New insights in outcome after major trauma
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PATIENTS BEYOND SALVATION? VARIOUS CATEGORIES OF TRAUMA PATIENTS WITH A MINIMAL GLASGOW COMA SCORE

Johanna M.M. Nijboer
Joukje van der Naalt
Hendrik-Jan ten Duis

ABSTRACT

Introduction
Trauma patients in an unresponsive state upon presentation to the Emergency Department have a poor prognosis. Rapid assessment of injuries combined with life-preserving therapy is required but defining the optimal strategy can be complicated when multiple organ systems are involved. This study analyzed various categories of trauma patients with a Glasgow Coma Scale (GCS) of 3 on admission and evaluated the relation between injuries, clinical condition, treatment and outcome.

Patients and Methods
A retrospective cohort-study, performed at a level 1 Trauma Center from 2002 - 2005. Trauma patients of all ages with GCS of 3 (without sedation) and Injury Severity Score (ISS) ≥ 16 were included. The collected patient data comprised data on demographics, mechanism of injury, physiological condition on admission, diagnosis, ISS, treatment, admission to Intensive Care Unit, complications and outcome.

Results
Ninety-seven patients were included and divided into three groups based on the pathology that caused the GCS of 3: traumatic brain injury N = 48 (49%), anoxic brain injury N = 27 (28%) and hemorrhagic shock N = 22 (23%). The overall mortality was 81%; 91% of the hemorrhagic shock patients, 81% of the ABI patients and 77% of the TBI patients died. Eighteen patients survived of whom five patients (5%) made a good recovery. The pupillary light response and pH on admission were related to mortality. No relation with ISS, age or hypothermia was found.

Discussion
Distinguishing salvageable patients from those beyond salvation remains problematic. This study illustrated the diversity of patients, their injuries and their condition upon presentation to the hospital as well as the limitations of therapy.

Conclusion
Trauma patients with a GCS of 3 have a poor outcome. Despite aggressive treatment only 5% of the patients made a good recovery. Pupil reactivity and the pH on admission were found to be related to mortality.
INTRODUCTION

Guidelines regarding triage, assessment, and treatment according to the principles of Advanced Trauma Life Support (ATLS) have enhanced the acute care of trauma patients. Despite these improvements trauma remains the leading cause of death in young adults. One of the most challenging situations is the management of a patient with life-threatening injuries arriving in the emergency department (ED) in a poor condition. Rapid assessment of injuries combined with life-preserving therapy is required. However, defining the optimal strategy can be complicated when multiple organ systems are involved as various injuries require conflicting treatment modalities.

Trauma patients admitted in an unresponsive state have a poor prognosis with the Glasgow Coma Scale (GCS) and pupil reactivity on admission as early prognostic factors. Various factors are known to influence the GCS, the most relevant being: core temperature, hypotension, hypoxia and the use of sedatives or alcohol. Poor outcome is seen in traumatic brain injury (TBI) with minimal GCS and nonreactive pupils. Patients suffering from other injuries and conditions, i.e. hemorrhagic shock and hypoxia, may also present with minimal GCS and nonreactive pupils but these patients were not analyzed separately in previous studies.

More insight in these patients in a condition possibly beyond salvation, may facilitate decision-making in the acute phase. This study analyzed various categories of trauma patients with a GCS of 3 on admission and evaluated the relation between injuries, clinical condition, treatment and outcome.

PATIENTS AND METHODS

Trauma patients with an Injury Severity Score (ISS) ≥ 16 who were admitted at the University Medical Center Groningen (level one trauma center) from September 2002 to January 2005 were analyzed. Patients were retrospectively identified from the Trauma Registry of our hospital (Trauma Registry of the German Society for Trauma Surgery). Inclusion criterion for this study was a GCS of 3 without pharmacological sedation, scored by a neurologist immediately after arrival in the ED. In our hospital we use a standardized protocol for intubation with a short-acting muscle blocking agent, combined with a sedative drug. When a patient is intubated and ventilated, Diprivan is used as sedative drug. This has a known pharmacological half life of five to ten minutes enabling interruption at any moment to evaluate the patient. The GCS can reliably be assessed ten minutes after discontinuation of the drug. Patients with a known use of drug or alcohol intoxication were excluded. Secondary referred patients were excluded as their data sets were less complete. The GCS used in this study is determined in the ED and defined as post-resuscitation score by the Traumatic Coma Data Bank, except for patients suffering from hemorrhagic shock in whom it concerned a pre-resuscitation...
GCS by definition. The verbal response of pre-hospitaly intubated patients was scored as 1 point. No age restrictions were set, even though for young children an adjusted GCS applies, a GCS of 3 represents an unresponsive state equal to adults.

