The Journal of TRAUMA® Injury, Infection, and Critical Care

Pelvic Circumferential Compression in the Presence of Soft-Tissue Injuries: A Case Report

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J Trauma. 2005;59:468–470.

Unstable pelvic ring disruptions are frequently associated with hemodynamic instability.[1–3] Although the source of hemorrhage can be from multiple sites, the severity and type of pelvic disruption strongly correlates with retroperitoneal blood loss.[4–7] Pelvic stabilization in the early posttraumatic phase is reported to provide an effective means of controlling this retroperitoneal hemorrhage.[8–11] Pelvic circumferential compression with a bed sheet has been recommended for emergent stabilization of unstable pelvic fractures in hemodynamically unstable patients.[12–16] More recently, pelvic circumferential compression devices (PCCDs) have become commercially available for time-saving, provisional stabilization.[17–19] This report describes a complication associated with the use of a PCCD for a patient with an unstable pelvic ring injury and associated Morel-Lavallee lesion.

CASE REPORT

A 15-year-old girl was injured in a rollover automobile crash. She was an unrestrained passenger and was ejected from the vehicle. At admission to a Level I trauma center, she was found to be hypotensive (55/30 mm Hg) and tachycardic (120 beats/min). Her initial hematocrit was 25%. Initial fluid resuscitation consisted of 4 units of packed red blood cells, 4 units of fresh frozen plasma, and 8 L of crystalloid. Physical examination showed a left femoral shaft deformity and a distended abdomen. A diagnostic peritoneal lavage was performed that revealed blood. Radiographic evaluation revealed an intraperitoneal bladder rupture and pelvic ring disruption. A plain anteroposterior pelvic radiograph and computed tomographic (CT) scan of the pelvis showed bilateral sacroiliac joint injuries, symphyseal disruption, and bilateral rami fractures (Figs. 1 and 2). Also evident on her admission CT scan was a severe posterior soft-tissue disruption in the subcutaneous layer.

A PCCD was applied around the patient's pelvis at the level of the greater trochanters. The particular PCCD used had a mechanism that limits circumferential compression at the time of PCCD application to the minimal amount required for pelvic reduction.[18,19] The patient was emergently taken to the operating room for an exploratory laparotomy. A left distal femoral traction pin was placed, laparotomy was performed, and the bladder rupture was repaired. After the abdominal procedures, repeat pelvic radiographs were obtained (Fig. 3).

The patient was transferred to the pediatric intensive care unit for continued resuscitation with the PCCD in place. Over the course of the next 48 hours, the patient became edematous. This was attributed to fluid resuscitation. Reviewing her hospital stay revealed that she was 14 L fluid overloaded over the initial 48 hours of hospitalization. Of note, the PCCD was applied early in the course of her resuscitation at a time when she had received only 4 L of crystalloid fluid and none of the blood products. Fifty-four hours after PCCD application, the device was removed and her pelvic fractures were stabilized operatively with open reduction and plating of both sacroiliac joints and the symphysis pubis. Her left femoral fracture was treated with an antegrade femoral nail.

During operative treatment of her fractures, the patient was found to have a Morel-Lavallee lesion in the left gluteal region and skin necrosis over the area of PCCD application (Fig. 4). Subsequently, the Morel-Lavallee lesion was found to communicate with the superficial area of skin necrosis in the region of the left hemipelvis. She was taken to the operating room for debridement of the Morel-Lavallee lesion and noted to have gluteal muscle necrosis. This was treated with serial debridements and placement of a vacuum wound dressing. After multiple debridements, partial wound closure was achieved primarily, and a portion of the wound required split-thickness skin grafting.

DISCUSSION

Circumferential compression of the pelvis has become a routine part of many protocols for resuscitation and stabilization of the patient with a disrupted pelvic ring.[12,13,16,17,19,20] Although bed sheets can readily provide such circumferential compression, specifically designed PCCDs can deliver stabilization in a more reproducible, controlled, and time-effective manner.[18,19] PCCDs are designed for temporary stabilization and can be applied by first responders before patient transport as

Submitted for publication January 26, 2005.
Accepted for publication May 23, 2005.

