

# Evaluation of trauma registry data in Asir region

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## ABSTRACT

**Objective:** To analyze and report trauma registry data; to assess the validity, reliability, and feasibility of the trauma registry; and to discuss lessons learned from this event.

**Methods:** A pre-designed trauma registry data was used for all injured patients admitted to Asir Central hospital after being involved in a major motor vehicle accident. A survey team registered and analyzed the trauma registry data using the statistics software SPSS for windows.

**Results:** Eighty-five patients were admitted to the hospital with different injuries. All victims were males with a mean age of 27 years. Injuries were dominated by musculo-skeletal trauma followed by neurotrauma, thoracic, and abdominal trauma respectively. Pre-hospital data was deficient and most of the hospital in-patient's

information was taken from the nurse's notes. Standard elements of the trauma registry were found essential for optimal trauma care. Morbidity was related mainly to neurological trauma. Mortality was related to head injury followed by thoracic and abdominal injuries.

**Conclusion:** Trauma registry was valid, reliable, and feasible. A national trauma registry program should be established. Trauma registry, prehospital care, and disaster planning and management should be integral parts of a regionalized trauma care system. Successful trauma care systems have shown significant reductions in morbidity and mortality from trauma.

**Keywords:** Trauma registry, mass casualty event.

**Saudi Med J 2001; Vol. 22 (5): 438-443**

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The trauma registry provides for the collection, storage, and reporting of information about trauma patients, including the facts related to the patient's injury event, severity, care, and outcome.<sup>1</sup> A mass casualty is an event in which there are variable degrees of injuries and death to a number of victims overwhelming local resources.<sup>1</sup> Successful management of these events requires adequate planning and practice drills.<sup>2,3</sup> In Saudi Arabia, motor vehicle accidents represent a major public health hazard<sup>4</sup> and accidents involving mass casualties are not uncommon. This paper reports a major accident involving a large truck carrying over 130 passengers when it turned-over as a result of

burned breaks in a steeply mountainous road near the city of Abha, Saudi Arabia. On March 14, 1996, the accident occurred at about 14:00 hours, "Red Alert", the code used for disasters, was announced at about 15:00 hours in Asir central hospital (ACH) at which time the hospital's major disaster protocol was initiated. At about 15:30 hours, patients reached the hospital in groups transported by ambulances, police vehicles, and private cars. Triage of the traumatized patients was made in front of the emergency room (ER) by the on call surgical team. Severely and moderately injured patients were sent immediately to the emergency room for resuscitation and management by multidisciplinary teams. Patients

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Received 30th November 2001. Accepted for publication in final form 9th January 2001.

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who had minor injuries were admitted directly to the wards. From ER some patients were sent immediately to the operating room (OR) for emergency surgeries, others were admitted to the intensive care unit (ICU) and intermediate care unit (IMCU). The number of traumatized patients overwhelmed the available resources and personnel, despite the generous hospital staff participation. Stand-down for the disaster management call was declared at 21:30 hour. A pre-designed trauma registry data was collected from the 85 patients admitted to the hospital. The objectives of this study are; to analyze and report trauma registry data; to assess the validity, reliability, and feasibility of the trauma registry; and to discuss lessons learned from this event.

**Methods.** Patients who died prior to their admission and those not reported to ACH were excluded from the study. Eighty-five patients were admitted to ACH with different injuries. A pre-designed trauma registry data form was used for all admitted patients. The trauma registry elements were obtained from standard data elements designed by the American College of Surgeons, Committee on Trauma (NATIONAL TRACS-ACS 1993 version).<sup>1</sup> The trauma registry contained elements on patient's demographics, injury, emergency department care, radiological findings, laboratory findings, treatment conducted, hospital diagnoses, operations, mortality, complications, trauma quality improvement indicators, and discharge. Trauma quality improvement elements were isolated to be discussed in a separate paper. Trauma management was provided in the ER, OR, ICU, IMCU, and the wards. A survey team consisted of the attending general surgeon, senior surgical resident, and analyst, registered and analyzed trauma registry data. Data base software, SPSS for Windows, was used for coding, registering, and analysis of data.