The collected patient data included gender, age, mechanism of injury, time and treatment to hospital, admission vital signs, blood tests, diagnosis, ISS, treatment, Intensive Care Unit (ICU) admission and related complications, including sepsis and multiple organ failure (MOF). MOF was defined by organ dysfunction in at least two organ systems, according to the Sequential Organ Failure Assessment-score28. An injury to a body region was considered severe in case of an assigned Abbreviated Injury Scale score ≥ 3. The primary outcome measure was the Glasgow Outcome Scale (GOS) on discharge, scored by the nurse practitioners collecting data for the Trauma Registry, and at six months after discharge by an experienced neurologist (JvdN). The GOS quantifies functional outcome ranging from death (GOS 1), vegetative state (GOS 2), severe disability (GOS 3), moderate disability (GOS 4) and good recovery (GOS 5)8.

For analysis the patients were divided in groups based on injury, comparing hemorrhagic shock, hypoxia and brain injury. Hemorrhagic shock was defined according to the ATLS classification of hemorrhagic shock class III and IV with a systolic blood pressure < 90 mmHg, a heart rate > 110 beats / minute, combined with internal and/or external blood loss, not sufficiently responding to fluid resuscitation, upon presentation to the ED. Patients were considered to have sustained anoxic brain injury (ABI) when the following criteria were present: 1. Respiratory distress with \( \text{PaO}_2 \leq 6.7 \text{ kPa} \) (50 mmHg) validating intubation and ventilation 2. cerebral computerized tomography (CCT) on admission disclosed no signs of traumatic brain injury 3. No signs of hemorrhagic shock. 4. Mechanism of injury that caused an oxygen desaturation (submersion, strangulation or cervical spine injury with paralysis with resultant coma). Patients with multiple injuries were designated to the group of the patient’s severest injury. If the prevailing presentation at the ED was hemorrhagic shock, patients were assigned to this category. Accompanying cerebral injury was not ruled out in all patients in the hemorrhagic shock category. In the other categories the CCT at admission and mechanism of injury was used as distinctive criteria. Classification of TBI was based on CCT images according to the Marshall criteria16.

Statistical analysis
All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, U.S.A) version 15 for Windows. Data was expressed as mean ± the standard deviation (SD) or as median and interquartile range (IQR) in the case of a skewed distribution. Differences between groups were assessed with the Student’s t test, Mann-Whitney test, the Chi-square test, or the Kruskal Wallis test. The following items were analyzed with respect to their possible relation to mortality and / or morbidity: age,
gender, pupillary light response, pH, hypothermia, and ISS. Differences were considered significant for a two-tailed p value < 0.05.

RESULTS

Demographics
In total 615 patients with an ISS ≥ 16 were admitted to the hospital. In forty-one patients (7%) no data on the GCS on arrival to the ED was available. Hundred-seventeen patients (19%) scored a GCS of 3. In 11 of these patients severe facial injuries limited complete assessment of the GCS. Two patients were excluded because of pathology causing the accident (epilepsy, myocardial infarction). In seven patients the reliability of the GCS was unclear as the effect of sedation or intoxication could not be ruled out. Subsequently, ninety-seven patients (16%) were included in the study. The study population was divided into three groups according to the underlying pathology: 1. TBI: 48 patients (49%), 2. ABI: 27 patients (28%) and 3. Hemorrhagic shock: 22 patients (23%).

Table 1 shows the demographics. The patients were predominantly male and suffering from blunt injury. TBI patients were older than other categories with a median (IQR) of 44 (25 – 61). The relatively low age of ABI patients is related to the trauma mechanism: 40% sustained a submersion (not as part of a traffic incident). In the other groups a traffic incident was the main cause of injury. Pre-hospital care was comparable in all groups: approximately half of the patients were pre-hospitally managed by the mobile medical team (medical specialist and specialized nurse on the scene), the remaining patients by...

