Prehospital trauma management: a national study of paramedic activities

S Sukumaran, J M Henry, D Beard, R Lawrenson, M W G Gordon, J J O’Donnell, A J J Gray

Objectives: The benefits of prehospital trauma management remain controversial. This study aimed to compare the processes of care and outcomes of trauma patients treated by paramedics, who are trained in advanced prehospital trauma care, with those treated by ambulance technicians.

Methods: A six year prospective study was conducted of adult trauma patients attended to by the Scottish Ambulance Service and subsequently admitted to hospital. Prehospital times, interventions, triage, and outcomes were compared between patients treated by paramedics and those treated by technicians.

Results: Paramedics attended more severely injured patients (16.5% versus 13.9%, p<0.001); they attended a higher proportion of patients with penetrating trauma (6.6% versus 5.7%, p=0.014) and had longer prehospital times. Patients managed by paramedics were more likely to be taken to the intensive care unit, operating theatre or mortuary, (11.2% versus 7.8%, p<0.001) and had higher crude mortality rates (5.3% versus 4.5%, p=0.07). However, no difference in mortality between the two groups was noted when corrected for age, Glasgow coma score and injury severity score.

Conclusions: This large scale national study shows that paramedics show good triage skills and clinical judgement when managing trauma patients. However, the value of the individual interventions they perform could not be ascertained. Further controlled trials are necessary to determine the true benefits of advanced prehospital trauma life support.

Trauma is the leading cause of death in adults less that 45 years of age in the United Kingdom. The trimodal distribution of trauma deaths described by Trunkey also highlighted a high proportion of deaths within the first hours of the trauma, which might have been prevented by earlier medical intervention. This prompted the proposal by the Department of Health to have at least one paramedic who was trained in advanced prehospital trauma care in all emergency ambulances in England and Wales. While both paramedics and ambulance technicians assess, triage, and treat trauma patients, paramedics receive a minimum of eight weeks' additional specialised training in endotracheal intubation, intravenous cannulation, fluid administration, and the use of a number of drugs. Despite its adoption, however, the benefits of this additional training have been questioned, as such interventions could delay the administration of definitive care to the patient. This study aims to compare the relative contributions made by paramedics with advanced prehospital trauma care skills, and ambulance technicians, with the processes of care and outcomes of patients after trauma in Scotland.

METHODS

We analysed all prospectively identified trauma patients, aged over 13 years, (the age used in Scotland to separate paediatric from adult patients) taken by the Scottish Ambulance Service to 26 emergency departments (EDs) in Scotland from 1 July 1996 to 30 June 2002. Data were collected by the Scottish Trauma Audit Group (STAG), whose inclusion and exclusion criteria are listed in the box. These criteria concur with those used by the Trauma Audit and Research Network for England and Wales, UK TARN; in addition, patients who arrived in the ED in cardiopulmonary arrest whose period of resuscitation was less than 15 minutes, inter-hospital transfers, and patients managed by a doctor at scene were excluded.

Patients are audited using TRISS methodology. The following data were used from the STAG database: mechanism and type of injury, prehospital times (response, on-scene, transport, and total times), interventions on-scene, triage category, revised trauma scores in the ED, injury severity scores, destination from the ED, and outcome. The on-scene interventions and times were obtained from the ambulance service patient report forms (PRF), which include the type of ambulance personnel attending the patient. The personnel response to an incident (paramedic or ambulance technician) was decided by central ambulance control, but was most commonly determined by which ambulance was closest to the scene.

Data were analysed using SPSS for Windows V11. Categorical variables were analysed using $\chi^2$ tests. The

Abbreviations: ISS, injury severity score; GCS, Glasgow coma score; ED, emergency department; STAG, Scottish Trauma Audit Group; SMR, standardised mortality ratios; PRF, patient report form
continuous prehospital times were of non-parametric
distribution and were compared using Mann-Whitney U tests.
Standardised mortality ratios (SMR) were standardised for
age, Glasgow coma score (GCS), and injury severity score
(ISS): eight age groups, five GCS categories, and five ISS
categories.

RESULTS
Altogether 26 523 patients who fulfilled STAG entry criteria
were identified in the study period. Of these, 5106 (19%)
were excluded because either the PRF or the grade of
ambulance response was unavailable. This left 21 417
patients for analysis.