**Results.** All victims were males. Age was documented for 69 patients, ranged from 14 to 50 years, with a mean value of  $26.80 \pm 7.97$ . The senior surgical resident filled up trauma registry forms using patient's medical chart and depending mainly on nurse's notes. This process took a few minutes for each patient and a few days for all admitted patients. Data was persistently suboptimal in some areas in all registries as documentation by physicians was deficient. Prehospital data was deficient and there was no prehospital trauma care data. Eleven patients were admitted to the ICU with an average stay of 8 days, 6 patients were admitted to the IMCU with an average stay of 14 days, and 68 patients were admitted to the wards with an average stay of 16 days. Pattern of injuries and related morbidity and mortality are presented in Table 1. The majority of

patients had musculoskeletal injuries, followed by neurotrauma, thoracic trauma, and abdominal injury. In ER, complete vital signs measurement was documented in 4 (5%) patients and Glasgow Coma Scale (GCS) measurement was documented in 14 (16.5%) patients. Chest x-rays were carried out for 75 patients, 21 (28%) had positive findings, and 54 (72%) had negative findings. Cervical spine x-rays were carried out for 77 patients, 10 (13%) had positive findings, and 67 (87%) had negative findings. Head CT scan was carried out for 13 patients, 11 (84%) had positive findings, and 2 (16%) had negative findings. Ultrasound of the abdomen was performed on 10 patients, 1 (10%) had positive findings, and 9 (90%) had negative findings. CT abdomen was carried out for 2 patients, 1 (50%) had positive findings, and 1 (50%) had negative findings. Diagnostic peritoneal lavage (DPL) was performed in 3 patients, 1 (33%) had a positive DPL, and 2 (67%) had negative DPL. Seventy-four patients had complete blood count (CBC) measurement, hematocrit level ranged from 18% to 57% with a mean value of  $36.45 \pm 6.34$ , hemoglobin level ranged from 1.9 g/dl to 16.7 g/dl with a mean value of  $12.13 \pm 2.47$  g/dl, white cell count ranged from 5.8,000/mm<sup>3</sup> to 25.3,000/mm<sup>3</sup> with a mean value of  $12.43,000 \pm 4.45,000$ /mm<sup>3</sup>, platelets count ranged from 105,000/mm<sup>3</sup> to 528,000/mm<sup>3</sup> with a mean value of  $241.47,000 \pm 76.39$ /mm<sup>3</sup>. Prothrombin time (Pt) and Activated prothrombin time (Aptt) were carried out for 19 patients; all of them had values within normal range. Five patients had arterial blood gases measurement based on clinical indications, all were hypoxemic (PO<sub>2</sub>  $71.80 \pm 30.16$  mmHg) and acidotic (HCO<sub>3</sub>  $20.77 \pm 2.77$  mmol/L), but with normal PCO<sub>2</sub> range ( $38.90 \pm 6.73$  mmHg) and compensated PH ( $7.39 \pm 0.04$ ). Treatment included cardiopulmonary resuscitation (CPR) attempted for 7 patients (8%), intravenous fluids were given to 83 (98%) patients, and blood transfusions were given to 15 (18%) patients. CPR was successful in 2 (2%) patients only. Excluding extremity procedures; 19 (16%) patients had chest tube drainage for hemo/pneumothoracies; 5 (4%) patients had laparotomy, 2 (2%) had liver tears treated by packing only, 2 (2%) had spleen rupture treated by splenectomy, and 1 (1%) had major retroperitoneal hematoma. Five patients (4%) had craniotomy; 1 (1%) had extradural hemorrhage, 1 (1%) had subdural hemorrhage, 1 (1%) had posttraumatic hydrocephalus treated by a ventriculoperitoneal shunt, and 2 (2%) patients for undocumented reasons. One patient (1%) had tracheostomy for prolonged ventilatory support. Mortality happened to 8 (9%) patients and was related to head injury in 4 (5%) patients. One (1%) patient died from severe blunt chest trauma. One (1%) patient died in OR from a major retroperitoneal hemorrhage. Two (2%) patients died from undocumented reasons. Morbidity occurred in 7 (8%)

