Mind the gap: 11 years of train-related injuries at the Royal London Hospital Major Trauma Centre

J Virdee, G Pafitanis, R Alamouti, K Brohi, H Patel

Royal London Hospital, Barts Health NHS Trust, London, UK

ABSTRACT

INTRODUCTION This study presents an extensive retrospective database of patients with polytrauma following train-related injuries and highlights the key lessons learnt in this rare clinical presentation.

MATERIALS AND METHODS We retrospectively collected data from 127 patients who presented to Royal London Hospital after sustaining train related trauma. We analysed demographics, accident report data, aetiologies and clinical management interventions. All data were screened and injuries were mapped to various anatomical regions. The revised trauma score, injury severity score and new injury severity scores were used to quantify injury extent.

RESULTS Mean patient age was 41 years (range 16–81 years) with a 73% to 27% male to female ratio. Deliberate injuries occurred in 71% of patients, with accidental injury accounting for 29%. The mean new injury severity score was 26.48 (range 1–75), with the most common injuries sustained to the chest and the extremities. Pneumothorax, haemothorax or tension pneumothorax occurred in 44% of patients, with 11% suffering a flail chest injury. Traumatic amputations occurred in 33% of patients and 56% of patients required admission to intensive care. Total mortality rates were 19%, with 12% of patients dying at day 0 and 18% at day 7, respectively.

CONCLUSIONS This study demonstrated the significant impact of train-related polytrauma and provided a comprehensive injury patterns. It was observed that deliberate polytrauma is related to psychiatric deliberate harm but there is no significant difference in the patterns of injuries between accidental and deliberately caused injuries. Overall injuries to the thorax and extremities were the most severe, demonstrating the highest mean injury scores.

KEYWORDS

Train-related injuries – Polytrauma – Railway – Suicide – Trauma – Trauma scoring

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CORRESPONDENCE TO

Georgios Pafitanis, E: g.pafitanis@qmul.ac.uk

Introduction

The London Underground is over 150 years old and comprises over 350 stations, making it one of the oldest and largest urban transport networks in the world.^{1,2} This vast network transports an estimated 3.5 million passengers daily.¹ Despite these passenger volumes, the Underground still has one of the best safety records of any of the older metro systems in the world, with only one fatal accident for every 300 metres.⁵ Although accidents between trains are infrequent, the annual number of incidents and fatalities on the network has continued to increase over the last decade (Fig 1), highlighting the real danger that trains and their tracks can pose to railway workers and the public. Injury commonly occurs when patients are caught under trains, either from accidents caused by pre-existing medical conditions or fueled by alcohol. More frequently, they occur when passengers deliberately jump in front of trains to commit suicide, a phenomenon known colloquially as a ‘one under’.⁴

Multiple preventative measures have been introduced over the years, from safety posters, which have been

produced since the early 1900s (Fig 2a,b) to newer platforms, which completely separate moving trains and passengers using sliding doors along the platform edge that only open once the train has come to a halt.⁴ In 1969, the infamous safety message ‘mind the gap’ was coined. It is now synonymous with the London Underground and acts as a visual and audible cue in London underground stations (Fig 2c), reminding users to take caution when crossing spatial gaps between the train and the platform edge. In 2008, a ban on drinking alcoholic drinks on the network was implemented, in an attempt to prevent the numerous accidental injuries that had previously occurred owing to intoxicated passengers (Fig 2d).

Railway suicide is no new phenomenon, with numerous cases of people deliberately jumping in front of trains to commit suicide every year, an occurrence that was first reported in a male subject in 1852.⁵ Current literature has investigated trends in railway suicides extensively across many countries.^{6–12} Little research, however, has actually been carried out to characterise injury patterns that follow train-related injuries. Furthermore, there is a lack of data

comparing the outcome of accidentally falling compared with deliberately jumping in front of trains. We present our experience with an extensive retrospective analysis of patients with polytrauma following train-related injuries, which were managed at a London-based major trauma centre, in an attempt to highlight key injuries findings and predictors of survival in this increasing clinical presentation.

