



Missed orthopaedic injuries in adult trauma patients at a major trauma centre

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Abstract

Introduction: Despite advances in trauma care, missed injury remains a significant cause of morbidity and mortality in trauma worldwide. In England, few have published their missed injury rates and there are no recent data for London. In 2010 London trauma networks were restructured and the impact on missed injury rates is not known. This study aimed to determine the incidence of missed orthopaedic injury for adult trauma patients at St George's Hospital, London, and to analyse missed injuries and comment on risk factors.

Method: Trauma patients were recorded prospectively at the daily trauma meeting from July to September 2012. The researcher attended clinical activities and reviewed the patient notes and radiology reports daily whilst each patient was an inpatient until discharge. Missed injuries were defined as fractures or dislocations discovered more than 12 h after arrival in the emergency department. The notes for missed injury patients were reviewed again at six months. Missed injury details were recorded/analysed.

Results: Three hundred and forty three adult trauma patients were referred to trauma and orthopaedics in the three-month study period; 5 (1.5%) had a missed injury and 148 (43.1%) had an ISS > 15. All missed injuries occurred in these major trauma patients, giving an incidence of 5/148 (3.4%). Four were extremity injuries and one was cervical. All missed injury patients had a GCS of 15/15, were admitted outside normal working hours, were direct admissions and had whole-body CT.

Conclusions: At 3.4% our missed injury incidence is comparable to those published from similar major trauma centres. This provides recent London data following the restructuring of trauma networks.

Keywords

Trauma, polytrauma, emergency, injury, fractures, error

Introduction

Despite significant advances in trauma care since the inception of Advanced Trauma Life Support principles in 1978, published missed injury rates for trauma patients worldwide suggest that the rate of this important adverse event has not significantly declined.^{1–4}

Missed injuries are important primarily because they are a patient safety issue. A meta-analysis of 17 articles found that 15–22% of missed injuries required a change in management.¹ Others have reported significant increases in markers of morbidity such as length of hospital stay or units of blood transfused.⁵ There is also evidence that having a missed injury increases the risk of death⁶ and can directly cause death^{7,8} including

autopsy evidence that as many as 6.5% of trauma deaths were directly attributable to an undiscovered missed injury.^{9,10} Of secondary importance, even clinically insignificant missed injuries reflect badly on the effective working of the trauma team, lead to patient dissatisfaction with possible legal action^{11–15} and have

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the potential to skew the appropriate classification of trauma severity data.⁹

Whilst globally many centres have published their missed injury rates, in the context of modern trauma care in England, only two centres, Nottingham in 2007 and Coventry in 2011, have done so^{16,17} and there is no recent data for London. In 2010, the National Health Service implemented an extensive overhaul of trauma services, including the establishment of four major trauma centres (MTCs) for London, one of which is St George's Hospital (SGH). Each is fed by smaller trauma units at district general hospitals in their respective regions and SGH serves hospitals in South-West London. In the year after MTC status, there were 560 trauma patients who triggered the acute trauma team response and of these 298 were for major trauma (injury severity score (ISS) >15).¹⁸

There is a need for data on the effectiveness of the new system of trauma networks. Missed injury data are needed as a standard by which trauma departments can compare their performance. It is also important to recognise and quantify the underlying risk of missed injury in order to inform patients and clinicians.

The aim of this study was to define the incidence of missed orthopaedic injury for adult major trauma (ISS >15) patients at SGH and to examine the details of missed injuries in order to identify and make comment on potential risk factors for missed injury. These included: the time of admission being outside of normal working hours, having a reduced Glasgow Coma Score (GCS) on admission, being a secondary transfer from another hospital (rather than a direct admission) and the mode of radiological imaging (whole-body CT or selective).

