

Hand Trauma: A Prospective Evaluation of Patients Transferred to a Level I Trauma Center

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ABSTRACT

We conducted this study to evaluate the hypothesis that the need for a higher level of care is the most important reason for the transfer of patients with hand trauma to a level I trauma center.

We prospectively assessed 53 patients transferred to our level I trauma center for evaluation of an acute hand injury. Specialty of referring physician, case complexity as assessed with visual analog scale, and patient insurance status were obtained before transfer and were reassessed after arrival. Only 9 patients were examined by a surgeon before transfer.

On the basis of injury severity, we judged that 40 of the 53 patients required the immediate care of a hand surgeon but that only 13 required the resources of a level I trauma center. Most of the patients were transferred without prior evaluation by a hand surgeon, despite there being an on-staff surgeon at many of the hospitals.

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Trauma centers were established to provide an improved system for the care of seriously injured patients. The American College of Surgeons designed specific standards for acute trauma centers, establishing the “levels” of care now in practice.^{1,2} Level I trauma centers are intended to offer expertise in the

patients based on insurance status, or “dumping,” as opposed to transferring based solely on medical necessity; most agree that this law has been successful in reducing such transfers. However, others³⁻⁵ have viewed EMTALA as placing an additional burden on level I trauma centers, as all patients, regardless of the receiving facility’s

“Trauma centers have become safety nets for community hospitals lacking satisfactory subspecialty coverage.”

care of multiple-injury patients and to provide subspecialized care that often cannot be provided by smaller community hospitals.

The Emergency Medical Treatment and Active Labor Act (EMTALA) changed the landscape of trauma care and patient transfers between hospitals when it became law in 1986.³ This act imposes obligations on Medicare-participating hospitals offering emergency services to provide both medical examination and treatment for an emergency medical condition, regardless of an individual’s ability to pay. Hospitals are required to stabilize patients or, if unable to stabilize a patient or if the patient requests, to transfer the care of the patient appropriately. A higher level of care hospital must accept a patient in transfer if it has the capacity to care for the patient. The purpose of EMTALA is to prevent transferring trauma

perception of need, must be accepted in transfer as long as the receiving hospital has the capacity to care for that patient. The 2003 clarification of EMTALA⁶ gave hospitals more leeway in establishing a list of on-call physicians to “best meet the needs of the hospital’s patients.” In addition, it clarified that specialists need not always be on call and, during a call period, may schedule elective surgery and participate in call at another institution. Finally, it elucidated that there should be a procedure for times when the on-call surgeon is not available, presumably for a reason related to care of other patients.

We recently evaluated the role of the level I trauma center in the care of transferred patients with isolated orthopedic trauma.³ In this series, most patients were transferred secondary to a need for the increased level of care that could be provided at our level I trauma center; how-

ever, transferred patients with injuries of a lower level of complexity had a significantly worse insurance status. Although a few upper extremity injuries were included in this previous study, the unique nature of care of the traumatized hand was not fully evaluated. There have been no previous studies with respect to subspecialty care within orthopedic surgery as it pertains to patient transfers. The present study was designed to be an extension of our previous study—to have similar data points and analysis but to be differentiated by factors unique to hand surgery.

We wanted to evaluate the hypothesis that the need for a higher level of care is the most important reason for the transfer of patients with hand trauma to a level I trauma center. We assessed the indications for transfer, the demographics of transferred patients, and the appropriateness of the transfers of patients with isolated hand injuries to our level I trauma center.

MATERIALS AND METHODS

The study was performed at a 904-bed level I teaching hospital serving a metropolitan area with a population of more than 2.5 million people. This hospital has a referral area of 6 states and 300 miles. We obtained institutional review board approval before commencing this study.

Study patients were identified through an existing, dedicated, continuously staffed referral line (Doctor's Access Line, DAL) that facilitates physician-physician communication regarding transfer of patients. Data were prospectively obtained on patients transferred through our emergency department (ED) to the orthopedic hand surgery service for isolated hand and wrist trauma facilitated by the DAL for a 6-month period beginning December 1, 2007. The strict inclusion criteria were that the patient be prospectively evaluated before transfer (ie, by telephone) and then be reevaluated after transfer by the

same physician. Exclusion criteria were multiple-extremity trauma or torso trauma, acceptance in transfer by the general orthopedic service or another surgical or medical service, and being seen primarily or accepted in transfer by the ED. Sixty-two transfer requests met all these criteria, and 53 of these patients were treated at our institution. Nine patients were not transferred: 3 because of lack of medical indication for the transfer, 3 because of a decision by the outside institution, 2 because of incomplete evaluation at the outside institution, and 1 because of limitations in our operating room availability.