Demographics and injury patterns
Paramedics attended to 12 339 (58%) of patients, while
ambulance technicians attended to 9078 (42%). Most
patients, 20 086 (93.8%) had blunt trauma. Paramedics
attended more patients who had been involved in a road
traffic accident, assault, and fall from over two metres
(table 1).

Prehospital times
Table 2 shows ambulance response times, on-scene times,
and transfer to ED times. Response times were similar in both
groups, but paramedics spent longer at scene and had longer
total prehospital times than technicians.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Demographic data and injury mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Paramedic</td>
</tr>
<tr>
<td>Total number of patients (%)</td>
<td>12339 (58)</td>
</tr>
<tr>
<td>Median age (y)</td>
<td>48</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>7461 (60)</td>
</tr>
<tr>
<td>Penetrating trauma (%)</td>
<td>810 (6.6)</td>
</tr>
<tr>
<td>RTA, assault or fall &gt;2 m</td>
<td>5984 (48.5)</td>
</tr>
</tbody>
</table>

Table 2 Prehospital times

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Paramedic</th>
<th>Technician</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response</td>
<td>Median</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Interquartile range</td>
<td>6–13</td>
<td>6–13</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>297</td>
<td>230</td>
</tr>
<tr>
<td>On-scene</td>
<td>Median</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Interquartile range</td>
<td>11–25</td>
<td>10–20</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>144</td>
<td>103</td>
</tr>
<tr>
<td>Travel</td>
<td>Median</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Interquartile range</td>
<td>11–27</td>
<td>11–26</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>195</td>
<td>185</td>
</tr>
<tr>
<td>Total time to hospital</td>
<td>Median</td>
<td>47</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Interquartile range</td>
<td>36–64</td>
<td>33–58</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>327</td>
<td>305</td>
</tr>
</tbody>
</table>

Table 3 On-scene times for patients receiving advanced prehospital trauma interventions
in the paramedic group

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>Intervention</th>
<th>No intervention</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubation Median</td>
<td>20</td>
<td>17</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>Interquartile range</td>
<td>15–25</td>
<td>11–25</td>
</tr>
<tr>
<td>Cannulation, no fluids</td>
<td>Median</td>
<td>23</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Interquartile range</td>
<td>18–33</td>
<td>10–20</td>
</tr>
<tr>
<td>Cannulation with fluids</td>
<td>Median</td>
<td>25</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Interquartile range</td>
<td>18–35</td>
<td>10–20</td>
</tr>
</tbody>
</table>

Interventions
An advanced trauma intervention, such as endotracheal
intubation or cannulation, was performed on 4011 (32.5%) of
the paramedic group: 128 patients (1.0%) were intubated at
scene, and 3958 (32%) were cannulated. Patients who
received an intervention spent longer on-scene than those
who did not (table 3). Patients who did not require an
intervention had similar median on-scene times in both the
paramedic and technician groups (14 versus 15 minutes, p = 0.75).

Triage
Paramedics attended proportionately more patients with an
abnormal RTS (1796 (14.6%) versus 1063 (11.7%); p<0.001)
or an ISS greater than 15 (2039 (16.5%) versus 1,262 (13.9%);
p<0.001). More patients from the paramedic group were also
triaged directly to the resuscitation room, regardless of RTS or
ISS value (table 4). Paramedics made a “standby” call to the
ED more frequently than technicians did for patients with
ISS more than 15 (1186 (58.2%) versus 578 (45.8%);
p<0.001). Almost all patients deemed physiologically com-
promised by the attending paramedic, and for whom a
standby call was made, were triaged directly to the
resuscitation room (98.4%). Of the 407 physiologically
compromised patients not triaged to the resuscitation room,
117 (29%) were subsequently re-triaged there.

