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Snapshot of trauma laparotomy deaths in Queensland

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Abstract

Background: Trauma remains the most frequent cause of death for patients under 35 years of age. Head injury and catastrophic haemorrhage account for the majority of early deaths. A trauma laparotomy is often necessary to arrest haemorrhage.
Methods: All patients who died in Queensland hospitals between 2011 and 2016 having had a trauma laparotomy were identified from the Queensland Audit of Surgical Mortality.
Results: About 69.0% of the 84 deaths were male with a median age of 47.6 years. About 64.3% of deaths occurred within the first 2 days following trauma. Mechanism of injury was typically road traffic accident (77.4%). Sixteen patients underwent a non-therapeutic laparotomy. Following peer-review, different management was recommended for only three patients.
Conclusion: This group of patients who died in the setting of a trauma laparotomy received high quality trauma care. Ongoing education is needed as some non-therapeutic laparotomies may be avoidable.

Introduction

Trauma remains the most frequent cause of death for patients under 35 years of age.[1] Death often occurs in the setting of the trauma triad of death (hypothermia, acidosis and coagulopathy) due to severe haemorrhage. Many models exist to describe the distribution of deaths after trauma. In the classical tri-modal distribution, the majority occur in the first phase (45%) which is classified as immediate death (i.e. within 60 min). The second phase (35%) occurs within 1 to 4 h and includes early deaths often due to haemorrhage. The final and lowest phase (20%) includes late deaths often in the setting of sepsis or brain injury.[2]

A laparotomy for unresponsive haemorrhagic shock may be performed during the first few hours. Trauma laparotomy is also indicated for hollow viscus injury. Delay in controlling haemorrhage in poly-trauma has been reported to be a significant cause of preventable trauma deaths.[3] In this study, we aimed to present a snapshot of mortality in trauma patients who underwent laparotomy as reported to the Queensland Audit of Surgical Mortality (QASM). Secondary goals were to determine the frequency of non-optimal initial care including non-therapeutic laparotomy (NTL).

Methods

The Australian and New Zealand Audit of Surgical Mortality (ANZASM), in which QASM participates, collects mortality data for inpatients who died under the care of surgeons in all Australasian hospitals. ANZASM retrospectively collects mortality data from hospitals. The functioning, governance and objectives of ANZASM have been previously described.[4] Briefly, participating hospitals independently notify ANZASM when a surgical inpatient dies. In Queensland, this occurs regardless of whether the patient was treated medically or operatively. The treating surgeon then provides additional clinical information using a 25-question standard Surgical Case Form (SCF). Cases are de-identified before First-Line Assessors receive the SCF, to ensure a blinded process. Assessors can recommend either no further action or further investigation; this occurs when there is insufficient information on the SCF or when an area of care requires clarification. Approximately 15% of notified deaths proceed to a more forensic Second-Line Assessment (SLA). Second-line assessors have access to the patients' medical records but are not privy to the first-line assessment. Each assessor is from the same surgical specialty but from a different geographical location.

Table 1 Demographics

	Total (n = 84)	No change in retrospect (n = 79)	Manage differently in retrospect (n = 5)	P-value
Male	58 (69.1%)	54 (68.4%)	4 (80%)	0.76
Age, years	48	48	49	0.94
LOS, days	5.3	5.1	7.0	0.28
ASA	3.7 (78/84)	3.7	4.4	0.31
RRMA M1 + M2	52 (61.9%)	49 (62.0%)	3 (60%)	0.96
Managed in critical care unit	61 (72.6%)	57 (72.2%)	4 (80%)	0.84
RTA	65 (77.4%)	63 (79.8%)	2 (40%)	0.33
Delayed diagnosis	6 (7.1%)	4 (5.1%)	2 (40%)	<0.01
Abdominal injury	68 (81.0%)	65 (82.3%)	3 (60%)	0.59
Pelvic fracture	10 (11.9%)	9 (11.4%)	1 (20%)	0.59
Death day 0	28 (33.3%)	27 (34.2%)	1 (20%)	0.59
Death days 0–2	54 (64.3%)	51 (64.6%)	3 (60%)	0.90
Death due HI	34 (40.5%)	33 (41.8%)	1 (20%)	0.46

ASA, American Society of Anesthesiologists; HI, head injury; LOS, length of stay; RRMA M1 + M2, rural remote and metropolitan areas Metropolitan 1 + Metropolitan 2; RTA, road traffic accident.