The initial data regarding the transfer were collected during the physician-physician telephone conversation that took place while the patient was being accepted in transfer. After the patient's case was discussed with the transferring physician, a data collection form was completed. This form asked for name of transferring hospital, specialty of transferring physician (eg, orthopedic surgeon, plastic surgeon, emergency medicine physician), presence of on-call orthopedic surgeon, presence of on-call hand surgeon, patient's specific diagnosis, complexity level of problem (described later in this article), transfer route, and transfer time of day. After accepting the transfer, we documented the patient's insurance status.

Level of complexity of the patient's problem was graded with

a visual analog scale (VAS), which had a score of 1 representing a simple injury that did not require specialized or acute treatment and a score of 10 representing a complex hand injury requiring urgent evaluation by a dedicated hand surgeon with the resources of a tertiary care center (Table I). This nonvalidated scale was developed for use in comparing case complexity. Higher scores represented injuries considered appropriate for transfer to a tertiary center for hand surgeon care, and lower scores represented injuries thought to be within the capabilities of a general orthopedic surgeon or hand surgeon without the resources of a tertiary care center. The scoring system was used only as a guide, and the score was raised for open or multiple-digit injuries or lowered for more straightforward injuries.

When a patient arrived in our ED, a routine history was obtained, a physical examination was performed, and radiographs were taken, if appropriate. Using this evaluation, the hand surgeon documented the admitting diagnosis and used the VAS to reassess the complexity of the patient's injury. The insurance status of the patient was also reevaluated. Finally, we subjectively assessed the complexity of the injury with respect to immediate need for a hand surgeon and need for a level I trauma center.

We evaluated the referring hospitals' characteristics, including number of beds, number of orthopedic

Table I. Visual Analog Scale Scores for Hand Injury Complexity

Score	Hand Injury Complexity
1	Hand infection/"fight bite"
2	Phalanx fracture, metacarpal fracture, fingertip injury
3	Metacarpophalangeal dislocation, 2-part distal radius fracture
4	Compartment syndrome, intra-articular distal radius fracture
5	Perilunate dislocation, Galeazzi fracture
6	Dorsal hand saw injury
7	Deep volar forearm laceration, severe distal radius fracture
8	Ring avulsion injury, finger revascularization
9	Single-digit or proximal replantation
10	Multiple-digit replantation, pediatric replantation

surgeons and hand surgeons on staff, and distance from our hospital. This information was collected from publicly available information on the Internet and from the general information provider at these hospitals.

Statistical analysis was performed with a paired Student *t* test or the χ^2 test with significance set at $P < .05$.

RESULTS

Transferring Physician

The transferring physician was an emergency medicine physician in 44 (83%) of the 53 cases, a plastic surgeon in 5 cases (10%), and an orthopedic surgeon, a general surgeon, a nurse practitioner, and an internist in 1 case each (7%). An orthopedist was on staff at the transferring facility in 47 cases (89%), but only 6 patients (11%) were examined by the orthopedic surgeon before transfer. A hand surgeon was on staff at the transferring facility in 35 (66%) of the 53 cases, and a hand surgeon was on call at time of transfer in 15 cases (28%) (Table II). The on-call hand surgeon examined only 3 of the patients before transfer and did not examine the other 12 cases for a variety of reasons, including being "too busy" or simply unavailable (10), the case clearly requiring transfer (1), and the patient's insurance not being accepted by the surgeon (1).

Transfer Route

The routes of transfer for the patients in this study were ambulance (44), car (8), and fixed-wing airplane (1). At our institution, the patients transferred by car had a mean postevaluation VAS score of 4.5 (range, 2-8), those transferred by ambulance had a score of 3.8 (range, 1-9), and the patient transferred by airplane a score of 10.