Outcome measures
Patients who had been managed by a paramedic were more
likely to be taken to a “critical” destination (ICU, theatre, or
mortuary) on leaving the ED than those treated by
ambulance technicians (1379 (11.2%) versus 706 (7.8%);
p<0.001). Paramedics attended a significantly higher pro-
portion of patients who subsequently stayed in hospital for
over four weeks (1284 (10.4%) versus 832 (9.2%); p = 0.003).
However, among those patients admitted to ICU there was no
difference in the length of time spent in ICU between the two
groups (median stay two days for both groups, p = 0.09).
A total of 1063 patients (5%) died. There was no difference in mortality rates between the paramedic treated and technician treated patients when age, GCS on arrival in the ED, and ISS were controlled for (SMR in the paramedic group 0.9984, 95% CI 0.9219 to 1.0749, and 1.0025 in the technician group, 95% CI 0.9053 to 1.0998; p = 1.00). There was also no significant difference between the two groups when patients with penetrating injuries were compared (64 versus 52 patients; p = 0.20). However, the paramedic treated blunt trauma patients had a higher mortality rate (59/1.3%) versus 356 (4.2%); p = 0.001). Their mortality rate was higher in the ED, (163 (1.3%) versus 80 (0.9%); p = 0.003), but not within one day of admission (335 (2.7%) versus 209 (2.3%); p = 0.06).

**DISCUSSION**

This is the largest study to date, conducted in the UK, comparing paramedic activities with those of ambulance technicians in the management of the trauma patient. The large sample size and high quality data showed small but significant differences in the groups studied. We found that patients treated by a paramedic were younger, and more likely to have suffered a penetrating injury. Paramedic treated patients also tended to have more serious injuries and a greater degree of physiological compromise. A third of their patients were cannulated, intubated, or both, and these interventions were associated with longer on-scene times. Prehospital times were consistent with other studies from the UK.12-14

This is the first national study to show paramedics’ ability to correctly identify patients who required triage to a resuscitation area. Triaging increased numbers of patients to the resuscitation room and this could have significant resource implications if practised indiscriminately. However, as a higher proportion of paramedic treated patients went to a critical destination from the ED, it suggests good decision making and appropriate triage skills. The informal targeting of paramedics to the severely injured that occurs in practice is likely to be in recognition of these capabilities.

There is however continued uncertainty about the benefits of the prehospital interventions they perform on trauma patients. In this study, there was no decrease in mortality for paramedic treated patients after correction for age. GCS on arrival in the ED, and ISS was made. Admittedly the two groups under comparison were not strictly matched, and we could not take into account the regional variations in prehospital service provision across the country. Nevertheless, these findings are similar to those in an earlier paper from Edinburgh, which noted that while paramedics delivered an improved process of care, their activities did not significantly reduce mortality or length of stay in intensive care.11 A health technology assessment (HTA) paper from 1998 came to a similar conclusion, although interestingly it found decreased morbidity at six months for survivors who had received prehospital trauma life support.14

The benefits of prehospital fluid therapy in particular have been frequently questioned.15-19 A recent trial by the HTA found no improvement in mortality rates or composite outcomes in trauma patients randomised to a conventional prehospital fluid replacement regimen.10 The authors wondered if this was because the delay to definitive care attributable to performing cannulation outweighed any benefits from receiving fluids. Using computer modelling, Lewis et al showed that fluids seemed to be beneficial only where prehospital times exceed 30 minutes.20 A policy of “scoop and run” has been proposed instead by several authors,21-23 with cannulation being performed “en route” to shorten prehospital times. One study of en route cannulation in a moving ambulance reported a success rate of 95%.22

Prehospital endotracheal intubation of the trauma patient also has come under scrutiny. In 1985 Pepe suggested that intubation provides the best method of airway control in patients with changed levels of consciousness, shock, or an unprotected airway.24 However, since then, several studies have indicated that intubation during prehospital care often results in delayed definitive care.18 Davis et al showed worse outcomes in patients with severe head injury who underwent rapid sequence intubation at scene.18 The benefit of this intervention to patients with other injury patterns is also unclear.25-26 Complication and failure rates are also higher than in non-trauma patients.27 This may be attributable to skill retention being difficult, given the low incidence of trauma intubations that occur in practice. In addition, UK paramedics are not trained in drug-assisted intubation, and thus may be unable to control for potentially lethal autonomic and intracranial pressure changes during the procedure. It is also an intervention that prolonged prehospital times in our study, although the three minute delay that occurred may not be clinically significant.

In conclusion, this study shows that advanced prehospital trauma care training improves identification of the seriously injured patient who will need resuscitation or intensive care. However, no reduction in mortality was noted when the interventions it teaches were practised. More research is necessary to decide if selected patients warrant a “scoop and run” policy of prehospital trauma care.

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**REFERENCES**