Inclusion criteria

We included data from all patients who died in Queensland hospitals between 2011 and 2016, having had a trauma laparotomy. The key inclusion criteria were a presenting complaint of trauma and a key surgical procedure of 'trauma laparotomy'. Trauma laparotomy was defined as any laparotomy where the indication for hospital admission was trauma. Whether the laparotomy was non-therapeutic was determined by the treating surgeon because chart review was not possible. Time frame between the traumatic event and surgery was not an inclusion/exclusion criterion. Baseline comparative data for patients undergoing trauma laparotomy and surviving was not available.

All data was from the QASM database consisting of responses to the SCF. Quantitative data was analysed on Microsoft Excel (Microsoft, Redmond, WA, USA). Summary statistics are presented as medians, with the interquartile (IQ) range in brackets, for continuous variables and frequency, with the percentage in brackets, for categorical variables. Significance values were based on two-tailed tests (Mann–Whitney U test and chi-squared test, respectively) with $P < 0.05$ considered statistically significant. Hospitals/Health Services were divided by the Rural, Remote and Metropolitan (RRMA) classification.[5]

Results

Epidemiology

Eighty-four deaths in patients with trauma who had at least one trauma laparotomy were reported to QASM between 1 January 2011 and 31 December 2016.

Demographics

Approximately two-third was male (54/84; 69.0%). The median age of all patients was 48 years (IQR: 25–72). The median length of stay (LOS, time from admission to death) was 5.3 days (IQR: 0–6). The mean number of co-morbidities was 2.8 (IQR: 1–2) and the mean ASA class was 3.6 (IQR: 2–5).

Surgeons assessed the risk of death on presentation before any surgery to be minimal (0%), small (0%), moderate (7%), considerable (43%) or expected (46%). This question was not answered in 4% of patients. 72.6% of included cases required critical care unit management. Question was not answered for seven patients.

The majority of patients (44.0%) were managed in RRMA Metropolitan 1 (major teaching) hospitals. Remaining were at RRMA Metropolitan 2 (17.9%), RRMA Rural 1 (26.2%) and RRMA Rural 2 (10.7%) centres. One patient was managed in a remote centre. The reason for delay in diagnosis was not stated for five patients, in one patient delay was determined to be unavoidable due to distances involved (Table 1).

One-third of deaths occurred on the day of admission (28/84 or 33.3%). Two-third of deaths occurred over the next 2 days (26/84 or 31.0%). Late death (greater than 7 days) occurred in 17 patients (20.2%). Details are shown in Figure 1.

Mechanism of trauma

The most common mechanism of trauma was road traffic accidents (77.4%). These were made up of motor vehicle accidents (46.4%), motorcycle accidents (14.3%), pedestrian injuries (10.7%) and cyclists

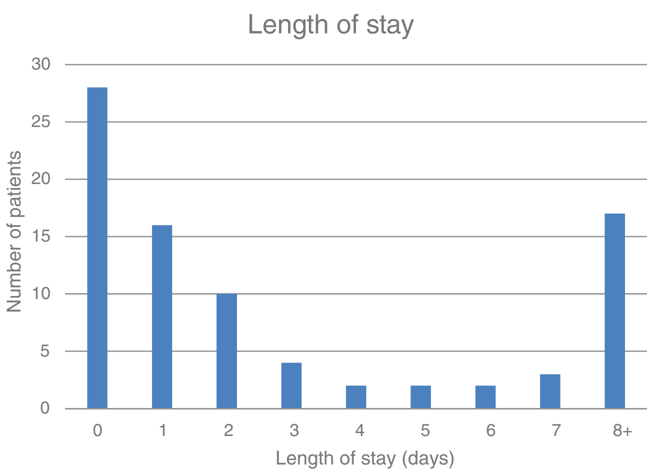

Fig. 1. Length of stay (LOS) in hospital, in days, by number of trauma laparotomy patients (n = 84).