Transfer Time of Day

Time of day of transfer was recorded for 43 of the 53 patients. Of the 43 patients, 19 (44%) were transferred between 7:00 am and

Table II. Transferring Hospital Physician Status

Specialty of Transferring Physician	Cases (n)		
Emergency department	44		
Plastic	5		
Orthopedic	1		
General	1		
Other	2		
Total	53		
Staffing at Transferring Facility		Pretransfer Cases Examined (n)	
Orthopedic surgeon on staff	47 (89%)	6	
Hand surgeon on staff	35 (66%)	3	

3:00 pm, 19 (44%) were transferred between 3:00 pm and 11:00 pm, and 5 (12%) were transferred between 11:00 pm and 7:00 am. There was no significant difference in case complexity based on time of arrival ($P = .97$). A trend suggested that late night transfers were more likely to carry Medicaid, Medicare, or no insurance than other insurance ($P = .08$).

Insurance Status

The reported pretransfer insurance data were accurate, as determined by insurance status reassessment after transfer, in 44 (83%) of the 53 patients. The overall payer mix reported before and after transfer was similar: 32% private, 21% worker's compensation, 17% Medicare, 15% Medicaid, and 15% uninsured. This mix is not dramatically different from the typical payer mix for the Orthopedic Trauma Service at our center. We cannot assess or compare these data with the payer mix at any of the transferring facilities.

Hospital Demographics

Patients were transferred from 26 different hospitals in Missouri, Illinois, and Arkansas. Mean bed count at the transferring hospitals was 291 (range, 15-615). Considering the transferring hospitals (rather than the breakdown by patients), 21 hospitals reported having an orthopedic surgeon on staff, and 11 reported having a hand surgeon on staff but not necessarily on call. Mean dis-

tance traveled was 49 miles. Two hospitals together transferred 22 patients; both had 2 or more orthopedic surgeons and 2 or more hand surgeons on staff. Mean VAS score from these 2 hospitals was 2.4 (range, 1-6). Of these 22 patients, 4 had private insurance (18%), 4 had worker's compensation (18%), and 14 were uninsured or had Medicare or Medicaid (64%).

Case Complexity

There was no significant difference ($P = .78$) between pretransfer VAS score (mean, 4.2; range, 1-10) and posttransfer VAS score (mean, 4.0; range, 1-10). Of the 53 patients, 37 had a VAS score of 5 or less, and 16 had a VAS score of 6 or more. There was no significant difference ($P = .88$) in insurance status between the low-score (≤ 5) and high-score (≥ 6) groups; 18 (49%) of the 37 patients in the low-score group had Medicare, Medicaid, or no insurance.

When the patients arrived at our institution, we determined that 40 (75%) of them needed the immediate expertise of a hand surgeon and that the other 13 could have been acutely treated by the transferring physician/surgeon or simply seen at an outpatient office visit. Of these 13 patients, 7 (5 fingertip injuries, 1 extra-articular distal radius fracture, 1 second-degree hand burn) were treated and discharged from our ED, and the other 6 were treated electively. Mean VAS score for patients thought to require the immediate expertise of a hand surgeon was 4.7 (range 6-10), and

mean score for patients thought not to immediately need a hand surgeon was 1.8 (range, 1-4).

In addition, we thought that only 13 patients (25%) needed the resources of a level I trauma center (Table III). Mean VAS score for patients thought to require the resources of a level I trauma center was 7.5 (range, 5-10), and mean score for patients thought not to require the resources of a level I trauma center was 2.9 (range, 1-6).

Bank) with Medicaid were 2.02 times more likely to be transferred to a level I trauma center, and 2.25 times more likely to be transferred during the evening or night hours, than patients with commercial insurance. Nathens and colleagues⁴ reported similar findings: general trauma patients without private insurance were 2.4 times more likely to be transferred to a level I trauma center. A University of Pennsylvania study⁵ found that

hospital's typical direct admission patients. Obremskey and Henley¹⁰ compared orthopedic trauma transfer patients with directly admitted patients and found a high percentage of Medicaid patients in both groups but no significant difference between the groups. Finally, Esposito and colleagues¹¹ reviewed the Illinois state trauma registry and found that general trauma transfer patients did not have a significantly different insurance sta-

"...patients were transferred to our level I trauma center because of lack of a local surgeon who was willing or able to care for the patient."

