The Incidence of Severe Trauma in Small Rural Hospitals

Nanette Smith, MD
Spokane, Washington

Trauma is the third leading cause of death in the United States, and yet relatively little is known about its epidemiology, especially in rural areas. A retrospective study was done in five Washington and Idaho communities to determine the incidence of severe trauma seen in small rural hospitals. Records were reviewed for the year 1983 on all trauma patients (565 cases) who were either admitted to or transferred from these hospitals. The study area included five hospitals and 30 physicians, serving a population of 57,600 people over 7,396 square miles. Each patient's injuries were rated according to the Injury Severity Score (ISS), a standardized trauma index. Of the cases reviewed, 3.4 percent of the cases had an ISS greater than or equal to 20, reflecting severe multisystem trauma, 14.7 percent had an ISS of 10 to 19, ie, severe trauma limited to one body system or multisystem trauma of a less-critical nature. There were 30 patients (5.3 percent) with critical head injuries, 24 patients (4.2 percent) with major chest injuries, and 21 patients (3.7 percent) with serious abdominal injuries. The results showed that each individual physician or hospital did not see the severe cases often, but that when they occurred, these types of injuries necessitated an experienced, rapid response on the part of the hospital staff. This finding has significant implications for trauma management in rural communities.

Trauma is the third leading cause of death in this country and the primary killer of young adults aged less than 40 years. Over the past decade increasing attention has been paid to this devastating condition with respect to both its prevention and management. A number of authors have suggested that improved initial assessment, aggressive early treatment, and regionalization of care can all decrease morbidity and mortality.[1–9] These studies have dealt almost exclusively with the treatment of trauma in an urban setting. Only a few have looked at the problem of trauma management in rural areas. Several studies have reviewed rural trauma fatalities and made suggestions for improving care.[10–13] Other authors have described efforts to establish regional trauma systems in rural areas.[14–16]

Certain factors in rural trauma, such as the large geographic areas that Emergency Medical Services (EMS) systems must cover, will always present challenges to the health care delivery system. Another factor unique to rural trauma is the infrequent nature with which severe trauma cases are seen. Indeed, that rural EMS and hospital staff may be called upon to assess and stabilize patients with injuries as severe as those seen by their urban colleagues, and yet only on a very infrequent basis, has major implications for rural trauma management. Case fatality studies provide important information on trauma care but cannot assess adequately the full spectrum of severe injuries seen by rural hospital and prehospital personnel. A retrospective study was thus done to examine the incidence of severe trauma seen in a small rural hospital.

METHODS

Data were collected retrospectively by reviewing charts of all trauma patients who were either admitted to or transferred from five rural hospitals in northeastern Washington and northern Idaho in 1983. All hospitals included in the study were located within 100 miles of Spokane, Washington, and had an average daily census of fewer than 25 patients. If two adjacent hospitals served

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From Group Health of Spokane, Spokane, and the Department of Family Medicine, University of Washington School of Medicine, Seattle, Washington. This paper was presented at the Annual Meeting of the Washington Academy of Family Practice, Tacoma, Washington, May 17, 1986. Requests for reprints should be addressed to Dr. Nanette Smith, S. 501 Bernard, Spokane, WA 99204.

the same geographic area, both had to meet the above criteria (thus eliminating small hospitals within the Spokane metropolitan area from the study). Seven hospitals met the above criteria. Based on data collected in a pilot study, it was decided that reviewing the records from five hospitals would identify an adequate number of trauma patients to allow meaningful conclusions to be drawn. Five of the seven hospitals were thus arbitrarily selected. The two that were excluded were similar in patient census, composition of medical staff, and size of communities served to the five sites included in the study.

The average 1983 daily hospital census of the five hospitals studied was 14.1 patients (range 9 to 19). Their distance from a larger referral hospital ranged from 36 to 74 miles; however, given road conditions, and in two cases mountain passes, travel times could range from 45 minutes to several hours. A total of 30 physicians served on the medical staffs, including 22 family physicians and general practitioners, 5 surgeons, and 3 internists. These five hospitals served a total population of 57,600 people over 7,396 square miles. The largest single community had a population of 4,510. Local economies were based on agriculture and wheat farming in one community, timber and recreation in two communities, and timber and silver mining in two communities.

