

Haemodynamic deterioration in lateral compression pelvic fracture after prehospital pelvic circumferential compression device application

Authors

Alan A Garner

Retrieval consultant

CareFlight

Northmead, NSW, Australia

alang@careflight.org

Ph. +61 411024614

Fax + 61 2 9843 5155

Corresponding author

Jeremy Hsu

Director of Trauma

Westmead Hospital

Hawkesbury Rd,

Westmead NSW Australia 2111

Anne McShane

Trauma Research Nurse

Westmead Hospital

Hawkesbury Rd,

Westmead NSW Australia 2111

Adam Sroor

Retrieval consultant

CareFlight

Northmead, NSW, Australia

Summary

Increased fracture displacement has previously been described with application of pelvic circumferential compression devices (PCCD) in patients with lateral compression type pelvic fracture. We describe the first reported case of haemodynamic deterioration temporally associated with the prehospital application of a PCCD in a patient with a complex acetabular fracture with medial displacement of the femoral head. Active haemorrhage from a site adjacent to the acetabular fracture was subsequently demonstrated on angiography. Caution in application of PCCD to patients with lateral compression type fractures is warranted.

Key words

Pelvic fracture, haemorrhage, binder, lateral compression

Introduction

Use of pelvic circumferential compression devices (PCCD) is becoming increasingly common in the prehospital care of blunt trauma patients including prophylactic placement in patients who have a mechanism of injury that may potentially cause pelvic ring disruption. Haemodynamic improvement has been documented in case series of patients with pubic symphysis diastasis associated with anteroposterior compression and vertical shear type injuries^{1,2}. There is, however, evidence of increased fracture displacement in lateral compression type injuries in both cadaver models³ and trauma patients⁴. We report here the first case of haemodynamic deterioration temporally associated with prehospital application of PCCD in a lateral compression pelvic injury.

Case report

A sixty two year old man with end stage renal failure was the front seat occupant of a vehicle that was struck by another vehicle at moderate speed directly into the patient's door, trapping him in the vehicle. GCS was initially 14 and the patient complained of pain in the right hip and chest. The initial observations by the responding physician helicopter emergency medical service (HEMS) team were recorded as GCS 14 (E4, M6, V4), heart rate 95 per minute, respiratory rate of 16 breaths per minute and systolic blood pressure of 115mmHg.

The patient was extricated from the vehicle and placed on an ambulance stretcher where no leg length discrepancy was noted. A PCCD (T-POD, Pyng Medical Corporation, Richmond, BC,

Canada) was applied at the level of the greater trochanters at which time the patient complained of increased pain in the right hip. Within 2 -3 minutes of application it was noted that the patient appeared to deteriorate with pulses difficult to palpate. Repeat observations revealed a heart rate of 140 per minute, respiratory rate of 18 breaths per minute and the systolic blood pressure was thought to be about 85mmHg but accurate measurement was difficult due to weakness of the pulse. eFAST scan was conducted but was normal, with no free fluid demonstrated in the abdomen, either thoracic cavity or pericardium. Significant pneumothoraces were excluded, but probable multiple rib fractures on the right hand side were identified during the examination.

The patient was urgently transported to the nearest major trauma centre during which time 1 gram of tranexamic acid was administered and packed red blood cells were prepared for transfusion. The transfusion actually commenced on arrival in the emergency department due to the short transit time. During transit the patient was noted to have shortening of the right leg.

On arrival at the major trauma centre, the patient's vital signs were heart rate of 138 per min, blood pressure 145/115mmHg, respiratory rate of 28 per min, and GCS 14 (E4, V4, M6). Initial assessment and resuscitation was performed as per ATLS protocol. The CXR demonstrated multiple rib fractures and associated pulmonary contusion on the right side. FAST scan was positive for intra-abdominal free fluid. The pelvic X-ray demonstrated a comminuted fracture of the right acetabulum with medial displacement of the femoral head, as well as a mildly displaced fracture of the right iliac wing (Young & Burgess Lateral Compression II) (Figure 1).