DISCUSSION

EMTALA has been effective in decreasing the number of patients transferred on the basis of insurance status alone, but, as several studies have demonstrated, it has not eliminated the problem. Archdeacon and colleagues⁷ evaluated all femur fractures treated in a 6-hospital health system with a single level I trauma center. Their findings demonstrated that the patients transferred to the level I trauma center were significantly more likely to be uninsured than the patients treated at the other 5 hospitals. Koval and colleagues⁸ found that general trauma patients (as reported in the National Trauma Data

neonates with no insurance or with Medicaid were more likely to be transferred than similar infants with private insurance. In our recent study of orthopedic patient transfers to a level I trauma center, we found that, although most patients (84%) required tertiary care, those with less complex injuries (ie, those that did not require higher level care) were significantly more likely to have Medicare, Medicaid, or no insurance.³

However, not all studies found such a disparity. Spain and colleagues⁹ reviewed all trauma patient transfers to a level I trauma center and found no difference in payer mix compared with the accepting

tus compared with direct admission trauma patients.

The present study of 53 patients with isolated hand or wrist trauma found that 53% had either private insurance or worker's compensation—a percentage not significantly different from that of our normal trauma center patient population. In addition, although there was a higher than expected percentage of low-VAS-score patients transferred, these patients had a similar insurance status to the group as a whole and to our typical trauma patient population. Insurance status, therefore, seems not to be the primary driving force behind most hand trauma transfers.

Level I trauma centers, designed to care for the most seriously injured patients, have greater resources, on-call expertise, and technology than smaller, community hospitals do. In our previous report on patient transfers for general orthopedic trauma,³ 84% had a VAS score of more than 5; these patients, therefore, in total, seem to be appropriate for transfer. However, in the present series only 30% of patients had a VAS score of more than 5. Furthermore, although 75% of patients were thought to need the services of a hand surgeon, only 25% were

Table III. Patients Appropriate for Level I Trauma Center Care

Case No.	Diagnosis	Visual Analog Scale Score
3	Multiple-digit amputation	9
6	Dorsal hand saw injury	5
7	Dorsal hand saw injury	6
8	Amputation	9
11	Ring avulsion injury	8
12	Crush injury with dysvascular finger	5
19	Severe hand/wrist saw injury	5
30	Amputation	7
31	Dorsal hand saw injury; dysvascular finger	8
37	Gunshot hand; dysvascular digits	9
39	Multiple-digit amputation	9
51	Multiple-digit amputation	10
54	Dorsal hand saw injury	6

thought to need a Level I trauma center. Therefore, we believe that the need for a higher level of care was not the impetus behind the majority of transfers evaluated in this study; rather, patients were transferred to our level I trauma center because of lack of a local surgeon who was willing or able to care for the patient. This disparity highlights a systemic health care issue labeled *secondary overtriage*.

Trauma centers were designed to care for the most seriously injured patients, but, because of societal demands—with consideration for the EMTALA mandate for acceptance of transfers as long as the accepting facility has the capacity to care for the patient—the mission of these centers has evolved. Trauma centers have become safety nets for community hospitals lacking satisfactory subspecialty coverage. Ciesla and colleagues¹² evaluated this problem in a comprehensive cohort study of 2,189 transferred patients. Sixty-four percent of the transferred patients had minor injuries, and 39% of these were considered “overtriage.” The authors identified this as a systems issue, different from “undertriage,” which may lead to increased mortality in individual patients. As in our study, Ciesla and colleagues found that patient transfers were not necessarily about insurance coverage, which

was not significantly different or worse in transferred patients. The American Orthopedic Association identified orthopedic ED coverage as a “critical issue,” and Bosse and colleagues¹³ noted that 2 of 3 EDs have difficulty with subspecialty coverage and that 1 of 3 has responded by increasing the number of patient transfers.

The present study has several limitations. First, we can report data only on patients transferred to our institution. We have no way of knowing whether other hand injuries were treated at these referring hospitals or whether other patients were referred to other institutions during the study period. In addition, we cannot confirm the specific hand surgery call schedules at these other hospitals. Second, the VAS scale we employed is nonvalidated. However, we believe it is helpful to have some means of comparing injury severity.

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