



Journal of Health and Medical Sciences

Haj, Abdullah al, and Deonandan, Raywat. (2019), The Use of Pelvic Binders in Prehospital Management: Risk vs Reward. In: *Journal of Health and Medical Sciences*, Vol.2, No.2, 214-217.

ISSN 2622-7258

DOI: 10.31014/aior.1994.02.02.39

The online version of this article can be found at:
<https://www.asianinstituteofresearch.org/>

Published by:
The Asian Institute of Research

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The Use of Pelvic Binders in Prehospital Management: Risk vs Reward

Abdullah al Haj¹, Raywat Deonandan¹

¹ Interdisciplinary School of Health Sciences, University of Ottawa

Correspondence: Raywat Deonandan, University of Ottawa, Ottawa, Canada K1N 6N5, E-mail: rdeonand@uottawa.ca

Abstract

Pelvic binding devices are used in prehospital management of cases of severe physical trauma, such as falls and motor vehicle accidents. From briefly reviewing the published evidence of the procedure's risks and effectiveness, we conclude that binding represents an inexpensive and easily applied emergency strategy that offers pelvic stability while only minimally raising the risk of bleeding and other undesirable outcomes.

Keywords: Pelvic Binding, Prehospital Management, Emergency Medicine

Introduction

Severe blunt trauma, such as motor vehicle collisions and falls from a height, usually result in a constellation of injuries with multiple system involvement. The ideal management of such patients is constantly evolving. (1) An important consideration in these patients is the potential for pelvic fracture. In patients with multiple blunt trauma injuries, 5-16% receive pelvic ring injuries leading to a 11-54% mortality rate that primarily attributed to hemorrhagic shock. In cases where hemorrhage isn't controlled, the patient rapidly approaches the lethal triad of hypothermia, coagulopathy, and acidosis secondary to hypotension and hypoperfusion. (1) These outcomes can be prevented by pelvic binding, which is the act of compressing the pelvis, usually through the use of a pelvic binding device. Below, we present a brief overview insights gleaned from the academic literature into the value of pelvic binding in general prehospital care.

The Value of Binding

Binding reduces the diastasis in the fractured pubic symphysis, which is strongly associated with pelvic volume. A diastasis of 5 cm results in 20% increased pelvic volume, while a diastasis of 10 cm results in 35-40% increased pelvic volume. (2,3) Decreasing pelvic volume via binding produces a tamponade effect on soft tissues as well as vessels commonly involved in hemorrhage, such as the presacral venous plexus and iliac vessels. Resultant diminished bleeding and decreased clotting time is crucial for good patient outcomes. (1,4) The proposed mechanism of tamponade is supported by a cadaver study measuring pelvic pressure. Pelvic binding

with the T-POD (trauma pelvic orthotic device) increased the mean pelvic pressure to 24cm water compared to a 8cm water baseline representative of average central venous pressure. (5)

Recently, the value of early pelvic stabilization was recognized by Hsu et al at a level 1 trauma center in Taipei, Taiwan. (1) In a comparison between a historical group of suspected pelvic fracture patients where stabilization was applied after radiological confirmation of fracture and the study group of early stabilization, it was found that early stabilization resulted in lower average blood transfusion requirements in the first 24 hours, as well as overall lower mortality. A similar study 2017 comparing treatment outcomes of pelvic fractures in 2002 and 2013 by Fitzgerald et al recorded a decrease in mortality from 20% to 7.7% with updated protocols emphasizing early stabilization. (6) The importance of early stabilization is further corroborated by Schweigkofler et al, who found that early binding led to decreased risk of hemorrhage. (7)

While the benefits of early pelvic stabilization have been established, they require correct use of the preferred device. The correct placement of the pelvic binder at the level of the greater trochanters as opposed to superior placement contributes to a greater reduction of the pelvic ring and results in a better outcome for patient with pelvic fractures. It was found that high placement was associated with a larger (2.8X) symphyseal diastasis, in a 2017 study by Naseem et al. (8)

Of course, it is also important that the benefits of pelvic binding outweigh the technique's potential negative outcomes. The most commonly observed drawback with these devices is the development of pressure sores after prolonged use. Research suggests that prolonged skin pressures of 9.3 kPa or more result in the occlusion of capillaries resulting in hypoxia and necrosis, and sores are more likely to develop at bony prominences and in patients with lean fat content; such patients include the elderly and poorly nourished. (9) Skin pressure was also measured to be higher while patients were on a spinal board. (10)

Choice of Device

There are several pelvic binding devices available on the market. Most prominent are the T-POD (Trauma Pelvic Orthotic Device), the pelvic sling from SAM Medical Inc., and of course the simple bed sheet. In 2013, Pizanis et al found that the use of true pelvic binding devices was associated with the lowest rate of lethal bleeding compared to other devices. (11) This study compared the use of true pelvic binders to C-clamps and sheet wrapping, and found that the latter had an incidence of 23% lethal hemorrhage compared to 8% for c-clamps and 4% for pelvic binders. While this study supports the use of pelvic binders, it should be noted that the patients treated with pelvic binders in this sample were significantly younger than the other groups. The mean age was 26 for pelvic binder users, 47 for sheet users, and 42 for C-clamp users. (11) It is unclear whether these age differences negate the study's otherwise compelling findings.

Furthermore, in a cadaver study comparing the sheet wrapping and T-POD's ability to reduce pelvic ring fractures, only the T-POD showed statistically significant improvement in injury measurement. Symphyseal diastasis was reduced from 39.3 mm to 17.4 mm with the sheet, and 39.3 mm to 7.1 mm in the T-POD. The T-POD reduced symphysis to normal measurements of <10 mm in 75% of cases vs 17% of cases with the sheet wrap. (12) This study did not assess the SAM sling. A study in living patients measured hemodynamic stability and diastasis distance in patients with untreated pelvic fractures and hypovolemic shock. Measured before T-POD application and two minutes after application, heart rate and mean arterial pressure showed statistically significant improvements of 107 to 94 bpm and 65.3 to 81.2 mmHg respectively. (13)

While much of the literature purports that pelvic binders (usually referring to the T-POD) have benefits over sheet wrapping, there are several studies that compare the T-POD and the SAM sling. In a skin pressure study between the three devices, it was found that the SAM sling had the smallest mean contact area, and the highest skin pressure, although this pressure difference was not statistically significant. (14) A second study performed on cadavers measured the force required for complete reduction of the pubic symphysis as well as displacement of fracture fragments during reduction. Both the SAM sling and T-POD achieved closure with no adverse displacement. The SAM sling required 112+/- 10N for closure and the T-POD required 60+/- 9N. (10)

Lastly, Schweigkofler et al. (2017) recommends that patients with suspected pelvic fractures not be cleared without pelvic imaging, in order to rule out any suspected fractures. (7) This is because the application of a pelvic binder leads to the anatomical closure of the pelvic ring, which could underestimate the injury.

Conclusion

Pelvic injuries can range from benign to life-threatening with a high mortality rate. These injuries can occur not only in patients who sustain a high-energy impact mechanism from injuries, such as motor vehicle collisions and high falls, but also from minor mechanisms such as ground-level falls in the case of the elderly patients. When comparing the risk of missing a rapid uncontrolled occult pelvic hemorrhage into the retroperitoneal space to the risk of pelvic binding complications associated with pelvic bleeding, we conclude that the balance of evidence indicates a recommendation for the consideration of pelvic binders in prehospital managements in all patients with a suspected pelvic trauma. Pelvic binders are not only inexpensive and easy to apply in a prehospital sitting, but also offer pelvic stability while representing a low potential for associated complications.

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