Materials and methods

Patient data

All patients admitted to the Royal London Hospital between June 2003 and July 2014, who had sustained injuries secondary to contact with London underground trains, were obtained from the Royal London Hospital trauma database and corroborated with data from the Trauma and Research Network where possible. Patients who experienced trauma as a result of direct contact with railway lines or trains were included, whereas those who experienced medical problems on platforms or near railway tracks were excluded. Patients who suffered trauma as a result of deliberate self-harm were included, as were patients who had suffered accidental trauma. The database was used to obtain patient gender, age, day and date of admission, together with mode of transport to hospital. Data regarding fatalities that did not present to hospital was obtained from external sources including Transport for London and the London Ambulance Service, as well as the number of incidents at underground and over-ground stations throughout the capital from 2003 to 2014.

Injury mapping and trauma scoring

Patient clinical records from first responders, ambulance services and helicopter emergency medical services were obtained from patient notes and the first documented Glasgow Coma Score, systolic blood pressure and unassisted respiratory rate used to calculate the revised trauma score, in line with previous literature.^{13,14} The score ranges from 0 to 7.84, where a score of 4 or greater has a 60% documented probability of survival, making this our first investigated potential predictor of survival. Essential information regarding prehospital interventions was also obtained in particular cases where extrication from under trains was difficult or

prolonged and where cardiopulmonary resuscitation had to be administered on scene.

The trauma booklet on admission was used, together with x-rays and computed tomography to assign bodily injuries segregated to the head and neck, face, chest, abdomen (including pelvic contents), extremities (including the bony pelvis) and external subregions. Injuries to visceral organs were classified and assigned grades 1 to 6 based on scales previously outlined by the American Association for the Surgery of Trauma.^{15–19} All other injuries were assigned an abbreviated injury scale from 1 to 620, with use of the

Colorado specific 'rules' to keep injury scoring consistent between patients and avoid any unwanted ambiguity or selection bias.²¹ The new injury severity score (NISS) is based on three bodily subregions with the highest injury severity score and ranges from 0 to 75, where a score of 75 is considered nonsurvivable.²² The NISS score was calculated for each patient, as previously described,²² and the revised trauma score value and NISS scores were used to give a final trauma score–injury severity score probability of survival (TRISS-Ps).²³ A TRISS-Ps 0.6 or greater was investigated as the second potential predictor of survival. Frequencies of patients suffering from pneumothoraces, haemothoraces or tension pneumothoraces and flail segments were recorded, together with the frequencies and levels of any amputations suffered.

Patient numbers, missing data and patient outcomes

An average number of 39 (range 26–45) annual incidences of rail versus person occurred on the London Underground between 2004 and 2015, from which 26 (range 15–29) were fatal. This demonstrates that a large percentage (66%) of these injuries result in instant death and do not undergo trauma service provision. A total of 127 incidences met the study methodology criteria. Of these, four patients were of unknown age (as they had not been identified postmortem) and 33 patients had no revised trauma scores available as documentation regarding their initial observations was missing. Of the patient cohort, revised trauma score and TRISS scores were therefore based on 93 participants for whom full data were available, whereas all other factors and injury patterns were compared in the full cohort of 127 patients. Inpatient notes were used to study clinical outcomes, recording any patients who died in the emergency department on admission or in the operating theatre shortly after admission. Patients requiring intensive care or surgery were also compared, as were the length of inpatient stays and overall mortality rates. Comparison of injury severity scores and the trauma scoring outlined above was made

between accidental and deliberate injury groups, as well as those who survived following trauma compared with those who had died.

Statistical analysis

Age, revised trauma scores, injury severity scores of the six bodily subregions, NISS scores, TRISS-Ps and length of stay were compared between the accidental/deliberate groups and the survival/nonsurvival groups. Statistical differences between the means were assessed using the Mann–Whitney U test as patient data did not meet requirements for normality. Contingency tables were formulated for our two investigated predictors of survival (revised trauma scores ≥ 4 and TRISS-Ps ≥ 0.6) and the Fisher's exact test used to assess any significant association of these parameters with survival.