The emergency room log was reviewed in all hospitals. Charts were reviewed on all patients with a trauma diagnosis who were either admitted to the local hospital, were transferred to a larger facility, or had died in the emergency room. In addition, charts were reviewed on all admissions and transfers when it was unclear whether the diagnosis was trauma related. Of a total of 574 cases that were identified, nine charts could not be found. In one hospital, several months of emergency room log admission information were incomplete. In this case the hospital admission log was reviewed to be sure no cases were overlooked. Prehospital deaths were not reviewed in this study for two reasons. First, in 1983 lack of a uniform charting system among the volunteer ambulance groups in these communities made accurate prehospital data difficult to obtain. (This situation has since changed.) Second, the intent of this study was to identify the group of trauma patients presenting with serious injuries who would benefit by appropriate acute interventions. It is known that 50 percent of trauma fatalities occur within seconds to minutes after an accident and that accident prevention is the only possible intervention in these cases.[17] It was not the intent of this study to review these immediate post-trauma deaths.

The following information was obtained for each trauma case reviewed: sex, age, mechanism of injury, description of injuries, and hospital and physician (both coded by number). Because the initial physician attending the trauma patient must make critical decisions affecting patient outcome, this physician was identified with the case, even though many of these patients were soon referred to a surgeon, either locally or at a larger medical center. A detailed description of injuries was obtained for each case based on a review of the physical examination, operative reports, and discharge summaries. When patients were transferred to a secondary facility the charts were also reviewed at that facility. (The only exceptions were a few patients who were transferred for treatment of isolated extremity injuries, such as tendon lacerations or uncomplicated hip fractures. These charts were reviewed at the local hospital only.)

A total of 565 cases were included in the study. All injuries were coded using the Injury Severity Score (ISS) of Baker et al, 1980 revision.[18] The decision to use the ISS for this study was based on several factors. It has been well accepted in the trauma literature and has been evaluated by several authors.[19–21] In addition, it is based on an anatomic description of injuries, while several other trauma indices[22,23] include both physiologic and anatomic variables. In this retrospective study, physiologic data were not always recorded in a format that would allow their use in trauma scoring.

The Injury Severity Score is a standardized trauma index that starts by dividing a patient's injuries into six categories: external, head or neck, face, chest, abdomen, and extremities. Each injury is then assigned a value based primarily on its severity and threat to life. Over 500 individual injuries have been classified in this manner, and this coding system is known as the Abbreviated Injury Scale (AIS).[18] The AIS codes can be summarized as follows; AIS 1-minor, AIS 2-moderate, AIS 3-serious, AIS 4-severe, AIS 5-critical. The following examples illustrate coding thoracic injuries using the Abbreviated Injury Scale: AIS 1—uncomplicated rib fracture, AIS 2—sternum fracture, AIS 3—rib fracture with hemothorax, AIS 4—rib fracture with flail chest, AIS 5—laceration of aorta.

To obtain the Injury Severity Score, the patient's three highest AIS injury scores are squared, and this total is the Injury Severity Score. An example of the application of this scoring system follows:

Case 427: 18-year-old man in motor vehicle accident:

		AIS	$(AIS)^2$
External	Contusions, chest, abdomen and extremities	2	4
Head	Closed-head injury, unspecified	2	
Face	Lip laceration	1	
Chest	Right pneumothorax	3	9
Abdomen	Spleen laceration	4	16
Extremities	Fractured clavicle	2	
		ISS =	29

Case 458: 36-year-old man with gunshot wound to abdomen:

		AIS	$(AIS)^2$
External		0	
Head		0	
Face		0	
Chest		0	
Abdomen	Multiple perforations of colon and small bowel	4	16
Extremities		0	
	ISS =		16

Before discussing the results of the study, its limitations must be addressed. One concern is that cases could have been missed at either the hospital or prehospital level. All patients included in this study were seen initially in the emergency room. It is possible that patients with some minor traumatic injuries were seen initially in physicians' offices and directly admitted to the local hospital, thus not being included in the sample. The intent of the study was to assess severe trauma, and it is unlikely that any patient with injuries having an ISS of 10 to 19 or an ISS greater than or equal to 20 would be evaluated initially in the office.

All hospitals involved were small community hospitals, and any patients directly transferred from the accident site to a referral center would definitely affect the results. The Emergency Medical Services system in these communities at the time of the study consisted of local EMS groups who responded to all calls within the study area and who transported all patients initially to the community hospital. The only exception was the EMS group in the study community closest to Spokane. That group treating a seriously ill or injured patient at the edge of their response area, close to Spokane, would at times transport that patient directly to a referral center. The ambulance records for this community were thus reviewed. Out of 144 total ambulance runs for 1983, four medical records could not be located, and three trauma patients were taken directly from the accident scene to a referral hospital. These patients had ISS of 9, 10, and 24. The patient with an ISS of 24 sustained major head and minor facial and extremity injuries.

