9% and low 10%, compared with 50%, 39% and 11%, respectively).[4] A lack of knowledge of where to apply the binder has previously been identified in a written survey of trauma units in the UK. Here, a significant proportion of registrars from emergency medicine (around 60%) and orthopaedic surgery (around 20%) did not identify the greater trochanters as the correct level of binder application.[8] These findings are concerning given that incorrect positioning reduces their efficacy.[2–4,9] This is also despite the popularity of training such as the Advanced Trauma Life Support course.

The index of suspicion for unstable pelvic injuries also remains low: 30 of 67 patients with a pelvic ring injury had no binder applied; 6 of these (20%) had unstable fractures (Table 3). A previous US study demonstrated similar findings with an absence of a PCCD in 37% of patients with an unstable anterior–posterior compression or vertical shear injury.[6] Clinical diagnosis of a pelvic ring injury is difficult and external clues may be absent.[10] Springing the pelvis is no longer recommended as it can cause further bleeding and has a poor sensitivity and specificity.[11] Given the potentially disastrous consequences of an untreated pelvic fracture, we recommend that PCCDs should be used routinely in cases of high-energy trauma.

The overzealous application of PCCDs is a potential cause for concern from some. Complications of skin necrosis and peroneal nerve palsies have been described in the literature. A 2016 systematic review, however, revealed that these complications are confined to case reports.[12] In comparison with binders, hard cervical collars, which are routinely recommended in the management of major trauma, have been shown to carry a higher risk of skin breakdown of up to 6.8%.[13] No complications from PCCD application were identified in our study group. The potential over-reduction of lateral compression injuries is an argument against widespread binder use, although we consider that this represents the binder performing its function and there is no significant evidence that harm is caused. Case reports do demonstrate the uncommon possibility that a binder can mask a potentially unstable pelvic injury on CT.[14] If clinical suspicion exists, we recommend that the binder be carefully loosened or removed in a level two or three care setting and that plain radiography be performed as soon as possible to exclude an unstable injury.

While Table 2 contains information on patients who died, the aims of this study were to determine the frequency of application and positioning of binders and not the effect of this on morbidity and mortality. Several patients had multiple injuries, including head injuries. As CT was used to assess the binders, the study would not include patients with pelvic injuries with absent or incorrectly positioned binders who died from the time of injury to their assessment in hospital prior to any imaging.

One of the limitations of this study is that it is restricted to a single major trauma centre and may not be representative of other centres in the UK. Paediatric patients were not studied as children were not treated at this centre. Finally, a pelvic binder can move after its application, either over time or during transfer. However, by assessing its position on CT, we believe that any malposition of the binder should have been identified and rectified by the trauma team at the initial survey.

Conclusions

Our results demonstrate that the application of PCCDs was unsatisfactory in the majority of patients presenting to our centre. A PCCD was not applied in nearly 50% of patients with a pelvic ring injury. This highlights a need for continuing education for paramedics, emergency department staff and orthopaedic teams dealing with patients who have suffered major trauma. We believe the potential benefits in the use of PCCDs outweighs the small risk of complications and recommend routine use of a PCCD in all patients with high-energy trauma and a suspicious mechanism.

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