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Pre-hospital pelvic girdle injury: Improving diagnostic accuracy in a physician-led trauma service

E. Yong [a], A. Vasireddy [b,*], A. Pavitt [a], G.E Davies [c], D.J Lockey [d]

[a] Foundation Doctor, Institute of Pre-Hospital Care, Royal London Hospital, London E1 1BB, UK
[b] Trauma & Orthopaedics Specialty Registrar (ST8) & Pre-Hospital Care Doctor, Institute of Pre-Hospital Care, Royal London Hospital, London E1 1BB, UK
[c] Consultant in Emergency Medicine and Pre-Hospital Care, Institute of Pre-Hospital Care, Royal London Hospital, London E1 1BB, UK
[d] Consultant in Intensive Care Medicine, Anaesthesia and Pre-hospital Care, Institute of Pre-Hospital Care, Royal London Hospital, London E1 1BB, UK

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ABSTRACT

Background: Examination of missed injuries in our physician-led pre-hospital trauma service indicated that the significant injuries missed were often pelvic fractures. We therefore conducted a study whose aim was to evaluate the pre-hospital diagnostic accuracy of pelvic girdle injuries, and how this would be affected by implementing the pelvic injury treatment guidelines recently published by the Faculty of Pre-Hospital Care.

Study design: All blunt trauma patients attended in a 5-month period were included in the study. The presence or absence of pelvic girdle injury on computed tomography (CT) or, if unavailable, pelvic X-ray was used as a primary outcome measure. A retrospective database and case note review was conducted to identify patients who had pelvic binder applied in the study period. For the purposes of the study, pelvic ring and acetabular fractures were grouped together as patients with suspected pelvic girdle injury that should be fitted with a pelvic binder in the pre-hospital setting. The sensitivity and specificity, relating to the presence of pelvic girdle injury in patients with pelvic binders, was calculated in order to determine pre-hospital diagnostic accuracy.

Results: 785 patients were attended during the study period. 170 met the study inclusion criteria. 26 (15.3%) sustained a pelvic girdle injury. 45 (26.5%) had a pelvic binder applied. There were eight missed fractures (31%), of which the majority (six) sustained less severe injuries that were managed non-operatively. Two patients required operative fixation. Radiological images and/or reports were available on 169 (99.4%) patients. As a test of the presence of pelvic fracture, pelvic binder application had a sensitivity of 0.69 (95% CI 0.50–0.85) and a specificity of 0.81 (95% CI 0.74–0.87).

Conclusions: Even with a careful clinical assessment and a low threshold for binder application, this study highlights the problems of distracting injury when trying to diagnose and manage pelvic fractures. By implementing the pelvic treatment guidelines published by the Faculty of Pre-hospital Care, the missed injury rate could be reduced from 31% to 8%.

Introduction

A detailed retrospective review of 115 pre-hospital trauma patients was carried out in our system in 2007 to assess the number of significant injuries missed in the pre-hospital phase of care by a physician-paramedic team (unpublished research). 65 (14%) of 457 injuries were missed or not documented and after review the significant missed injury rate was 5%. This is comparable with, or better than, published studies that describe missed injury rates after arrival in hospital [1–3]. Missed pelvic fractures made up 25% of significant missed injuries and this was considered the most clinically significant missed injury group. On the basis of this we conducted this study to investigate our pre-hospital assessment of pelvic injury in greater detail.

Importance

Major pelvic injury commonly occurs after high impact blunt trauma. It can be classified by the anatomical lesion, for example a pubic ramus or open book fracture (i.e. pubic symphysis disruption and/or fracture of pubic rami with sacroiliac joint disruption). It

* Corresponding author at: Institute of Pre-Hospital Care, London's Air Ambulance, Royal London Hospital, London E1 1BB, UK. Tel.: +44 020 3594 0000.
E-mail address: avasireddy@nhs.net (A. Vasireddy).

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can also be classified according to mechanism of injury, for example lateral compression, anteroposterior compression, vertical shear or combined mechanical injury [4]. Despite the many classifications described, it can be difficult to apply them in practice, particularly in the pre-hospital emergency scenario [5].

Importantly, serious pelvic fracture can be life-threatening. Mortality has been reported to range between 7.6% and 50% in open pelvic fractures [6–8]. Significant pelvic ring disruption is an indicator of high levels of energy transfer associated with a high incidence of concomitant injury. Blood loss from the sacral venous plexus, branches of the internal iliac artery, surrounding soft tissue or fracture surfaces into an unrestricted retroperitoneal space can result in exsanguinating haemorrhage and is often the cause of death in this group of patients. Crucially, pelvic girdle injuries can be identified on primary survey and are potentially manageable with appropriate early intervention. Rapid diagnosis and prompt management are thus potentially critical in avoiding unnecessary mortality [9].