<table>
<thead>
<tr>
<th></th>
<th>TBI N = 48</th>
<th>ABI N = 27</th>
<th>Shock N = 22</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)(^1)</td>
<td>44 (25 - 61)</td>
<td>21 (3 - 50)</td>
<td>26 (21 - 39)</td>
<td>0.006</td>
</tr>
<tr>
<td>Gender (male)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td></td>
</tr>
<tr>
<td>Trauma type (blunt)</td>
<td>47 (98)</td>
<td>27 (100)</td>
<td>21 (96)</td>
<td></td>
</tr>
<tr>
<td>Traffic</td>
<td>29 (60)</td>
<td>9 (33)</td>
<td>19 (86)</td>
<td></td>
</tr>
<tr>
<td>Fall/jump from height</td>
<td>17 (35)</td>
<td>1 (4)</td>
<td>1 (5)</td>
<td></td>
</tr>
<tr>
<td>Submersion</td>
<td>-</td>
<td>11 (40)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Assault</td>
<td>-</td>
<td>1 (4)</td>
<td>2 (9)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2 (5)</td>
<td>5 (19)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Time injury – arrival ED(^1) min</td>
<td>90 (69 - 118)</td>
<td>86 (68 - 105)</td>
<td>65 (37 - 103)</td>
<td>0.157</td>
</tr>
</tbody>
</table>

TBI= traumatic brain injury, ABI = anoxic brain injury, \(^1\)= median (IQR)
paramedics. The median time between injury and arrival to the trauma center was also comparable and varied from 65 to 90 minutes.

Emergency Department
On arrival to the ED 93% of the patients were intubated and mechanically ventilated. Half of the patients presented with bilateral fixed pupils: 59% of hemorrhagic shock patients, and 48% of the ABI and TBI patients (Table 2). Hypothermia was present in 96% of hemorrhagic shock patients and 70% of ABI patients compared to 13% of TBI patients. Arterial blood gas analysis showed the lowest pH in hemorrhagic shock patients with a median of 6.99 (IQR 6.94 - 7.19). Additionally, hemorrhagic shock patients were the most severely injured according the ISS: a median of 41 (IQR 31 - 50). Half of the TBI patients suffered from additional injuries: mostly injuries to the chest (44%) or upper extremities (35%). In none of the hemorrhagic shock patients the diagnostics were completed. Patients died prematurely or according protocol were transported to the operating room after performing an ultrasound scan of the abdomen and X-rays of chest and pelvis. In nine patients diagnostics were completed after surgery (or post-mortem) but TBI and injuries to spine and extremities have not been ruled out in 13 hemorrhagic shock patients.

Figure 1 illustrates the in-hospital course of the different patient groups. Twenty-five patients (26%) died in the ED, including one third of the hemorrhagic shock patients. Of the 72 patients who left the ED alive, 31 patients went directly to the operating room. All hemorrhagic shock patients, except one, underwent a laparotomy and/or thoracotomy.

Table 2. Emergency department data.

<table>
<thead>
<tr>
<th></th>
<th>TBI N = 48</th>
<th>ABI N = 27</th>
<th>Shock N = 22</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupillary light response</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilaterally positive</td>
<td>20 (42)</td>
<td>14 (52)</td>
<td>5 (23)</td>
<td></td>
</tr>
<tr>
<td>Bilaterally negative</td>
<td>23 (48)</td>
<td>13 (48)</td>
<td>13 (59)</td>
<td></td>
</tr>
<tr>
<td>Unilaterally negative</td>
<td>5 (10)</td>
<td>-</td>
<td>4 (18)</td>
<td></td>
</tr>
<tr>
<td>Core temperature &lt; 35 °C</td>
<td>6 (13)</td>
<td>19 (70)</td>
<td>21 (96)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Arterial pH1</td>
<td>7.28 (7.17 - 7.38)</td>
<td>7.11 (6.87 - 7.35)</td>
<td>6.99 (6.94 - 7.19)</td>
<td>0.003</td>
</tr>
<tr>
<td>Injury Severity Score1</td>
<td>29 (25 - 41)</td>
<td>29 (25 - 34)</td>
<td>41 (31 - 50)2</td>
<td>0.010</td>
</tr>
<tr>
<td>Injury to</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head / neck</td>
<td>48 (100)</td>
<td>27 (100)</td>
<td>12 (55)2</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Chest</td>
<td>21 (44)</td>
<td>-</td>
<td>18 (82)2</td>
<td></td>
</tr>
<tr>
<td>Abdomen</td>
<td>6 (13)</td>
<td>-</td>
<td>15 (68)2</td>
<td></td>
</tr>
<tr>
<td>Extremities</td>
<td>17 (35)</td>
<td>1 (4)</td>
<td>12 (55)2</td>
<td></td>
</tr>
</tbody>
</table>