(6.0%). 8.3% of patients suffered from falls, while 7.1% had miscellaneous mechanisms of injury. 10.7% of patients did not have a stated mechanism of injury. Of the five patients who in retrospect surgeons may have managed differently, two were work-place accidents, two road traffic accidents and one was a fall at home.

Patterns of trauma

Two-third of patients (64/84; 67.9%) injured in more than one body region (32.1% in one, 39.3% in two and 28.6% in three regions). 81.0% (68/84) patients had abdominal involvement either alone, or in various combinations of head (44.0%), chest (27.4%), pelvis (11.9%) or other injuries (long bones, spine, neck, subclavian vessels). Of the 68 patients with abdominal trauma, three quarters (70.59%) had other concurrent patterns of injuries are shown in Table 2.

Almost one in five (16/84; 19.1%) did not have abdominal involvement, but had head (*n* = 12), chest (*n* = 6), pelvis (*n* = 5) or other injuries. Half (8/16) were managed in RRMA 1 hospitals. Nine patients underwent an NTL with the only reason provided being 'trauma laparotomy' – eight of these patients had a severe head injury. Five patients underwent a laparotomy only for pelvic packing in the setting of pelvic fracture haemorrhage. Three had miscellaneous indications.

The 10 patients who had a pelvic fracture (11.9%) were managed mostly in Capital City Hospitals (RRMA M1 – six patients) or Small Rural Centres (RRMA R2 – four patients). Two each presented to other metropolitan or large rural centres.

Almost half of the deaths were due to head injuries (40.48%). Causes of death (as recorded by the treating surgeon) are shown in Table 3.

Surgeon self-reflection

The treating surgeon for five of the patients thought in retrospect they would manage a similar patient differently – although in four instances the surgeon believed the outcome would have been the same (two decision to operate in the setting of futility; two earlier recognition of deterioration and one earlier angio-embolization of pelvic haemorrhage).

Table 2 Distribution of injured body regions as described by the treating surgeon in the Surgical Case Form (*n* = 84)

Region	Patients
Abdomen alone	20 (23.8%)
Abdomen + head	14 (16.7%)
Abdomen + chest + head	9 (10.7%)
Abdomen + chest	6 (7.1%)
Abdomen + other	6 (7.1%)
Abdomen + pelvis ± other	5 (6.0%)
Abdomen + head + pelvis	4 (4.8%)
Abdomen + chest + other	2 (2.4%)
Abdomen + head + other	2 (2.4%)
Head ± other	8 (9.5%)
Chest ± other	6 (7.1%)
Other (pelvis alone and neck alone)	2 (2.4%)

Table 3 Distribution of causes of death as described by the treating surgeon in the Surgical Case Form (*n* = 84)

Cause of death	Patients
Head injury	34 (40.5%)
Bleeding	13 (15.5%)
Multi-organ failure	13 (15.5%)
Not stated	6 (7.1%)
Other	6 (7.1%)
Cardiac	4 (4.8%)
Pulmonary	4 (4.8%)
Ischaemic bowel	4 (4.8%)

First- and second-line assessments

First-line assessors found no areas of concern/consideration or adverse events in 73 patients (86.9%) but queried the management of 11 patients: eight were determined by first-line assessors (*n* = 5) or SLA (*n* = 3) to be not preventable by the treating surgeon, two related to intraoperative decision-making and one to the thoroughness of the initial assessment. Of these three potentially preventable situations, only one was identified by the treating surgeon.