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DOI: 10.1097/01.ta.0000174866.27374.c5

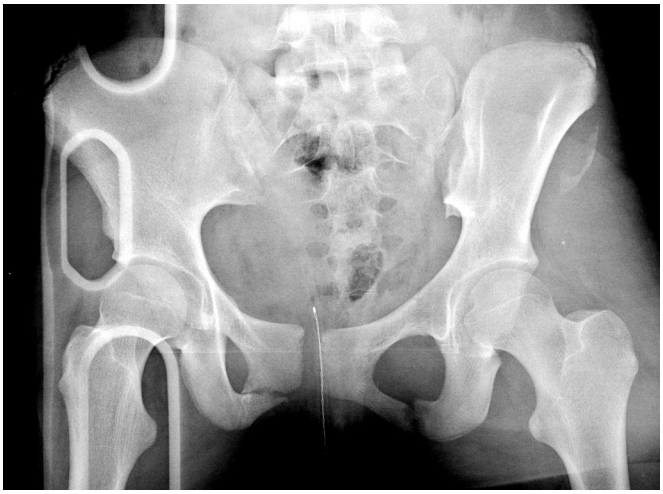

Fig. 1. *Pelvic anteroposterior radiograph before intervention.*

Fig. 2. *CT scan of the abdomen before intervention.*

a potentially live-saving intervention to reduce retroperitoneal hemorrhage in the early stages. Prolonged application of circumferential compression potentially can cause pressure-induced necrosis of skin underlying the PCCD, although no such cases have been reported in the indexed literature.

To minimize the risk of skin necrosis, the PCCD used in the reported case (SAM Sling, The Seaberg Co., Newport, OR) has a mechanism that controls and limits the application force of the PCCD to the minimum level required for reduction and stabilization of open-book type pelvic fractures.[18,19] This feature has been adopted in a recently enacted standard by the American Society for Testing and Materials. This standard, ASTM F2428-04, states that PCCDs should provide the capability to apply a controlled level of circumferential compression force.

Our case represents the first instance of skin necrosis associated with use of a PCCD. That skin necrosis was observed despite application of controlled and relatively low application force may be contributed to the occurrence of two concomitant factors. First, the PCCD was applied immedi-

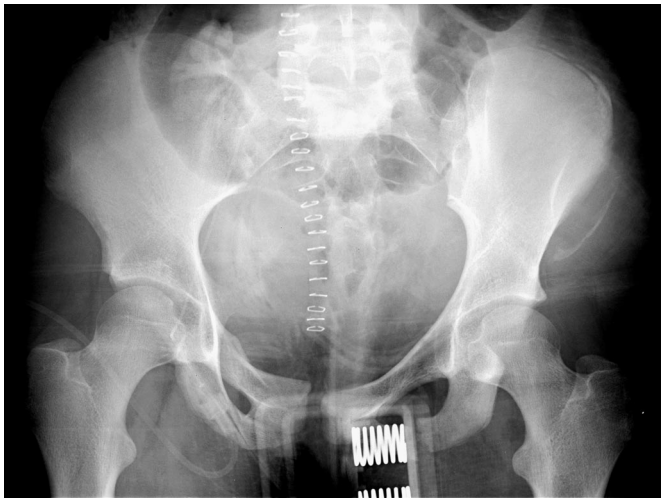

Fig. 3. *Pelvic anteroposterior radiograph with the pelvic circumferential compression device in place.*

Fig. 4. *Skin necrosis over the left hemipelvis.*

ately at admission. The patient was subsequently resuscitated and, after 48 hours, had received at least 14 L of fluid in excess of her output. The degree of edema this created was clinically obvious. We suspect that the associated swelling led to an unforeseen increase in pressure under the PCCD.

Another factor in her course was the degree of soft-tissue injury that was associated with her pelvic ring injury. At surgery, she was noted to have a large Morel-Lavallee lesion. This was most obvious over the left buttock. The admission CT scan shows this quite well. Once the skin broke down, the Morel-Lavallee lesion was communicating with the open wound. At debridement, the underlying gluteal musculature was also noted to be partially necrotic. Approximately one third of the gluteal muscles were debrided, along with the subcutaneous and skin layers. This amount of soft-tissue

injury is not unusual in severe pelvic trauma.[21–23] Unfortunately for this patient, the combination of deep and superficial soft-tissue injury led to a more significant wound problem. Once the skin became necrotic, the implications of the open wound were obviously magnified, given the presence of underlying necrotic muscle.

This case has caused us to reexamine three aspects in the use of circumferential pelvic compression. First, it seems prudent to release and re-tension the PCCD after massive fluid resuscitation. Second, the duration of sling use should be minimized when practical, especially in the presence of compromised skin underlying the PCCD. Finally, caution should be exercised, especially with use of uncontrolled compression with either slings or wraps that do not limit compressive forces.

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