In 1983 there was only one major EMS air transport service operating in the study area, and the service was in the early stages of its operations. In the geographic area served by these five study hospitals, there were only seven cases transported by air directly from the accident site to a referral hospital. Two of these cases had an ISS of greater than or equal to 20; the rest had an ISS of 8, 9, or 10. One case had an ISS of 22 with chest and abdominal injuries. In the other case, with an ISS of 41, the patient sustained major abdominal and mediastinal injuries and died intraoperatively after air transport to a tertiary care center. (This accident, however, occurred only 28 miles from Spokane, at the far edge of the area served by the rural hospital. Whether this case should even be included is debatable based on the location of the accident, but is mentioned here because of the severity of the injuries and for the sake of completeness).

In summary, the local hospitals were bypassed only on rare occasions. Bypass accounted for three cases with an ISS greater than or equal to 20, and seven cases with an ISS of 8, 9, or 10, a difference of 1.8 percent of the total cases. This minor difference would not affect the conclusions drawn from the results below.

RESULTS

Five hundred sixty-five trauma patients were seen in five rural emergency rooms in 1983. Of these, 159 patients were transferred to larger medical centers. It is important to note that only two of the 565 patients died. (One patient sustained a self-inflicted gunshot wound to the head with massive brain destruction. He was stabilized, rapidly transferred by air to a tertiary care center, and died shortly after arrival at the referral hospital. The other patient was an elderly woman who died on the 16th day of hospitalization following a hip fracture and complications from multiple underlying medical problems.) The cases were separated into three groups, those with an ISS of greater than or equal to 20, an ISS of 10 to 19, and an ISS of 1 to 9. While these divisions were somewhat arbitrary, it was felt that because of the nature of the ISS system, the group of cases that had an ISS of greater than or equal to 20 would include those cases with severe multisystem trauma, those with an ISS of 10 to 19 would include cases with severe trauma limited to one body system or multisystem trauma of a less severe nature, and those cases with an ISS of 1 to 9 would be the least severe, including the many patients with less severe orthopedic injuries who were seen and transferred to secondary centers.

The breakdown of trauma cases by ISS is given in Table 1. Of the 565 cases, 3.4 percent had an ISS of greater than or equal to 20, 14.7 percent had an ISS of 10 to 19, and 81.9 percent had an ISS of 1 to 9. This information was then analyzed by physician and by hospital. For an ISS of greater than or equal to 20, severe multisystem trauma, there was a total of 19 cases seen. Each hospital saw an average of 3.8 cases (range 1 to 7) in 1983, and each physician saw an average of 0.6 cases (range 0 to 3) that year.

For an ISS of 10 to 19, major trauma but not so extensive as in the preceding group, there was a total of 83 cases seen. Each hospital treated an average of 17 patients in this group (range 11 to 31), and each physician saw 2.8 cases (range 0 to 9) during 1983.

In the least severe group, an ISS of 1 to 9, there were

TABLE 1. NUMBER OF PATIENTS SEEN BY INJURY SEVERITY SCORE (ISS)

Score	No. (%)	Number per Hospital	Number per Physician
ISS ≥ 20	19(3.4)	3.8	0.6
ISS 10–19	83(14.7)	16.6	2.8
ISS 1–9	463(81.9)	92.6	15.4
Total cases	565(100)	113	18.8

TABLE 2. MECHANISM OF INJURY BY INJURY SEVERITY SCORE (ISS)

	ISS ≥ 20	ISS 10–19	ISS 1–9	All Patients
Type of Injury	No.(%)	No.(%)	No.(%)	No.(%)
Fall	1(5)	20(24)	143(31)	164(29)
Motor vehicle accident	10(53)	31(37)	104(22)	145(26)
Industrial and machinery	2(10.5)	11(13)	58(12.5)	71(12)
Recreation	0	7(8)	53(11.5)	60(11)
Assault or blow	0	4(5)	46(10)	50(9)
Burn	1(5)	2(2.5)	18(4)	21(4)
Miscellaneous	0	3(4)	22(5)	25(4)
Animal	2(10.5)	2(2.5)	14(3)	18(3)
Gunshot wound	3(16)	3(4)	5(1)	11(2)
Total	19(100)	83(100)	463(100)	565(100)

463 cases seen with the average number per hospital being 92.6 cases (range 55.4 to 154) and the average each physician saw being 15.4 (range 0 to 28) during 1983.

