The effect of delayed presentation and surgery in pelvic trauma on morbidity and mortality

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Introduction

The presentation of pelvic trauma can be time critical given the association with high energy trauma, haemodynamic instability and life threatening injuries [1,2]. The mortality risk from pelvic fracture is 19% [1,3,4], but as high as 37% with haemodynamic instability [5]. However, there has been little research to establish and quantify the link between presentation of pelvic trauma with morbidity and mortality. Continued advances in prehospital care, management of haemorrhage, trauma management and operative intervention have been thought to result in a reduction of mortality and morbidity [6], yet this has not been clearly documented in scientific literature.

Patients with pelvic fractures should initially be managed by Advanced Trauma Life Support (ATLS) principles [7]. Application of pelvic binder [8] can help control arterial and venous bleeding and bleeding from the pelvic bones [9]. Hypotensive patients are at significant higher risk of mortality [3]. Surgical options with ongoing, unresponsive haemodynamic instability include angioembolisation, external fixation, internal fixation, direct surgical haemostasis and pelvic packing [10,11]. Which option is centre dependent [6], with no clear evidence for an optimal protocol [3]. However, recent data has shown that mortality decreases with the implementation of a protocol emphasizing early rapid and appropriate use of pelvic angiography [12]. Angioembolisation is not available in rural hospitals [6].

Currently, the Victorian State Trauma Guidelines specify that for non-trauma hospitals any patient with a suspected fractured pelvis should be triaged to the highest level of trauma service within 30 minutes [13,14]. If transport is greater than 30 minutes or there is an immediate life-threatening situation, transfer should occur to the nearest designated trauma service. Rural hospitals in Victoria are typically Level 3 Trauma centres and act as regional trauma a service that provide resuscitation and stabilization of major trauma patients prior to their transfer to a major trauma service and provides definitive care when transfer is not required [15]. In Victoria all rural hospitals are located between 90 minutes and 4 hours by road from Royal Melbourne Hospital (RMH), one of two adult Level 1 Trauma Centre’s in the state.

This study aims to identify the impact delayed presentation has on morbidity and mortality in pelvic trauma patients. It will examine the effect of initial presentation at a rural or other metropolitan non-Level 1 Trauma Centre prior to definitive management at a Level 1 Trauma Centre. Finally this study will identify the effect of time to pelvic surgery on patient outcomes.

Methods

A retrospective review of patients with major pelvic trauma.
Table 1. Comparison of data between those patients transferred and those directly presenting.

<table>
<thead>
<tr>
<th></th>
<th>Transferred patients n=180 (mean, standard deviation)</th>
<th>Direct presentation n=1120 (mean, standard deviation)</th>
<th>Mean difference (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury Severity Score</td>
<td>23.96 (11.35)</td>
<td>28.01 (13.23)</td>
<td>-4.044 (-6.091, -1.998)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Days in ICU</td>
<td>3.58 (6.45)</td>
<td>3.95 (6.76)</td>
<td>0.365 (-1.423, 0.693)</td>
<td>0.197</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>15.81 (12.92)</td>
<td>14.97 (15.92)</td>
<td>0.83918 (-1.609, 3.287)</td>
<td>0.370</td>
</tr>
</tbody>
</table>

Table 2. Comparison of data between those patients transferred and those directly presenting managed surgically.

<table>
<thead>
<tr>
<th></th>
<th>Transferred patients n=79 (mean, standard deviation)</th>
<th>Direct presentation n=370 (mean, standard deviation)</th>
<th>P value (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury Severity Score</td>
<td>21.39 (10.7)</td>
<td>28.11 (13.7)</td>
<td>&lt;0.001 (-9.943, -3.494)</td>
</tr>
<tr>
<td>Days in ICU</td>
<td>3.04 (5.3)</td>
<td>5.30 (8.4)</td>
<td>0.023 (-4.209, -3.321)</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>17.43 (14.3)</td>
<td>19.75 (17.9)</td>
<td>0.28 (-6.528, -1.895)</td>
</tr>
</tbody>
</table>

Table 3. Comparison of data between those patients transferred and those directly presenting with severe pelvic fractures (AIS Injury code severity ≥4).

<table>
<thead>
<tr>
<th></th>
<th>Transferred patients n=37 (mean, standard deviation)</th>
<th>Direct presentation n=235 (mean, standard deviation)</th>
<th>P value (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury Severity Score</td>
<td>30.5 (13.4)</td>
<td>37.6 (14.3)</td>
<td>0.005 (-11.855, -2.250)</td>
</tr>
<tr>
<td>Days in ICU</td>
<td>3.3 (5.1)</td>
<td>5.6 (7.7)</td>
<td>0.019 (-4.283, 0.099)</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>15.7 (13.8)</td>
<td>20.4 (21.6)</td>
<td>0.082 (-10.038, -0.608)</td>
</tr>
</tbody>
</table>
present initially to a rural hospital. These patients have approximately half the risk of mortality but lower ISS. Mortality was not associated with transfer time. Transferred patients had the same length of stay, risk of ICU admission and time spent in ICU than patients who presented directly. Patients who required ICU were transferred faster. Angioembolisation rarely occurred for transferred patients. Half of patients transferred were managed surgically compared with one third of patients presenting directly. The ISS of transferred patients requiring surgery was less. There was no difference in time to surgery between groups. For patients presenting directly there is a reduction in mortality with more timely arrival, but time of arrival did not change ICU requirements. Overall the mortality risk following pelvic surgery was low, with most surgical procedures being external fixation and mostly likely damage control measures which ended up being definitive. Sub-analysis of patients with severe pelvic fractures showed that transferred patients had lower ISS and fewer requirements for immediate surgery on presentation and lower mortality risk.