Results

Common injuries and mortality rates

The most common injuries suffered in the patient cohort overall were injuries to the chest and extremities. 32 patients (25.2%) suffered a pneumothorax, 17 (13.4%) had a haemothorax, 7 (5.5%) had a tension pneumothorax and 14 patients (11%) had a flail chest injury. Ten patients (7.9%) suffered an upper limb traumatic amputation, 23 (18.1%) had a lower limb amputation and a further 9 patients (7.1%) suffered bilateral lower limb amputations. Admission to intensive care was necessary for 72 patients (56.7%) at some point during their inpatient stay. Of the total patient cohort, 22 patients (17.3%) died, with 16 (73%) of these dying in the emergency department or operating theatre shortly after admission.

Accidental compared with deliberate injury groups

The demographics and injury patterns of all participants, when grouped by cause of injury (accidental or deliberate) are shown in Table 1. Some 37 patients suffered accidental

Table 1 Demographics, injury patterns and survival predictions grouped by cause of injury.

Parameter	Accidental (<i>n</i> = 37)	Deliberate (<i>n</i> = 90)	Mann-Whitney U test (accidental vs deliberate)			
			<i>U</i>	<i>Z</i>	<i>P</i>	Sig.
Age (years):						
mean (SD)	36.21 (14.78) ^a	42.33 (15.25) ^d	636.50	−1.682	0.093	<i>ns</i>
median (range)	33.50 (17–81) ^a	41.00 (16–79) ^d	–	–	–	–
Gender, <i>n</i> (%)						
Male	29 (78.4)	64 (71.1)	–	–	–	–
Female	8 (21.6)	26 (28.9)	–	–	–	–
CPR on scene, <i>n</i> (%)	0 (–)	3 (3.3)	–	–	–	–
Revised trauma score:						
mean (SD)	6.95 (1.44) ^b	6.5 (1.69) ^e	653.50	−1.603	0.109	<i>ns</i>
median (range)	7.84 (1.31–7.84) ^b	6.9 (1.47–7.84) ^e	–	–	–	–
< 4, <i>n</i> (%)	24 (64.9) ^b	62 (68.9) ^e	–	–	–	–