Methods

A missed injury was defined as any new orthopaedic injury (i.e. fracture or dislocation) discovered >12 h after the documented emergency department arrival time. The data were obtained prospectively, with a researcher sitting in the daily trauma meeting every weekday for three months (July–September 2012) collecting details of all adult trauma admissions referred to trauma and orthopaedics from the previous day or weekend. The researchers were senior medical students at the affiliated St George's Hospital Medical School and were not part of the regular trauma team involved in patient care. The patients were not aware that the project was ongoing and it did not alter the regular care they received. Regular clinicians in the team were aware of the researchers being present as if on a university training placement but not the details of the data collection. The researchers attended clinical activities and reviewed the patient notes and radiology reports daily

whilst each patient was an inpatient up to the end-point of discharge from hospital. The notes for those patients who had a missed injury were reviewed again six months later to obtain the full patient journey details and medium-term outcome of their missed injuries. Patient demographic data, time of admission, GCS on arrival, grade of reviewing clinician, transfer status, radiographic images taken, radiation dose for whole-body CT and missed injury details were recorded and analysed. The project was authorised and registered with the trauma audit and research department.

Results

Demographic data and results are shown in Table 1. There were 343 adult trauma patients referred to trauma and orthopaedics in the three months from July to September 2012 and five (1.5%) of these had a missed orthopaedic injury. Overall, 148 (43.1%) patients had an ISS >15 and all missed injuries occurred in these major trauma patients giving a major trauma missed injury incidence of 5/148 (3.4%). Twelve (3.5%) patients died from their injuries and none of these had a missed injury.

The mechanisms of injury for all 343 admissions are shown in Table 2. All the missed injuries occurred in blunt trauma patients and in four cases the mechanism was a road traffic accident and in one it was a fall (Table 3).

Table 1. Demographic data for 343 adult trauma patients.

Total adult trauma patients, n	343
Males, n (%)	248 (72)
Mean Age, years (SD)	42 (20)
Major Trauma Patients (ISS>15), n (%)	148 (43)
Trauma patients with ISS = 1, n (%)	105 (31)
Mean ISS (SD)	14 (15)
Patients with missed injury, n (%)	5 (1.5)
Major trauma patients with missed injury, n (%)	5 (3.4)

Table 2. Mechanisms of injury in 343 adult trauma admissions.

Mechanism	n (%)
Blunt	304 (89)
Penetrating	39 (11)
RTA	138 (40)
Fall	114 (33)
Assault/self-harm	54 (16)
Sport	16 (5)
Other	21 (6)

Table 3. Details of the five missed injuries. All patients had GCS 15 on admission and all were from RTA except the second patient who suffered a fall.

Age (Sex) ISS Time Day	Missed Injury	How It Was Missed	Interval In Days	How It Was Detected	Clinical Significance
60 (M) 24 00:08 Thurs	# L fibula	CT: Whole body (extremity not scanned)	12	Radiograph: tibia and fibula	<ul style="list-style-type: none"> • Leg swelling investigated for DVT • Anticoagulation had to be stopped as haematoma was forming • Surgical intervention likely would have been indicated but not performed due to delay • Poor alignment of healed bone at follow up
36 (M) 18 20:30 Sat	# (displaced multifragment) L radial head	CT: Whole body (extremity not scanned)	11	Radiograph: elbow	<ul style="list-style-type: none"> • Surgical intervention likely would have been indicated but not performed due to delay
48 (M) 17 02:24 Sun	# R occipital condyle	CT: Whole body	<1 (16 h)	Tertiary survey	<ul style="list-style-type: none"> • Unstable neck # immobilised • Miami J collar applied for six weeks • Minimal delay but shows importance of tertiary survey
40 (M) 20 16:51 Sun	Dislocation L acromioclavicular joint	CT: Whole body	1	Radiograph: Shoulder	<ul style="list-style-type: none"> • Outpatient surgical intervention was required • Minimal delay and no adverse outcome
26 (M) 22 04:28 Thurs	# L calcaneus (intra-articular affecting calcaneocuboid joint)	CT: Whole body Radiograph: Ankle (patient uncooperative)	3	Repeat radiograph: Ankle	<ul style="list-style-type: none"> • Management not altered • Highlights particular risk to uncooperative patients

All missed injuries occurred outside of normal working hours, with two during a weekend and three in a weekday early mornings. In all five patients, the primary and secondary surveys were conducted by a consultant or registrar and where it was a registrar initially, a consultant conducted the tertiary survey. All scans were reported by a consultant or a registrar with a subsequent consultant review.