**Table 1** - Patterns of injury and related morbidity and mortality.

Injury distribution	Patients (%)	Morbidity (%)	Mortality (%)
Musculoskeletal injuries only	37 (43.5)	2 (2)	-
Neurotrauma and musculoskeletal injuries	29 (34)	2 (2)	1 (1)
Musculoskeletal and thoracic injuries	6 (7)	1 (1)	-
Neurotrauma injury only	3 (3.5)	-	3 (3.5)
Musculoskeletal and thoracic and abdominal injuries	3 (3.5)	-	1 (1)
Thoracic injury only	2 (2)	-	2 (2)
Abdominal injury only	1 (1)	-	-
Neurotrauma and thoracic injuries	2 (2)	1 (1)	1 (1)
Neurotrauma and musculoskeletal and thoracic injuries	1 (1)	-	-
Neurotrauma and thoracic and abdominal injuries	1 (1)	1 (1)	-
<b>Total</b>	<b>85 (100)</b>	<b>7 (8)</b>	<b>8 (9)</b>

patients, 1 (1%) patient had quadriplegia related cervical spine injury at the level of C6, 1 (1%) patient had paraplegia and burst fracture of L3, 1 (1%) patient had right ulnar nerve palsy, 1 (1%) patient had amputation of the right thumb and index fingers, 1 (1%) patient had right lung collapse, 1 (1%) patient had bilateral foot drop, and 1 (1%) patient had aggressive behavioral changes.

**Discussion.** Trauma registry is an essential component of any trauma program because optimal care of trauma patient involves decision-making based on a detailed understanding of the causes, treatments, outcomes of injury, and continuous monitoring and evaluation of trauma care. Ideally, data collection on trauma patients would be population-based, with participation of all hospitals receiving trauma patients in a geographic area. However, such participation might not be feasible in most countries due to some logistic, financial, and may be other reasons. Therefore trauma hospitals would be the optimum source for trauma registry. A trauma assistant who is familiar with medical terminology and basic computer skills can fill up trauma registry forms. In Saudi Arabia, most major mass casualty incidents pass unreported in the medical literature. Only few mass casualty incidents were reported in the medical literature<sup>5,6</sup> during the Gulf war in 1991. Khan and Mirdad<sup>7</sup> reported the musculoskeletal injuries of the same mass casualty event we are reporting. Although the impact of the prehospital care on trauma outcome ("scoop and run" vs. "stay and play") is controversial,<sup>8-10</sup> however, certain factors were shown to improve mortality and morbidity of the traumatized patient. These factors include rapidity of response to the scene, transfer of

trauma patients to an appropriate trauma facility, appropriate life saving interventions carried out at the scene or during transportation such as establishing an airway, insertion of chest tubes, arresting hemorrhage, appropriate stabilization of the cervical spine, and splinting of fractures.<sup>8-11</sup> These interventions cannot be measured and assessed critically without appropriate prehospital data. Modern prehospital care started with the EMS Systems Act in 1973 in the United States,<sup>12</sup> where two distinct levels of care were available: basic life support (BLS) and advanced life support (ALS) programs. Intermediate life support (ILS) program was evolved later. Basic emergency medical technicians (EMTs - ambulance) who provide BLS are trained to do skills such as cardiopulmonary resuscitation, basic airway maneuvers, musculoskeletal immobilization, and basic wound care. Emergency Medical Technicians (intermediate) who provide ILS are trained on additional skills such as intravenous therapy, esophageal obturator airway insertion, and pneumatic anti-shock garment application. Emergency Medical Technicians (paramedics) who provide ALS are extensively trained to perform more sophisticated procedures including orotracheal and nasotracheal intubation, needle thoracostomy, administration of controlled medications, and can perform cricothyroidotomy in some programs<sup>12,13</sup> EMTs of the EMS systems deal with injured and non-injured cases including cardiac conditions. Then the Prehospital Trauma Life Support (PHTLS) program elapsed as a pilot project in 1983-1984 in three U.S. states. Since then PHTLS has become as internationally promulgated as the Advanced Trauma Life Support (ATLS) program for physicians. Paramedics trained in concepts of