The systolic blood pressure subsequently dropped to 80mmHg, and the patient was rapidly transferred to the operating room for exploratory laparotomy and extraperitoneal pelvic packing. An American Association of Surgery for Trauma Grade 2 liver injury was found and packed. The pelvis was packed as described by Pohlemann⁵. The patient subsequently underwent angioembolization of an arterial bleeding site adjacent to the right acetabulum.

Other injuries identified included traumatic brain injury, right sided rib fractures 1-9 with associated haemothorax, right scapula fracture and a distal thoracic aortic injury. Despite appropriate chemical thromboprophylaxis, the patient suddenly deteriorated on hospital day 3 within the Intensive Care Unit from a massive pulmonary embolus. Despite maximal medical treatment, the patient continued to deteriorate and ultimately died from cardiorespiratory failure.

Discussion

Increased anatomical displacement of lateral compression type pelvic ring fractures with application of a PCCD has previously been described in both cadaver models³ and in trauma patients⁴ although there are no previous reports of associated haemodynamic deterioration. Although temporally related it is not possible to definitively demonstrate that the haemodynamic deterioration in this case was caused by application of the PCCD and other sites of haemorrhage were present with a haemothorax and small liver laceration. Further evidence for causality however is the lack of leg shortening prior to application of the binder suggesting that the binder was responsible for displacement of the femoral head through the

acetabulum, and the haemorrhage site identified on subsequent angiography as being from the acetabulum.

There is one previous report of clinically significant haemodynamic deterioration after application of a PCCD contained in a case series of emergency department cases where the PCCD was placed after pelvic X-ray had been obtained.¹ The reported case had a Tile C1 fracture and demonstrated a 19 mmHg drop in mean arterial pressure two minutes after the PCCD was placed. Although this series describes a rise in blood pressure in most other cases (particularly where reduction of pubic diastasis was demonstrated) there were no lateral compression injuries included. We are unaware of any other reports of deterioration after application of a PCCD although it has also been noted that emergency department staff are poorly compliant with policies advocating PCCD application in known lateral compression injuries⁴ presumably because of concerns about increased displacement and additional injury.

The patient reported here was haemodynamically stable prior to application of the PCCD. Prophylactic application has been advocated in patients with mechanism of injury consistent with possible pelvic fracture^{1,6} as it has been considered low risk. However, there is no published data indicating improved outcomes with prophylactic use. As the patient reported here was stable prior to PCCD application and it is possible that the PCCD caused the deterioration, a more prudent practice may be to place the device, but only tighten it if haemodynamic deterioration occurs. Although there are reports of improved blood pressure and heart rate with binder application in haemodynamically unstable patients^{1,2} as well as

decreased blood product usage⁷ no study to date has demonstrated a significant mortality benefit and the risk of causing deterioration needs to be considered.

Avoiding PCCD application specifically in lateral compression fracture types during prehospital care is problematic as the force vector that created the injury is often unclear and X-ray is not available. Using ultrasound to identify patients with pubic diastasis has been suggested as a possible screening tool to identify the subgroup of patients who may benefit from PCCD application⁸ as published case series suggest that it is patients with an open symphysis who benefit.^{1,2}

Conclusion

We report a case of significant haemodynamic deterioration associated with prehospital PCCD application in a patient with a lateral compression fracture. Ideally PCCDs would be applied only to patients with fracture types that are likely to benefit. Further research is required to investigate modalities such as ultrasound that are both pragmatic for use in the prehospital environment and can be used to triage cases for suitability for PCCD application.

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Conflict of interest statement

None of the authors have any conflicts of interest to declare.

Figure legend

Plain pelvic radiograph demonstrating a comminuted fracture of the right acetabulum with medial displacement of the femoral head, and a mildly displaced fracture of the right iliac wing.