Parameter	Accidental (<i>n</i> = 37)	Deliberate (<i>n</i> = 90)	Mann-Whitney U test (accidental vs deliberate)			
			<i>U</i>	<i>Z</i>	<i>P</i>	Sig.
Injury severity score, mean (SD):						
Head and neck	2.05 (1.81)	1.63 (1.75)	1425.00	−1.318	0.188	<i>ns</i>
Face	0.43 (0.69)	0.72 (0.94)	1421.50	−1.470	0.142	<i>ns</i>
Chest	1.70 (1.71)	2.22 (1.63)	1379.00	−1.583	0.113	<i>ns</i>
Abdomen	0.68 (1.45)	0.67 (1.20)	1540.00	−0.828	0.408	<i>ns</i>
Extremity	2.81 (1.51)	2.97 (1.41)	1552.00	−0.616	0.538	<i>ns</i>
External	0.43 (0.77)	0.47 (0.72)	1565.50	−0.633	0.527	<i>ns</i>
NISS:						
mean (SD)	26.46 (19.03)	26.49 (14.65)	1541.50	−0.656	0.512	<i>ns</i>
median (range)	19.00 (3–75)	24.50 (1–75)	–	–	–	–
TRISS-Ps:						
mean (SD)	0.90 (0.17) ^c	0.80 (0.28) ^e	552.50	−2.435	0.015	<i>P</i> < 0.05
median (range)	0.99 (0.27–1.00) ^c	0.94 (0.04–1.00) ^e	–	–	–	–
> 60%, <i>n</i> (%)	22 (59.5) ^c	57 (63.3) ^e	–	–	–	–
Pneumothoraces, <i>n</i> (%):						
Pneumothorax	11 (29.7)	21 (23.3)	–	–	–	–
Haemothorax	4 (10.8)	13 (14.4)	–	–	–	–
Tension pneumothorax	1 (2.7)	6 (6.7)	–	–	–	–
Flail chest, <i>n</i> (%)	2 (5.4)	12 (13.3)	–	–	–	–
Limb amputation, <i>n</i> (%):						
Upper	2 (5.4)	8 (8.9)	–	–	–	–
Lower	8 (21.6)	15 (16.7)	–	–	–	–
Bilateral lower	2 (5.4)	7 (7.8)	–	–	–	–
Death in ED/OR, <i>n</i> (%)	5 (13.5)	11 (12.2)	–	–	–	–
ITU admission, <i>n</i> (%)	17 (45.9)	55 (61.1)	–	–	–	–
Patients needing surgery, <i>n</i> (%)	11 (29.7)	28 (31.1)	–	–	–	–
Length of stay (days):						
mean (SD)	22.89 (22.67)	42.40 (52.66)	1307.50	−1.900	0.057	<i>ns</i>
median (range)	17.00 (0–86)	24.00 (0–360)	–	–	–	–
Survival, <i>n</i> (%)	30 (81.1)	75 (83.3)	–	–	–	–
CPR, cardiopulmonary resuscitation; ED, emergency department; ITU, intensive care unit; NISS, new injury severity score; <i>ns</i> , not significant; OR, operating theatre; SD, standard deviation; Sig., significance; TRISS-Ps, trauma score–injury severity score probability of survival.						
^a Data missing for 3 patients.						
^b Data missing for 12 patients.						
^c Data missing for 13 patients.						
^d Data missing for 1 patient.						
^e Data missing for 21 patients.						

train-related injuries, with the remaining 90 patients deliberately causing themselves injury. A preliminary analysis was conducted to determine any key differences in the mean values of factors between the two groups. There was no statistical significant difference in mean age, revised trauma score, injury severity scores (for all six bodily subregions), NISS scores or the length of stay between the two groups.

The mean TRISS-Ps was significantly higher for the accidental group at 0.90, compared with the deliberate injury group at 0.80 ($U = 552.50$, $Z = -2.435$, $P = 0.015$).

Survival compared with non-survival groups

Injury patterns grouped according to the survival status of participants were studied for the cohort (Table 2). There

Table 2 Demographics, injury patterns and survival prediction grouped by patient survival status.