TBI = traumatic brain injury, ABI = anoxic brain injury, 1= median (IQR), 2= diagnostics incomplete
The injuries of one hemorrhagic shock patient (six years old, combination of severe abdominal, chest and brain injuries, ISS 59, fixed and dilated pupils) were considered fatal and she was directly transported to the ICU to await arrival of family. Six TBI patients underwent a craniotomy and another six TBI patients underwent (maxillofacial) fracture surgery. In three ABI patients active rewarming by means of extra corporal perfusion was performed. A total of 11 patients died in the operating room because of uncontrollable blood loss (9 hemorrhagic shock patients), pulmonary edema (ABI patient) or cerebral herniation (TBI patient).

Intensive Care Unit
Sixty-one patients (63% of total population; approximately three quarters of TBI and ABI patients, 27% of hemorrhagic shock patients) were admitted to the ICU. Sixteen of the 35 TBI patients (46%) admitted to the ICU received intracranial pressure (ICP) monitoring. The remaining TBI patients did not meet the criteria for ICP monitoring as refractory cerebral herniation was present. During admission complications occurred in half of the patients, most frequently in hemorrhagic shock patients (83%). Pulmonary (18%) and cardiac problems (13%) were most frequently noted. MOF and sepsis occurred in nine patients (15%). Forty-three patients died during ICU-admission (44% of the total population, 70% of ICU-admissions). The mean duration of ICU-admission of the

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survivors (N = 18) was 25 ± 30 days (IQR 5 – 30 days). The number of survivors was too small for subgroup analysis.

Outcome and influencing factors
The overall-mortality was 81% without a significant difference between TBI (77%), ABI (81%) or hemorrhagic shock (91%) patients (p = 0.385). The median time to death was 4.6 hours (IQR 1.4 – 25.5 hrs). Hemorrhagic shock patients died significantly earlier than TBI and ABI patients with a median time to death of 1.2 hours. The main cause of death in the majority of ICU-patients was deterioration of the primary injury, except for five patients who died of MOF and/or sepsis. Eighteen patients survived, mainly in a vegetative or severely disabled state. In only five patients a good recovery after six months (GOS 4 and 5, Table 3) was observed.

Analysis of factors related to outcome showed the pupillary light response and the pH on arrival to the ED to be correlated to mortality. All patients with two fixed pupils died compared to 60% of patients with reactive pupils (p value < 0.001). When comparing different groups: 83% of hemorrhagic shock patients, 60% of ABI patients and 50% of TBI patients with two responsive pupils died. The pH on arrival is related to mortality with a significant difference between non-survivors and survivors with a mean of 7.13 ± 0.25 and 7.29 ± 0.09 resp. (p = 0.038). No patient with a pH < 7.10 survived.