Specific literature on time of presentation and time to theatre on major pelvic trauma is lacking. With rural general trauma, time from injury to definitive care is known to be prolonged [17], with a 19% increased risk of death per hour of time for ambulance transfer [18]. Research from Western Australia has shown that if the patient survives transfer to a Level 1 Trauma Centre, then mortality outcomes are equivalent to metropolitan trauma [19], which is supported by this study. The number of patients presenting by either helicopter or fixed wing (18.5%) was higher than the total number of patients transferred from rural hospitals (10.3%). This figure does not include arrival via road. As such it is not clear how many patients directly bypassed a rural hospital despite Victorian State Trauma Guidelines recommending initial presentation there. All these factors make drawing definitive conclusions on the success of the guidelines and determining whether best management occurs thorough direct admission to a Level 1 Trauma Centre versus earlier and temporary management at a rural hospital vexed.

In reviewing the data and interpreting the applicability of the Victorian State Trauma Guidelines, Victoria is a smaller state than elsewhere in Australia and rural Victoria typically has combined general/trauma surgery and orthopaedic surgery. Most of the available Australian literature on mortality for trauma transfers from rural centers is largely from Western Australia [18,19] a state with more remote areas that typically only have general/trauma surgery access without orthopaedics. Accordingly the Victorian State Trauma Guidelines may not be directly transferable and other states may need to make appropriate modifications to suit their geography and surgical services provided.

Whilst the mortality rate for patients initially presenting to RMH appeared higher than transferred patients, this is not surprising given that their ISS scores were higher and patients may have bypassed a rural hospital. The ISS scores reported are similar to those that have been published elsewhere. McMurty et al. [4] found that the average ISS pelvic trauma patient is 33.5. Overall the mortality rate for patients requiring pelvic surgery was lower than figures previously reported in the literature [1,3,4], as was the case for haemodynamic patients receiving angioembolisation [5]. When solely looking at patients with severe pelvic fractures, our mortality rate of 19.5% was similar to that reported in the literature. Our angioembolisation rate was almost exactly the same as the 9% that has recently been reported in a large series at a Level 1 Trauma Centre [20]. The higher mortality rate found with earlier definitive pelvic surgery is likely related to the fact that these patients were unwell and the surgery was damage control in nature, which ended up being definitive. In support of this, for 9/11 deaths, the definitive pelvic surgery was external fixation. It appears that timing of surgery was appropriate, with surgery occurring at a time frame once patients would have been physiologically optimised [21].

There are limitations in the study. Notably, there is a high association with other life threatening injuries in pelvic trauma [4]. These may have concurrently impacted on patient outcomes and timing of surgery is often dictated by associated injuries. Along with associated injuries we did not factor in patient physiology, age or comorbidity. These are likely confounding variables. We also do not have data for patients who died at the scene, prior to transfer or on the management provided at rural hospitals. Without this, it is not fully possible to critique the outcomes at these hospitals and comment on the true success of the pre-hospital triaging. Timing of surgery may not be related to severity as it could be driven by surgeon’s availability, the nature of the injury and the need for surgery for other reasons unrelated to pelvic injury. It is most probable that patients who were rushed to RMH bypassing other hospitals were likely to be sicker than those surviving in a Level 3 trauma hospital for secondary transfer. The higher severity of injured patients and the pelvic trauma at a Level 1 Trauma Centre produces a selection bias when comparing outcomes to rural hospitals. In recording time to surgery, we recorded time from presentation to the hospital. Time between injury and surgery may have been more valuable, but this was not recorded and unable to be analyzed. We also did not examine how specific pelvic fracture types impacted on outcome, although we attempted to analyze this by looking at patients with severe pelvic fractures defined as AIS Injury code severity ≥4. Lastly this is data from a single institution and the generalizability of findings may be limited.

Conclusion

Presentation of major pelvic trauma occurs at rural hospitals. This does not increase their risk of mortality or time to surgery when transferred to a Level 1 Trauma Centre, although these patients had less severe injury and data is not available for patients who died at the scene, prior to transfer or on the management provided at rural hospitals. Delayed direct presentation to a Level 1 Trauma Centre is associated with a higher mortality. There is a higher mortality with earlier surgery, although this likely reflects the seriousness of the patient’s condition rather than the surgery itself.

References
6. Wong JM, Bucknill A (2013) Fractures of the pelvic ring. Injury. [Crossref]


17. Rogers FB, Shackford SR, Osler TM, Vane DW, Davis JH (1999) Rural trauma: the challenge for the next decade. *J Trauma* 47: 802-821. [Crossref]


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