In December 2013, the Faculty of Pre-Hospital Care (FPHC) published three consensus statements, one of which sought to provide guidance on the early treatment of pelvic injuries [10]. The recommendations state that a pelvic binder should be applied if any one of the following four risk factors is present in any setting where the mechanism of injury suggests a possible pelvic fracture. The risk factors include a heart rate of >100 bpm; systolic blood pressure <90 mm Hg; GCS score of 13 or less; distracting injury and/or pain on pelvic examination. These guidelines were released only recently and were not available during the original study period.

Study aim

This study retrospectively evaluated the pre-hospital diagnosis of pelvic girdle injuries in blunt trauma patients. The aim was to establish the diagnostic accuracy, i.e. the sensitivity and specificity, of a pre-hospital physician-led trauma service in the detection of these potentially life-threatening injuries. We then analysed the effect of the new FPHC pelvic injury treatment guidelines on diagnostic accuracy.

Methods

Study design

All patients attended by our pre-hospital service with blunt trauma between August and December 2011 who were admitted to our base major trauma centre were included in the study. The study did not include collection of any non-standard data and was conducted retrospectively. It was therefore registered as a service evaluation at the Major Trauma Centre. Patients were identified and data extracted from the standard service Microsoft Access™ trauma database. Age, sex, mechanism of injury and baseline Glasgow Coma Score (GCS) were recorded. The application (or not) of a pre-hospital pelvic circumferential compression device (pelvic binder) was also recorded. This was judged to indicate a pre-hospital suspicion of pelvic girdle injury. The radiological investigations of all the patients in the study cohort were followed-up on a picture archiving and communication system (PACS). The presence or absence of pelvic girdle injuries on computed tomography (CT) or, if unavailable, pelvic X-ray was used as a primary outcome measure. For the purpose of the study, the term pelvic girdle injury includes both pelvic ring and acetabular fractures. These two types of injuries were grouped together because all suspected pelvic girdle injuries are fitted with a pelvic binder. If and when injuries were missed in the pre-hospital phase, we intended to subcategorise injuries as 'severe' if they required internal fixation or 'less severe' if the injuries were managed non-operatively. Case notes were reviewed to verify the accuracy of all the data collected. In addition the on-scene suspicion of intoxication (drugs or alcohol), presence of circulatory shock on baseline observations (systolic BP < 90 or weak/impalpable radial pulse) and intubation status were documented. Patients were excluded from the study if they sustained drowning, hanging or burns. For a number of blunt trauma patients (23) who did not have in-hospital pelvic imaging, we examined case-notes to determine why clinical features made imaging unnecessary. They included patients with isolated head injuries or medical collapse (17), young children aged 1–5 years with normal physical examination (three) and patients with long bone injuries, but no in-hospital clinical suspicion of pelvic injury (three).

Setting (key background/fixed system variables)

The study was undertaken in a physician-based trauma service set at an urban Major Trauma Centre [11]. A doctor-paramedic team are dispatched primarily to major trauma missions and respond by helicopter or fast response car. The doctors usually have a background in emergency medicine or anaesthesia, with 5 years postgraduate experience. The flight paramedic has significant clinical experience and advanced training. On scene, the crew is responsible for assessing and initiating treatment. Patients are transported to an appropriate receiving hospital where there is a formal handover to a trauma team.

Local pelvic binder protocol

The decision to apply a pelvic binder is made by the on-scene physician. Clinical indications in the service's standard operating procedure are any obvious or potential pelvic disruption. In addition, the standard operating procedure (SOP) states that on the background of severe trauma, injured patients complaining of pain in the pelvis, lower back, or hips should be assumed to have a pelvic injury. Clinical evaluation consists of identification of pelvic deformity on careful visual inspection without manipulation of the pelvis (as that is considered potentially harmful) [12]. In the unconscious patient a pelvic binder is applied if the mechanism suggests the possibility of pelvic injury. The pelvic binder applied by the service is the SAM Pelvic Sling (SAM Medical Products TM, Oregon, USA) [13–15]. For paediatric patients, a wide-strap closed with velcro is used. This guideline was developed with the expectation of moderate overtriage (application of pelvic binder with only moderate suspicion of significant injury) with the aim of no undertriage (no significant fractures without application of pelvic binder), i.e. an expected higher specificity and an expected lower sensitivity, where specificity (the proportion of true negatives who are correctly identified as negative) is a measure of overtriage and sensitivity (the proportion of true positives who are correctly identified as positive) is a measure of undertriage respectively.

Statistical analyses

Statistical analyses were conducted using Microsoft Excel 2007 (Microsoft Corp. Washington, USA) and PASW 18.0 (SPSS Inc. Chicago, IL, USA). Data were compared using the independent samples *t*-test for normally distributed continuous variables and the Mann–Whitney rank sum test for non-normally distributed continuous variables. Pearson's chi-square was used for categorical variables and Fisher's exact test was used if counts were less than five. A level of $p < 0.05$ was taken to indicate statistical significance. Missing data were excluded from analysis. The sensitivity, specificity and likelihood ratios were calculated as key results to evaluate diagnostic accuracy. Confidence intervals as estimates of precision were reported. With regards to 'severe'