Parameter	Nonsurvival (<i>n</i> = 22)	Survival (<i>n</i> = 105)	Mann-Whitney U test (accidental vs deliberate)			Significance
			<i>U</i>	<i>Z</i>	<i>P</i>	
Age (years):						
mean (SD)	42.53 (17.63) ^a	40.29 (14.92) ^d	158.00	−1.611	1.107	ns
median (range)	42.00 (19–81) ^a	39.50 (16–79) ^d	–	–	–	–
Gender, <i>n</i> (%)						
Male	17 (77.3)	76 (72.4)	–	–	–	–
Female	5 (22.7)	29 (27.6)	–	–	–	–
Deliberate injury, <i>n</i> (%)	15 (68.2)	75 (71.4)	–	–	–	–
Difficult extrication, <i>n</i> (%)	2 (9.1)	9 (8.6)				
CPR on scene, <i>n</i> (%)	3 (13.6)	0 (–)	–	–	–	–
Revised trauma score:						
mean (SD)	4.27 (2.26) ^b	6.81 (1.43) ^e	–	–	–	<i>P</i> ≤ 0.01
median (range)	5.03 (1.31–6.90) ^b	7.55 (1.47–7.84) ^e	–	–	–	–
< 4, <i>n</i> (%)	4 (18.2) ^b	82 (78.1) ^e	–	–	–	–
Injury severity score, mean (SD):						
Head and neck	2.41 (2.32)	1.62 (1.61)	941.50	−1.408	0.159	ns
Face	0.36 (0.72)	0.70 (0.90)	917.00	−1.725	0.085	ns
Chest	3.09 (1.48)	1.86 (1.63)	693.50	−3.068	0.002	<i>P</i> ≤ 0.01
Abdomen	1.27 (1.96)	0.54 (1.05)	990.5	−1.308	0.191	ns
Extremity	3.68 (1.56)	2.76 (1.37)	708.50	−3.015	0.003	<i>P</i> ≤ 0.01
External	0.09 (0.43)	0.53 (0.76)	359.00	−5.077	0.000	<i>P</i> ≤ 0.001
NISS:						
mean (SD)	45.05 (17.94)	22.59 (12.49)	359.00	−5.077	0.000	<i>P</i> ≤ 0.001
median (range)	46.50 (18–75)	21.00 (1–57)	–	–	–	–
TRISS-Ps:						
mean (SD)	0.44 (0.42) ^c	0.85 (0.23) ^e	79.00	−2.865	0.004	<i>P</i> ≤ 0.001
median (range)	0.39 (0.04–0.95) ^c	0.95 (0.06–1.00) ^e	–	–	–	–
> 60%, <i>n</i> (%)	3 (13.6) ^c	76 (72.4) ^e	–	–	–	–
Pneumothoraces, <i>n</i> (%):						
Pneumothorax	8 (36.4)	24 (22.9)	–	–	–	–
Haemothorax	2 (19.1)	15 (14.3)	–	–	–	–
Tension pneumothorax	3 (13.6)	4 (3.8)	–	–	–	–
Flail chest, <i>n</i> (%)	4 (18.2)	10 (9.5)	–	–	–	–
Limb amputation, <i>n</i> (%):						
Upper	1 (4.5)	9 (8.6)	–	–	–	–
Lower	6 (27.3)	17 (16.2)	–	–	–	–
Bilateral lower	2 (9.1)	7 (6.7)	–	–	–	–
Death in ED/OR, <i>n</i> (%)	16 (72.7)	–	–	–	–	–

Parameter	Nonsurvival (<i>n</i> = 22)	Survival (<i>n</i> = 105)	Mann-Whitney U test (accidental vs deliberate)			
			<i>U</i>	<i>Z</i>	<i>P</i>	Significance
ITU admission, <i>n</i> (%)	6 (27.3)	66 (62.9)	–	–	–	–
Patients needing surgery, <i>n</i> (%)	13 (59.1)	26 (24.8)	–	–	–	–
Length of stay (days):						
mean (SD)	1.05 (2.21)	44.19 (48.17)	102.50	–6.718	0.000	$P \leq 0.001$
median (range)	0.00 (0–8)	30.00 (0–360)	–	–	–	–
CPR, cardiopulmonary resuscitation; ED, emergency department; ITU, intensive care unit; NISS, new injury severity score; ns, not significant; OR, operating theatre; SD, standard deviation; Sig., significance; TRISS-Ps, trauma score–injury severity score probability of survival.						
^a Data missing for 3 patients.						
^b Data missing for 15 patients.						
^c Data missing for 16 patients.						
^d Data missing for 1 patient.						
^e Data missing for 18 patients.						

was no significant difference demonstrated in mean age or mean injury severity score for the head and neck, face or abdominal sub-regions between the two groups. There was a significant difference in mean chest injury severity score, with the nonsurvival group scoring 3.09 compared with the survival group at 1.86 ($U = 693.50$, $Z = -3.068$, $P = 0.002$). Likewise, mean injury severity score for the extremity sub-region was 3.68 in the nonsurvival group compared with 2.76 in the survival group ($U = 708.50$, $Z = -3.015$, $P = 0.003$). External injury severity scores were higher in the survival group compared with the nonsurvival group at 0.53 and 0.09, respectively ($U = 359.0$, $Z = -5.077$, $P = 0.000$).