In survivors the pupillary light response and pH were not associated with the degree of recovery. Neither were age, gender, hypothermia, or ISS. The group of survivors with good recovery is too small for subgroup analysis but some advantageous details are

<table>
<thead>
<tr>
<th>Table 3. Outcome data</th>
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<tr>
<td></td>
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<tr>
<td>Glasgow Outcome Score</td>
</tr>
<tr>
<td>1 Death</td>
</tr>
<tr>
<td>2 Vegetative state</td>
</tr>
<tr>
<td>3 Severe disability</td>
</tr>
<tr>
<td>4 Mild disability</td>
</tr>
<tr>
<td>5 No disability</td>
</tr>
<tr>
<td>Time to death hours¹</td>
</tr>
<tr>
<td>Cause of death</td>
</tr>
<tr>
<td>Cerebral herniation</td>
</tr>
<tr>
<td>Hemorrhage</td>
</tr>
<tr>
<td>Multiple organ failure</td>
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<tr>
<td>Sepsis</td>
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</table>

TBI = traumatic brain injury, ABI = anoxic brain injury, ¹ = median (IQR)
important to note. Three of these survivors, with a varying age (2, 12 and 52 years), suffered from ABI. Their pupils were reactive and they suffered from severe hypothermia (core temperature < 35°C). CCT showed no abnormalities. One survivor (43 years) suffered from TBI. His pupils were reactive but mild hypothermia (> 35°C) and a pH of 7.30 were present. His Marshall classification was 3. One survivor (36 years) suffered from hemorrhagic shock combined with TBI. He had reactive pupils, no hypothermia and a pH of 7.14 on admission. His Marshall classification was 2. In the ICU complications ranging from convulsion, atrial fibrillation and respiratory insufficiency were observed but none of these survivors suffered from MOF or sepsis.

**DISCUSSION**

The aim of this study was to gain insight in various categories of trauma patients arriving to the ED with a GCS of 3. Not only patients with TBI presented in this condition: patients suffering from an anoxic injury or hemorrhagic shock also presented in an unresponsive state. Decision-making is essential as the majority of the patients suffered from injuries beyond salvation. Unfortunately no quickly accessible tool is available to identify these patients with 100% accuracy. This study illustrated the diversity of the patients, their injuries and condition upon presentation to the hospital as well as the limitations of therapy.

As expected in our population of trauma patients with a GCS of 3 the outcome was poor. The overall mortality was 81%, and only five out of 18 survivors made a good recovery. One quarter of the patients suffered from hemorrhagic shock and showed an undeniably poor prognosis; most of them died in the ED or in the operating room, despite emergency surgery. This in contrast with the TBI and ABI patients who mostly died in the ICU and only one of the TBI and ABI patients who underwent emergency surgery did not survive. Poor outcome was seen in all patients presenting with fixed and dilated pupils. These patients showed a 100% mortality irrespective of injury, in accordance with the literature\(^{12,26}\). Patients with reactive pupils showed the most favorable outcome: forty percent survived. However, in hemorrhagic shock patients responsive pupils were the least indicative of a good prognosis: 83% of hemorrhagic shock patients with responsive pupils died. Patients suffering from ABI constitute a distinct entity: factors which could have facilitated recovery were the relatively low age of this group and the hypothermia on admission. Other factors than the clinical condition on admission, were found to be related to outcome. The pH on admission, representing physiological derangement, served as a prognostic factor with a significant difference between survivors and non-survivors. The lowest pH was present in hemorrhagic shock patients with a pH lower than 7.10 indicating a fatal outcome. The ISS as an estimate of injury severity was not associated with mortality. Intrinsic to the ISS-formula the scores were relatively low in a
population that merely consisted of patients with isolated cranial injuries. Probably no association was found between the ISS and mortality in hemorrhagic shock patients because of the low number of survivors in this group. Other factors like age, gender, trauma mechanism and duration of transport and therapeutic procedures were not found to be related to outcome either. Additionally, a correlation between hypothermia and mortality has not been found in this study. Besides its suppressive effect on the GCS, it is known that hypothermia plays a controversial role in trauma patients. In multiple injured patients a core temperature < 35°C contributes to the lethal triad of death: hypothermia, coagulopathy, and acidosis. However, submersed patients and patients suffering from a cardiac arrest may benefit from the hypothermia-induced decrease in cerebral metabolic demand. Previous publications showed hypothermia to be associated with a marked increase in mortality but it remains difficult to determine if the mortality is due to the hypothermia itself or to the severity of the underlying injuries.

One may question the classification of ABI due to submersion as a trauma. However, in our hospital every patient with an injury due to an accident, whether or not traffic-related, is treated by the trauma team according to the ATLS-principles. Often distinction between various mechanisms of injury is not possible at admission and during the acute phase there is no time to elaborate on the mechanism of injury.