In total, 16/343 (4.7%) patients were secondary transfers from another hospital and none of these had a missed injury; of the major trauma patients, 44/148 (30%) had selective imaging and 104 (70%) had whole-body CT. None of the selectively imaged patients had a missed injury. The mean dose-length product from whole-body CT was 2.5 Gy/cm.

Discussion

The missed injury rate of 3.4% for major trauma patients at SGH is low and in keeping with published rates from similar MTCs^{6,15–22} although it is difficult to compare published rates between studies due to differences in sampling, methodology and definitions of missed injuries. Our incidence can be expected to be skewed downwards by the fact that we included only those injuries missed in patients referred to the inpatient orthopaedic service as it is possible that occult orthopaedic injuries also occurred in those admitted with only overt general surgical problems, and that only missed injuries which were ultimately discovered were included as some missed injuries may not have been discovered at all during our study timeframe. Conversely, it can be expected to be skewed upwards due to the strict 12 h definition meaning we are in fact reporting a delay in diagnosis (e.g. one of our missed injuries was discovered at 16 h by the tertiary survey), the fact that we included all missed injuries regardless of their clinical significance, the prospective study design making it less likely that missed injuries were not accounted for in the data collection¹⁵ and the significant proportion of major trauma in our study population.¹⁹ Nevertheless, our incidence can be compared to a literature review of 17 transnational papers published between 1980 and 2006 which found a mean incidence of 9% (range 1.3–39%).¹ In the United Kingdom, incidences of 4–22% have been reported.^{16,17,23} The highest incidence reported in the literature was 65% in Australia.⁸ This was due to the comprehensive inclusion criteria of that study, for example, the authors included soft tissue injuries and injuries found at autopsy. By including missed orthopaedic injuries only we increased the likelihood of injuries being objectively verifiable and of adequate severity to warrant inclusion. In previously published studies, they have also tended to make up the majority of significant missed injuries.^{15,22,24}

This is an appropriately low missed injury incidence for major trauma patients at an MTC and can be used as a standard by which to compare performance. It also demonstrates to clinicians and patients that even in a modern MTC, a significant baseline complication rate of missed injury persists. Elsewhere, it has even been suggested that a certain low level of missed injury should be accepted, as to completely eliminate it would require an inappropriate allocation of resources such as consultant time and overuse of scans.¹³

Whilst our sample size is comparable to many published missed injury series, it is not an especially large cohort and this combined with our low rate of missed injury meant that we only had five missed injury patients. Therefore, the power of the study to bring out risk factors for missed injury is limited. As far as comment is possible, it is interesting that all our missed injury patients had a GCS of 15/15. Others have also found that a reduced GCS is not a risk factor for missed injury⁸ whereas some have published findings that a GCS below 8 increased the risk of having a missed injury by a factor of 3.⁹ It is also noteworthy that all our missed injuries happened out of normal working hours, in keeping with findings which others have published.^{8,25,26}

None of our missed injury patients were secondary transfers. This group had previously been identified as having worse outcomes in trauma.²⁷ Our findings suggest that with appropriate mechanisms in place to receive transfers, such as online image transfer prior to arrival, this group is not at increased risk of missed injury.

All our missed injury patients had whole-body CT initially, which did not detect injuries of the fibula, radial head, occipital condyle, acromioclavicular joint and calcaneus. This warns against over-reliance on whole-body CT, especially for extremity and cervical spine injuries, known to be anatomical areas at risk of missed injury.^{12,21,28} The proportion of major trauma patients undergoing whole body CT rose from 49% in February 2011 to 70% in this study (unpublished departmental data) which is similar to other UK units.¹⁷ The mean dose-length product of 2.5 Gy/cm recorded for these scans equates to an effective radiation dose to the tissues of approximately 45 mSv (roughly 450 chest radiographs), an estimate supported by the literature.²⁹ Clinicians should be aware of the magnitude of the whole-body CT radiation dose and the limitations of whole-body CT which should not replace the need for meticulous clinical examination.

Conclusions

The missed injury rate for adult major trauma patients in a London MTC is 3.4% which is comparable to

published rates from similar MTCs. This provides recent data for London following the restructuring of trauma networks.

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Conflict of interest

None declared.

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