Discussion

This study provides a snapshot of deaths in the setting of a trauma laparotomy in the state of Queensland between 2011 and 2016. Two-third of patients was male (58/64). Two-third had multi-system injuries (57/84). Two-third died within 2 days (54/84) mostly due to head injury (40.5%) or bleeding (15.5%). Only a minority of surgeons felt in retrospect they may have managed their patients differently, although most believed the outcome would have been the same (4/5). Assessor surgeons identified potential areas of improvement in only three patients (3.6%).

Our finding that head trauma was the leading cause of death is similar to Pfeifer *et al.* who assessed patterns of trauma mortality over the past 30 years.[6] They noted that: (i) brain injury was the most common cause of deaths; and (ii) the incidence of brain injury-related deaths has not changed. Sepsis and multi-organ failure were less frequent causes of death, however, they represented higher incidence of late death (LOS > 7 days).[6] Similarly, of our 17 late deaths (LOS > 7 days) seven were due to multi-organ failure.

Non-therapeutic laparotomies

Interestingly, 19% (16/84) of the patients did not have a significant abdominal injury, that is, underwent an NTL as determined by the treating surgeon. NTL is defined as intraoperative findings of injuries or haematomas that do not require any further surgical intervention. Incidence of NTL ranges from 1.7% to 38%.[7] The cause of such variation is multifactorial and influenced by the range of experience, management approaches and types of institution. Half of our NTL patients (8/16) underwent a trauma laparotomy in the setting of severe head injury. Five did so to control pelvic fracture haemorrhage.

In a report of 16 studies with 8111 patients, the overall incidence of NTL was 20.6%.[7] The reported incidence of NTL does not vary between blunt and penetrating trauma.[8,9] There is a significant morbidity, directly related to laparotomy and anaesthesia, with early complication rates ranging from 8.6% to 25.9% and a significant increase in LOS.[7] Mortality rate may be increased with an NTL.[10] The frequency of NTL may be reduced by serial examination, blood tests, imaging and care in a high dependency setting.[10–12]

Pelvic fractures

Six percent (5/84) of patients underwent laparotomy only for haemorrhage due to pelvic fracture in order to perform pelvic packing. The reported incidence for laparotomy in multi-trauma patients with pelvic fractures is 14.3%.[13] In most circumstances, haemodynamic abnormality from pelvic fracture haemorrhage alone does not warrant urgent laparotomy.[14] Indeed, mortality rates are greater in patients with pelvic fractures who undergo laparotomy compared to those who are managed without laparotomy.[13] Non-laparotomy methods include angio-embolization and pre-peritoneal packing.[15] A small prospective comparison between the two has shown pre-peritoneal packing is quicker and is associated with reduced transfusion requirements, and possibly lower mortality.[16] Delay to angio-embolization increases mortality because it adequately controls arterial haemorrhage in almost all patients.[17] Ability to perform pre-peritoneal packing to control pelvic fracture haemorrhage may be particularly useful in centres without access to interventional radiology. Adequate pelvic packing via laparotomy is often not achievable.

All deaths in the setting of a trauma laparotomy in Queensland over a 6-year period were included. Key strength lies in the peer-review aspect of the study: first-line analysis and SLA (where available) are important in that just because outcome was death does not imply a deficiency in care. Self-reporting bias is unlikely as our group has previously demonstrated.[18] There are limitations with any such audit. We were unable to compare patients who underwent trauma laparotomy and survived. This is a diverse group of patients with more than 12 injury patterns. The clinical context was not always clear which is particularly relevant to the group with an NTL. Not all the questions in the questionnaires were answered by every surgeon. An injury severity score is not part of the SCF limiting comparison with other jurisdictions. Chart review was not possible due to the study design.

Conclusion

This snapshot of trauma laparotomy deaths in Queensland highlights high quality trauma care. Notwithstanding, there is a need for a systematic trauma laparotomy audit and ongoing education given that some of the 19.1% who had an NTL may have avoided this either because it was non-therapeutic or because pelvic fracture haemorrhage may be managed differently.

Conflicts of interest

None declared.

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