Even though prediction of certain death during the acute phase is complicated, prognostic factors facilitate decision-making regarding triage, treatment, and dialogue with relatives. Since the introduction of the GCS in the early seventies by Jennett and Teasdale it has become a widely used tool in predicting outcome in patients suffering from TBI and ABI, often combined with the pupillary light response. These prognostic factors have not been considered in patients with hemorrhagic shock. The most challenging is the patient suffering from both TBI and hemorrhagic shock. These injuries both entail a poor prognosis and require different and possibly conflicting strategies.

The question is whether any treatment could have influenced the outcome of the patients. In three-quarter of the patients (i.e. TBI and ABI patients) decision-making was straightforward; no treatment-delaying diagnostic tests were indicated and no conflicting organ systems were involved. Based on the fact that all patients with a GCS of 3 and fixed dilated pupils on arrival to the ED died, a tentative assumption could be that this category of patients is beyond salvation. However, in hemorrhagic shock patients even responsive pupils were not indicative of a good prognosis as only one patient survived. Overall, the hemorrhagic shock patients formed a complex group. They were in a poor condition (severely hypotensive, acidic, and hypothermic) and sixteen patients died shortly after arrival to the ED or before completion of damage control surgery. Apparently the unresponsive state on admission represented a degree of hemodynamic and metabolic impairment that could not be recovered from. Previous publications showed a detrimental interaction between TBI and extracranial injury:
systemic hypotension or hypoxia superimposed on brain injury induces secondary brain injury and serious TBI adversely affects cardiovascular responses to hemorrhage. In most of these patients the concomitant brain injury was not verified and treatment was limited to the hemorrhagic shock. The existence of TBI could very well have played an additional role in some hemorrhagic shock patients and it is unclear whether it affected outcome. This is not a problem limited to this study but constitutes a relevant issue in daily trauma practice: the decision to transport a patient with fixed and dilated pupils due to hemorrhagic shock and possibly additional TBI, to the operating room. Although our study is small, it may contribute to the discussion of the limits of aggressive patient management in trauma care.

Were there patient related factors which favored a good outcome? Only one in five patients with a GCS of 3 survived. Of these survivors, one in four made a good recovery; 5% of all patients or 10% of patients with at one or two reactive pupils. This is comparable with the results of Waxman et al. although in their study no distinction was found between pupil reactivity. Another study showed only survivors under 40 years of age made a good recovery. Noticeable, the present study included two patients over 40 years of age with a good outcome. The hemorrhagic shock patient with a good outcome had reactive pupils on admission and only minor abnormalities on the CCT. During ICU admission none of the survivors with good recovery experienced sepsis or MOF. The number of survivors was too small for subgroup analysis.

The results have to be regarded with caution, mostly because of the small number of patients and the retrospective study design. Some other limitations complicated this study but reflect the daily clinical practice in trauma care. Since in our hospital tests for alcohol or drugs intoxications are not performed routinely, it could not be completely ruled out that in a few cases this may have affected the GCS assessment. However, intoxications have been ruled out in perhaps the most relevant group; the survivors with a good outcome. Furthermore, a significant number of patients was in a too critical condition to complete diagnostics. A combination of hemorrhagic shock and TBI could not be ruled out and treatment was limited to the management of hemorrhagic shock, according to ATLS principles. This complicated our study but constitutes a relevant and often encountered problem in trauma care. In patients in a critical condition, decisions on treatment need to be made without knowing the full magnitude of injuries. Every doctor involved in trauma care will encounter this problem and hopefully this study will increase the awareness of the complexity of these patients.
CONCLUSION

Trauma patients presenting with a GCS of 3 have a poor prognosis irrespective of underlying pathology. Despite aggressive management ultimately only five percent of the patients survived with a good outcome. Patients suffering from hemorrhagic shock comprised one quarter of the population and only two patients survived. The pupillary light response and the pH were found to be predictive of outcome. Distinguishing salvageable patients from those beyond salvation remains problematic. Hopefully future insights will enable better identification of patients with a good prognosis for whom aggressive treatment will be beneficial.
REFERENCES


30. The World Health Organization, Geneva, Switzerland. Website: www.who.int