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 than 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 specialist 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 χ² tests. The

Inclusion and exclusion criteria of the Scottish Trauma Audit Group

Inclusion criteria:
- Patients who are admitted to hospital for at least three days, or who die as a result of trauma.

Exclusion criteria:
- Patients aged over 65 with an isolated fracture of the neck of femur or pubic ramus.
- Children aged under 13.

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.

**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 compromised 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 proportion 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).

---

**Table 1** Demographic data and injury mechanism

<table>
<thead>
<tr>
<th></th>
<th>Paramedic</th>
<th>Technician</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patients (%)</td>
<td>12339 (58)</td>
<td>9078 (42)</td>
<td></td>
</tr>
<tr>
<td>Median age (y)</td>
<td>48</td>
<td>51</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>7461 (60)</td>
<td>5183 (57)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Penetrating trauma (%)</td>
<td>810 (6.6)</td>
<td>521 (5.7)</td>
<td>0.013</td>
</tr>
<tr>
<td>RTA, assault or fall &gt;2 m</td>
<td>5984 (48.5)</td>
<td>3780 (41.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Table 2** Prehospital times

<table>
<thead>
<tr>
<th></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></th>
<th>Intervention</th>
<th>No intervention</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubation</td>
<td>Median</td>
<td>20</td>
<td>17</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>
Prehospital times were consistent with other studies from the interventions were associated with longer on-scene times. Their patients were cannulated, intubated, or both, and these and a greater degree of physiological compromise. A third of patients treated by a paramedic were younger, and more significant differences in the groups studied. We found that a large sample size and high quality data showed small but the procedure. It is also an intervention that prolonged 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.

### ACKNOWLEDGEMENTS

The Scottish Ambulance Service personnel. STAG local coordinators.

### REFERENCES

Prehospital trauma management