The mean revised trauma score was significantly lower in the nonsurvival group at 4.27 compared with 6.81 ($U = 88.00$, $Z = -2.831$, $P = 0.05$), whereas the NISS score was higher in the nonsurvival group at 45.05 compared with 22.59 ($U = 359.00$, $Z = -5.077$, $P = 0.000$). The TRISS-Ps was 0.44 in the nonsurvival group compared with 0.85 in the survival group ($U = 79.00$, $Z = -2.865$, $P = 0.004$). Length of stay was significantly lower in the nonsurvival group at 1.05 days compared with 44.19 days ($U = 102.50$, $Z = -6.718$, $P = 0.000$).

Predictors of survival

A revised trauma score of 3 or less (Table 3) was not associated with survival, nor did it demonstrate an ability to predict survival ($P = 0.065$); however, a TRISS-Ps 59% or less (Table 3) significantly predicted survival in our patient cohort ($P = 0.042$). Additionally, injury severity scores of 3 or less in the chest ($P = 0.001$), abdominal ($P = 0.034$) and extremity ($P = 0.037$) subregions also significantly predicted survival in our patient cohort, with no significance associated with values 3 or less in any other subregions (Table 3).

Discussion

Our study provides a comprehensive account of injury patterns sustained by patients affected by train-related trauma. Overall, injuries to the thorax and extremities were the most severe, demonstrating the highest mean injury scores

(Fig 3). These injury patterns are in keeping with the nature of the ‘person versus train’ collision, with a direct blunt force hitting the thoracic cage and extremities then being amputated as trains run over limbs trapped between the train and tracks. Lower limb amputations were the most frequent injury to the extremities, with nine patients sustaining either bilateral above- or below-knee amputations (Fig 3). Over 50% of all patients required admission to intensive care and, although not directly documented in this study, many patients required intubation at scene and transport to the Royal London Hospital via helicopter.

Additionally, train-related trauma inferred a high level of mortality, with 17% patients in our study dying following their admission to hospital, with 73% of these dying in either the emergency room or operating theatre shortly after admission. Cocks’ study in the 1980s found that 35% of the patient cohort died before reaching hospital, with 15.4% then dying following admission to hospital.²⁴ Interestingly, our inpatient mortality rate is slightly higher than Cocks’ quoted mortality rate; however, this does not take into account the large cohort of patients who died in his study prior to reaching hospital, whereas our study focused only on patients admitted alive. The introduction of sophisticated prehospital treatment, including rapid sequence induction and intubation, has undoubtedly enhanced the lifespan of many who would have died at scene, although exact confirmation of this would be difficult to prove.

In our study, patients who suffered accidental train-related injuries were just as likely to get injured in all six bodily subregions (as measured by injury severity score) but they were predicted as 10% more likely to survive the trauma overall when compared with those who had jumped in front of a train. The accidental group accounted for less than one-third of the overall patient cohort, suggesting that our results concur with the popularity of railway suicide, which still remains a problem to this day. Mortality rates between the accidental and deliberate injury groups were almost the same, highlighting that those who attempt railway suicide are not more likely to

Table 3 Contingency table for survival against revised trauma score, trauma score–injury severity score and subregion injury severity score.

Factor	Nonsurvival <i>n</i> (%)	Survival <i>n</i> (%)	Significance
Revised trauma score (<i>n</i> = 93): ^a			
≤ 3	2 (2.15)	5 (5.4)	<i>P</i> = 0.063 (ns)
4	4 (4.3)	82 (88.2)	
TRISS (<i>n</i> = 93): ^a			
≤ 59%	2 (2.15)	5 (5.4)	<i>P</i> = 0.042 ^b
60%	3 (3.2)	76 (81.7)	
Head and neck ISS (<i>n</i> = 127):			
< 3	11 (8.7)	68 (53.5)	<i>P</i> = 0.146 (ns)
3	11 (8.7)	37 (29.1)	
Face ISS (<i>n</i> = 127):			
< 3	22 (17.3)	101 (79.5)	<i>P</i> = 0.001
3	0 (0.0)	4 (3.1)	
Chest ISS (<i>n</i> = 127):			
< 3	3 (2.4)	55 (43.3)	<i>P</i> = 0.001
3	19 (15.0)	50 (39.4)	
Abdominal ISS (<i>n</i> = 127):			
< 3	17 (13.4)	98 (77.2)	<i>P</i> = 0.034 ^b
3	5 (3.9)	7 (5.5)	
Extremity ISS (<i>n</i> = 127):			
< 3	3 (2.4)	37 (29.1)	<i>P</i> = 0.037 ^b
3	19 (15.0)	68 (53.5)	
External ISS (<i>n</i> = 127):			
< 3	22 (17.3)	104 (81.9)	<i>P</i> = 0.827 (ns)
3	0 (0.0)	1 (0.79)	
ISS, injury severity score; ns, not significant; TRISS, trauma score–injury severity score. ^a Data missing for 34 patients. ^b Significant to <i>P</i> ≤ 0.05.			