The mechanism of injury was also noted and is displayed in Table 2.

The information was then reviewed from a descriptive point of view to determine what specific types of injuries were being assessed in these rural emergency rooms. All head, chest, and abdominal injuries were analyzed separately if they were classified by the AIS as serious (AIS 3), severe (AIS 4), or critical (AIS 5); the results are shown in Table 3. There were 30 trauma cases of 565 studied that had significant head injuries (5.3 percent). To determine the number of cases that also had significant multisystem trauma, the ISS score for each of the head injury cases was examined. Of the head injury patients, 33 percent had major multisystem trauma (ISS of greater than or equal to 20). Each physician in the study area saw an average of one patient with a significant head injury during 1983. Each hospital cared for an average of six patients that year with severe head injuries. A description of the head injuries seen in these hospitals is listed in Table 3.

A similar analysis was done with the data on significant chest and abdominal injuries, and the results are in Tables 3 and 4. While 24 patients with significant chest injuries were seen in this population, 29 percent of whom had major multisystem trauma, each individual physician saw an average of less than one case in 1983. Each hospital provided acute care for an average of 4.8 of these chest-

TABLE 3. NUMBER OF PATIENTS WITH INJURIES ON ABBREVIATED INJURY SCALE OF 3 TO 5 SEEN PER PHYSICIAN AND PER HOSPITAL IN ONE YEAR

Type of Injury	Number of Patients	Percent With ISS ≥ 20	Number Seen per Physician	Number Seen per Hospital
Head	30	33	1.0	6.0
Chest	24	29	0.8	4.8
Abdomen	21	38	0.7	4.2

ISS—Injury Severity Score

TABLE 4. DESCRIPTION OF HEAD, CHEST, AND ABDOMINAL INJURIES WITH ABBREVIATED INJURY SCALE OF 3 TO 5

Number	Description
Head injuries	
1	Large subdural hematoma with hemiparesis
1	Gunshot wound with massive brain destruction
1	Cervical cord injury with quadriparesis
4	Major concussion with focal neural findings
2	Intracerebral hemorrhage with focal neural findings
2	Major basal skull fracture
7	Cervical spine fracture and/or subluxation
2	Major skull fracture—vault
1	Subarachnoid hematoma without focal neural findings
9	Moderate concussion with or without focal neural findings
Chest injuries	
2	Flail chest with hemothorax or pneumothorax
1	Hemothorax and bilateral pneumothorax
2	Pulmonary contusion
6	Pulmonary contusion with multiple rib fractures
1	Small cardiac contusion
7	Unilateral pneumothorax or hemothorax (one-sided injury only)
5	Major compression fracture—thoracic spine
Abdominal injuries	
1	Ruptured uterus with term pregnancy
2	Multiple colon perforations—deep
1	Ruptured liver
1	Spleen laceration
3	Bowel perforation—superficial
2	Kidney laceration—superficial
1	Retroperitoneal hematoma
8	Renal contusion
2	Bowel contusion
1	Ureter perforation—extensive
1	Deep laceration—perineum
4	Major fracture—lumbar spine

injured patients that year. For the 21 patients with major abdominal injuries, 38 percent had major associated injuries, but each physician encountered such a patient only an average of 0.7 times per year and each hospital saw an average of 4.2 of these individuals annually. While the individual physician or hospital who cares for these patients encounters these severe injuries infrequently, the descriptions of the injuries make it clear that these patients are presenting with major, often life-threatening injuries that demand immediate and appropriate actions for optimal patient care.

DISCUSSION

Research in trauma in the past decade has focused primarily on the concept of preventable death. Houtchens[12] in Utah and Certo and colleagues[11] in Vermont have reviewed autopsy reports and clinical histories of patients fatally injured in the rural areas of their states. They determined which patients had potentially survivable injuries, and then used this information to make recommendations for improved care. West et al[9] examined motor vehicle fatalities in two counties in California. In addition to reviewing hospital and autopsy records, they applied the objective criteria of the Injury Severity Score to assess which deaths may have been preventable. He used this information to support the concept, now widely accepted, that regionalization of trauma care for the severely injured victim will improve patient outcome. Cales and Trunkey[2] have also reviewed a large number of trauma case studies, and used the concept of preventable deaths as an end point for evaluating various interventions in trauma care.