prehospital trauma care provide PHTLS.<sup>11</sup> Injury distribution outlined in Table 1 shows that the incidence of extremity trauma was the highest followed by head, thoracic, and abdominal injuries. This injury distribution matches other international reports<sup>14,15</sup> that studied the pattern of injuries in vehicular occupants, however, all of the injured patients in this accident were ejected from the truck and found scattered at different distances from the vehicle. Ejected patients would be expected to have an inconsistent pattern of injuries.<sup>14</sup> As indicated above, documentation throughout phases of trauma care in general was deficient. Although documentation might have no direct impact on mortality and morbidity, however, research into aspects of the care of injured patients depends on accurate and complete documentation. Inadequate documentation is medico-legally unacceptable and makes trauma audit impossible.<sup>16,18</sup> Trauma registry would be expected to facilitate proper documentation. The yield of chest and cervical spine x-rays was quite significant in the diagnosis of serious and may be life-threatening injury in studied patients (28% and 13% positive findings). This confirms the general recommendation of performing these radiological modalities in addition to pelvic x-ray for most blunt trauma patients as part of their primary survey.<sup>17,18</sup> Pelvic x-ray that was not included in the trauma registry may demonstrate fractures that indicate the need for early blood transfusion and treatment.<sup>18</sup> Pelvic x-ray was found essential during the initial assessment and needs to be added to the essential radiological investigation section in the trauma registry. The yield of head CT scanning used for patients suspected to have head injury was significant where positive findings were found in 11 out of 13 patients. This also confirms the general recommendation of performing CT-head for all patients known or suspected to have head injury, even minor head injury with a GCS of 13 to 15.<sup>17,18</sup> The rationale for using DPL, CT-abdomen, and abdominal ultrasound for the assessment of abdominal injury was not stated in patient's charts neither in the trauma registry, however, DPL was presumably used for the hemodynamically unstable patient, and the other two investigations for the hemodynamically stable patients. DPL has been the "gold standard" for assessing intra-abdominal injury in hemodynamically unstable patients<sup>18</sup> especially in suspected bowel injury cases, however, it is an invasive procedure and highly sensitive and may result in too many non-therapeutic celiotomies associated with morbidity.<sup>19</sup> CT-abdomen is the most specific investigation for suspected intra-abdominal injury especially retroperitoneal structures in the hemodynamically stable patient,<sup>18</sup> but it is costly and time consuming and requires oral and intravenous contrast agents. Recently abdominal ultrasound is gaining momentum in the diagnosis of intra-

abdominal injury because it is noninvasive, inexpensive, use no ionizing radiation, portable, repeatable, and in many instances as accurate as DPL,<sup>20</sup> however, it is operator dependent, injuries can be obscured by bowel gas and subcutaneous air, and can miss the detection of bowel and some pancreatic injuries.<sup>18</sup> Use of one or more of the above investigations for the assessment of intra-abdominal injury should be individualized according to patient's hemodynamic condition, suspected organ injury, and facilities available. Blood work that includes hematological and chemical analyses, pregnancy test for all females of productive age, type and cross match, and arterial blood gases are considered essential parts of the initial assessment of injured patients.<sup>18</sup> Blood work that was carried out for 74 patients was found essential, as variations in CBC levels were obvious though the mean values for these tests were within normal range. Chemical analyses and pregnancy test, which were not included in the trauma registry, should be added to the essential blood work section. Clotting profile (Pt and APTT) values, however, did not show significant variations in the 19 tested patients, therefore, these tests may be selectively ordered for patients who require blood and blood product transfusions and for post transfusion monitoring. The arterial blood gases measured for 5 patients were all abnormal. Although the number of patients is small, this may indicate that arterial blood gases measurement is also necessary to be checked for all injured patients. Pulse oxymetry and end-tidal CO<sub>2</sub> measurements are essential for prediction and monitoring of patients with airway and ventilatory compromise.<sup>18</sup> Resuscitation items including airway methods, resuscitate chest tubes, supplemental oxygen, use of pulse oxymetry and end-tidal CO<sub>2</sub>, intravenous cannulas, venous cut down, and central venous line are essential elements to be added to the trauma registry. Adjuncts to primary survey and resuscitation such as nasogastric tube, urinary catheter, and ECG monitoring are also essential standard items to be added to the trauma registry. Cardiopulmonary resuscitation was performed for 7 patients who arrested in ER, 2 of them were revived evident by the ECG tracings, but eventually succumbed in the ICU. External cardiac massage, whether it is useful or useless in a witnessed arrested trauma patient, is a controversial issue. In one report CPR found to be of no value in patients who have sustained cardiac arrest from truncal trauma.<sup>21</sup> Almost all patients (98%) received intravenous crystalloid fluids and (18%) received blood transfusions. The choice of resuscitation fluids continues to be a debatable subject. A meta-analysis of mortality rates of injured patients comparing fluid resuscitation with either crystalloids or colloids indicated that fluid resuscitation with a balanced crystalloid solution is more appropriate.<sup>22</sup> Hypertonic saline solutions have been used successfully in the