ISS, injury severity score; ns, not significant; TRISS, trauma score–injury severity score.

^aData missing for 34 patients.^bSignificant to *P* ≤ 0.05.

die. Injury severity scores in the chest and extremity subregions varied significantly between the survival and nonsurvival patient groups (Fig 5). In both cases, the mean scores were higher in the nonsurvival groups but, for the external category, the survival group had a higher mean score. This is consistent with survival status, where we would expect those patients who do not survive to have more severe chest and extremity injuries, while the survival group demonstrated more external injuries with lower scores (e.g. lacerations and haematomas).

Trauma scores and predictions of survival also varied with survival status, with the revised trauma score, NISS score and TRISS-Ps all calculated as significantly lower in the nonsurvival group. The mean nonsurvival revised trauma score was significantly lower than the mean survival

revised trauma score, confirming that a lower Glasgow Coma Scale, systolic blood pressure and unassisted respiratory rate in the first set of observations recorded following the trauma can be indicative of a propensity to die. However, using our data, a revised trauma score of 3 or less was not significantly associated with survival and therefore cannot be used to predict mortality in train-related trauma patients in our patient cohort. NISS scores were significantly higher in the nonsurvival group, with mean values twice as high as those in the survival group. The TRISS-Ps based on the revised trauma score, NISS and patient age was also significantly higher in the survival group, at 0.85, almost double that of the nonsurvival group, at 0.44. A TRISS-Ps of 59% or less was significantly associated with survival, demonstrating that TRISS may be able to predict the likelihood of

mortality in patients who have suffered train-related trauma. Finally, injury severity scores of less than 3 in the chest, abdominal and extremity subregions demonstrated ability to predict survival across our patient cohort. This demonstrates that severe chest, abdominal and extremity trauma (injury severity score ≥ 3) may be able to predict the likelihood of mortality in train-related trauma.

Within the patient cohort, 34 of 127 patients had incomplete initial observations and therefore could not have their revised trauma score and thus TRISS-Ps calculated. As we were still able to calculate revised trauma score and TRISS in 93 patients, there was still a good cohort from which to make an inference regarding survival. As many of the patients who had their initial observations missing were in the nonsurvival group, to exclude these completely from the study would have skewed both the injury severity scores and mortality rates towards the survival group, making the injuries look far less severe and the mortality rates appear much less than they actually were. Although calculating revised trauma scores and TRISS based on 93 patients and injury severity and mortality on 127 patients reduces the power of our comparisons, this non-ideal situation far outweighs the skewing effect that would have occurred had we have kept just 93 patients for all comparisons.

Conclusion

This study demonstrated the significant impact of train-related polytrauma, providing a comprehensive account of injury patterns sustained by patients. It was observed that deliberate polytrauma is related to psychiatric deliberate harm but there is no significant difference in the patterns of injuries between accidental and deliberately caused injuries. Overall, injuries to the thorax and extremities were the

most severe, demonstrating the highest mean injury scores. High mortality rates clearly demonstrate the devastating impact associated with these types of injuries, with patients often not surviving beyond hospital admission.

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