The vast majority of these most recent studies, however, have reviewed trauma fatalities in urban areas. Waller[16] noted in 1973 that "urban oriented methods [fail] to solve rural emergency care problems." He went on to identify a number of problems that are unique to rural areas: the limited number of physicians and hospitals in rural communities, a shortage of persons with trauma management skills and experience, low population density and consequently long distances and poor roads for transport, and limited financial resources. Not surprisingly, nearly 15 years later these continue to be major problems facing rural trauma care. Waller[24] also documents how infrequently ambulance crews are called upon to handle severe emergencies, and suggests that this lack of experience contributes to the problem of their having adequate clinical skills available.

Preventable death studies, by definition, must review a large number of deaths over a given area and time to provide meaningful data from which conclusions can be drawn. It is thus not a useful method for assessing the extent of traumatic injuries seen in an individual rural community hospital. Solutions to the problems involved in trauma care in general, or rural trauma care in particular, cannot be proposed until these problems have been identified. A retrospective study on the incidence of severe trauma seen in small rural hospitals was the best way to begin to identify some of these problems. A review of the literature found two other studies looking at the incidence of rural injuries. One study by Walker and Raines[25] was limited to pediatric accidents. Perry and colleagues[26] described injuries seen in the physician's office and emergency room in a rural Washington community. They described 20 percent of the injuries as serious and 4.2 percent as requiring hospitalizations, but they did not quantify the extent of injuries by a trauma scale.

This study documents the incidence of trauma seen in five rural hospitals over a period of one year. The total population base studied was fairly small; however, having a small population spread over a large geographic area is typical of much of the rural West. Because of the small population base, all trauma cases were analyzed to increase the accuracy of the information obtained. The results show that the incidence of severe trauma is not high, but that when it occurs, these patients have injuries requiring aggressive early management for optimal outcome. Trunkey[17] has shown that trauma deaths have a trimodal distribution: approximately 50 percent of deaths occur within seconds to minutes of the accident, 30 percent occur within the first two to three hours, and 20 percent occur after days to weeks of hospitalization, usually from secondary medical complications. The 30 percent in this middle group are the persons that will benefit from major acute medical interventions, thus it is called the "golden hour" of trauma care. The challenge facing rural health care practitioners is how to optimize patient care during this golden hour given the problems that already exist in providing health care over a large geographic area.

Patient assessment, stabilization, and transport will continue to be the key parts of golden hour care. Regionalization of rural trauma care with the development of tertiary referral centers and rapid air transport have definitely contributed to improved patient outcomes. Bypassing community hospitals, however, and transporting patients directly to a larger center will not in and of itself improve patient survival.[10,11] Regional centers and transport services must be used appropriately; they are not substitutes for accurate initial patient assessment, airway management, fluid replacement, etc. In rural areas these initial resuscitation decisions and actions will usually be made by prehospital and emergency room personnel, with physician backup as soon as he or she is available. This study has shown that these individuals will not have extensive clinical experience in caring for these injuries because of the infrequent nature with which severe trauma is seen. There will thus always be the ongoing educational challenge of how to stay current in the area of trauma

management. A number of excellent programs, ranging from Emergency Medical Services continuing education for ambulance personnel to the Advanced Trauma Life Support courses for physicians, are available to help practitioners improve both cognitive knowledge and skills. However, a back-to-basics approach should also not be overlooked. Educational efforts need to continuously emphasize the basics of injury recognition, assessment, and stabilization, in addition to addressing the more recent advances in trauma care and technology. In this way, when the emergency medical technician, nurse, or physician is presented with the rare but seriously injured trauma patient, he or she will have the skills available to provide initial care for that patient and thus reduce rural trauma morbidity and mortality.

CONCLUSIONS

Rural hospital and EMS personnel must be prepared to deal with critically ill patients with major traumatic injuries. These patients require aggressive early treatment if morbidity and mortality are to be reduced. The challenge facing physicians is how to provide a rural health care delivery system to meet these needs.

Despite advances in air transport and regionalization of prehospital care, direct rapid access to tertiary trauma centers will continue to be difficult logistically for many trauma victims in rural areas such as those described in this study. Local rural medical communities will continue to play a vital role in the treatment of these individuals. Medical and paramedical personnel in rural communities must have the skills available to stabilize and appropriately refer patients with severe trauma. Regional backup services for both acute referrals and continuing education are essential. This study shows that the incidence of severe trauma in rural areas is not high, but that when traumatic injuries occur, they are as severe as those seen in the largest of metropolitan communities.

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