resuscitation of traumatized human subjects as an alternative to isotonic crystalloid solutions. Hypertonic saline solutions have the advantage of requiring smaller volumes, better rise of the blood pressure, and more survival benefit for patients low (GCS) from head injury.<sup>23</sup> Using hypertonic saline solutions for the treatment of hypovolemic shock, however, have a marginal beneficial effect in terms of survival in a multicenter trial<sup>24</sup> and their use during uncontrolled hemorrhage has been strongly questioned.<sup>25</sup> Blood and blood products transfusion would be the ideal substitute for lost blood due to trauma. It has the advantages of volume expansion, oxygen transport, and remains in the intravascular space for prolonged periods. There are, however, many disadvantages of blood transfusions as a resuscitation fluid, these include longer time requirement for preparation, transfusion reactions, transmission of infection, and complications related to massive transfusions. These disadvantages should not preclude the prompt and timely transfusions as a life saving measure. Probably more patients of this accident would have required blood and blood product transfusions as all units in the blood bank where exhausted and an appeal for publics for blood donation was announced. A regional blood bank center or a system for interhospital blood bank cooperation to supply large amounts of blood and blood products to a disastrous area in a limited time frame would be the ideal solution to this problem. Other treatment measures, which were individualized to specific injuries, included tube thoracostomy that was performed in 19 (16%) patients, laparotomy for hemoperitoneum in 5 (4%) patients, and craniotomy for intracranial hemorrhage in 5 (4%) patients. There is no doubt that these treatment measures were life saving, however, timing of these procedures and the degree of injury are also detrimental factors contributing to mortality and morbidity. Eight (9%) patients died after being admitted to the hospital. Three patients died from severe head injury alone, 1 patient died from a combination of severe head injury and fracture femur, 1 patient died from a combination of thoracic and abdominal trauma. Of the 3 patients who died from head injury alone, 1 patient died despite craniotomy that was performed after approximately 3 hours from the accident time for acute subdural hematoma, depressed skull fracture, and brain edema that were evident on the preoperative head CT scan. Mortality in this case was related mainly to the severity of injury rather than the timing of the procedure as it was done within the acceptable 4 hours safe time frame for treatment of acute subdural hemorrhage.<sup>26</sup> The other 2 patients who died from head injury alone had very low GCS and were admitted to ICU/IMCU respectively without head CT scan. The only CT machine in the hospital was burned out from the excessive use at that time thus stable patients were

referred to other local hospitals where CT scan facilities were available. It is very difficult to conclude the exact cause of death in those 2 patients, and whether any intervention could have saved them, with low GCS and no CT diagnosis, is unpredictable. The patient who died from severe head injury and fracture femur had visible extruding brain tissue. This patient was admitted to ICU despite the fact that he was triaged in ER as unsalvageable patient. The patient who had a combination of head and thoracic trauma died in the ICU post craniotomy and bilateral chest tubes insertion for undocumented indications. Of the 2 patients who died from thoracic trauma alone, 1 had severe right chest contusion, fixed and dilated pupils, and no recordable blood pressure upon admission. The patient responded to CPR, intravenous fluids, and bilateral chest tube insertion initially but succumbed later on in the ICU. This patient probably died from a major intrathoracic bleeding evident by low hemoglobin (6.4 g/dl) and hematocrit (20%) levels, and negative DPL. Unfortunately this patient did not have any radiological evaluation even in ICU where he died. The other patient who died from thoracic injury alone was unfortunate case and death could have been prevented as he was fully conscious and stable upon admission to a regular ward with a right-sided chest tube in place for undocumented reason. This patient did not have any investigations and arrested in the ward after 3.5 hours from the accident time. Obviously this patient did not have adequate initial assessment and management and may have died from a missed tension pneumothorax, massive intrathoracic bleeding, or may be other intrathoracic life threatening injury. The patient who died from a combination of thoracic and abdominal trauma had a left-sided hemothorax treated by chest tube insertion and laparotomy after approximately 2.5 hours from the accident time. This patient had an expanding retroperitoneal hematoma due to laceration of the left kidney. The patient died in the OR despite transfusion of 6 units of whole blood. The cause of mortality in this case most likely was due to hemorrhagic shock related to delayed or inadequate blood transfusion, or delayed laparotomy. Regarding the 7 (8%) morbidity cases, 1 patient had fracture of the 6th cervical spine complicated by quadriplegia that was diagnosed in ICU after splenectomy. This patient had anterior fusion of C6 with bone grafting few days later. Early assessment and management of this injury prior to laparotomy and careful manipulation of the cervical spine could have prevented or at least lessened such complication. The patient with fracture L3 and paraplegia had laminectomy of L3 and cancellus bone grafting few days later. Early assessment and stabilization and treatment of this injury were adequate and such complication could not have been prevented. The patient who had right ulnar nerve palsy may have had

ulnar nerve compression, as there is no bony fracture or subluxation in the corresponding upper limb. This patient was discharged 10 days later without ulnar nerve conduction studies and no definitive treatment. The patient who had amputation of the right thumb and index fingers had a prior surgical reconstruction attempt post injury. This type of reconstruction requires special expertise in hand and microsurgery that were not available at that time. The patient who had right lung collapse had severe head injury with posttraumatic hydrocephalus that required ventriculoperitoneal shunt and tracheostomy. Although this complication is quite common in ventilated ICU patients, however, it is preventable by frequent chest physiotherapy and suctioning, and if not recognized and treated promptly could lead to sudden death. The patient who had aggressive behavioral changes had cerebral concussion, right chest tube for pneumothorax, and laparotomy for hemoperitoneum of undocumented source. These aggressive behavioral changes could be related to psychological disturbances as well. All survived patient, however, would have needed psychological counseling.

In conclusion, trauma registry is valid evident by reflection of other similar reports (face validity),<sup>27</sup> reliable evident by its reproducibility of its items from one patient to another (internal consistency),<sup>27</sup> and feasible evident by the ease of registration and analysis of its data with minimal cost. As trauma is the leading cause of mortality and morbidity in Saudi Arabia,<sup>4</sup> a national trauma registry center should be established. All hospitals in Saudi Arabia that receive trauma patients should participate in one way or another in a national trauma registry program. Trauma registry, prehospital care, and disaster planning and management should be integral parts of a regionalized trauma care system. A regionalized trauma care system is an integrated community approach where all agencies in a region concerned with trauma work together in an organized and coordinated fashion to manage and care for trauma patients.<sup>28</sup> This system implies a method for rapid access to the injured patient, prehospital care, medical direction, field triage, transport to appropriate trauma care facility, acute care in an appropriate trauma care facility where experienced personnel and resources are available, and provision of rehabilitation for the disabled. Some successful systems reported 50% reduction in mortality and 85% reduction of disabilities from trauma.<sup>29</sup>

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