The Effectiveness of Regionalized Burn Care: An Analysis of 6,873 Burn Admissions in North Carolina from 2000 to 2007

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BACKGROUND: The effectiveness and benefits of regionalized trauma care are well substantiated; however, the effectiveness of regionalized burn care and potential benefits of burn center verification have not been fully validated.

STUDY DESIGN: This was a retrospective study of all acute burn admissions using a statewide discharge database from October 1, 2000, to Septmber 30, 2007. Demographics, referral patterns, care practices, and outcomes were compared between 2 American Burn Association (ABA)–verified burn centers (VBCs) and the remaining 107 nonburn centers (NBCs) in North Carolina.

RESULTS: Overall, 6,873 adult burn patients required admission, with 79% of them meeting ABA burn center referral criteria. Of the 5,402 patients meeting ABA referral criteria, 43% were admitted to an NBC, and 25% of all NBC patients had burn operations. Burns admitted to NBCs tended to involve the hand/wrist and lower extremities. Older patients with comorbidities/concomitant trauma were more likely to be admitted to NBCs ($p < 0.0001$); however, larger burns were more likely to be admitted to a VBC ($p < 0.0001$). More NBC patients were discharged to nursing homes ($p < 0.0001$). Patients with Medicare were more likely to be admitted to NBCs ($p < 0.0001$), and uninsured patients or those with Workman's Compensation insurance were more likely to be admitted to VBCs ($p < 0.0001$), and payer status remained a significant predictor of treatment at a VBC on regression analysis.

CONCLUSIONS: This is the most comprehensive study of its kind and demonstrates that ABA burn center referral criteria are not always used for effective regionalized burn care or to ensure the best possible outcomes. Even with establishment of the burn center verification process, the mere presence of a VBC is insufficient for effective regionalized care. A greater emphasis is needed on the development of burn care systems. (J Am Coll Surg 2011;212:487–495. © 2011 by the American College of Surgeons)

Burns are a major burden to the US healthcare system, with 40,000 burn injuries requiring hospitalization and an additional 4,000 burn-related deaths each year.[1] As demand and costs escalate, America has made quality and accessibility to health care major priorities in public policy.[2] Numerous studies have supported the creation of high-volume accredited centers for the optimal treatment of many disease processes. For example, the regionalization of trauma care and verification of trauma centers has resulted in a reduction in acute mortality rates.[3] For nearly 2 decades, the American Burn Association (ABA) has promulgated a list of criteria for referral to burn centers (Table 1).[4] The ABA has also developed, in collaboration with the American College of Surgeons Committee on Trauma (ACSCOT), a burn center verification process similar to that for trauma centers. However, few studies have compared admission, treatment, and discharge patterns for patients suffering burn injuries, as a function of whether or not the treating institution was an ABA-verified burn center. One method of improving care is through the use of large administrative databases to examine referral patterns and outcomes.[5] The ABA National Burn Repository (NBR) collects data from >128 US burn centers each year; however,

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Abbreviations and Acronyms

%TBSA = percentage of total body surface area
ABA = American Burn Association
ACS-COT = American College of Surgeons Committee on Trauma
CI = confidence interval
ICD-9 = International Classification of Disease, 9th Edition
LOS = length of stay
NBC = nonburn center
NBR = National Burn Repository
NCHPDS = North Carolina Hospitals Patient Data Systems
OR = odds ratio
UNC = University of North Carolina
VBC = verified burn center
WFUBMC = Wake Forest University Baptist Medical Center

these data represent only 60% of hospitalized burn injuries. Investigation into the care of burn patients is necessary not only for improving the quality and accessibility of burn care today from a systems perspective, but also to reduce resource-intensive care for less capable facilities, ensure appropriate long-term follow-up for burn patients, and prepare for disaster management. Our goal was to analyze the effectiveness of regionalized burn care and potential benefits of burn center verification by examining referral patterns, potential demographic discrepancies, and outcomes of patients admitted to verified burn centers (VBCs) and nonburn centers (NBCs) in North Carolina over a 7-year period.

METHODS

Using the North Carolina Hospitals Patient Data System (NCHPDS), we performed an analysis of all patients sustaining burn injuries who were discharged from North Carolina hospitals over a 7-year period encompassing federal fiscal years 2001 to 2007 (ie- 10/1/2000–9/30/2007) . The NCHPDS includes detailed medical/surgical information and demographics on all North Carolina inpatient discharges using International Classification of Disease (9th Edition; ICD-9) codes and deidentified information, respectively. By law, 109 total hospitals submit all of their discharge data for inclusion in this system, with 2 of these hospitals being VBCs: the Wake Forest University Baptist Medical Center (WFUBMC) Burn Center in Winston-Salem and the University of North Carolina (UNC) Jaycee Burn Center in Chapel Hill. This study was approved by the WFUBMC Institutional Review Board.

All patients with primary ICD-9 discharge codes for burn injuries, 940.0–945.59, were queried and identified from the NCHPDS. The following were then abstracted on each identified burn patient: demographic data to include age, sex, and ethnicity; burn distribution and severity using ICD-9 codes 946.0–946.5 and 948.00–948.99; presence or absence of inhalation injury; presence or absence of concomitant nonthermal injuries; preexisting comorbidities; payer status; length of stay (LOS); burn-specific operations performed; and discharge disposition. Then, by cross-referencing appropriate ICD-9 codes to the ABA burn center referral criteria (Table 1), patients were defined as either "meeting" or "not meeting" ABA burn center referral criteria. Patients not meeting ABA burn center referral criteria were excluded from further analysis. Only those patients meeting ABA referral criteria comprised the study population and were analyzed based on treatment at a VBC or NBC.

Table 1. American Burn Association Burn Center Referral Criteria

1. Partial thickness burns >10% total body surface area
2. Burns that involve the face, hands, feet, genitalia, perineum, or major joints
3. Third-degree burns in any age group
4. Electrical burns, including lightning injury
5. Chemical burns
6. Inhalation injury
7. Burn injury in patients with preexisting medical disorders that could complicate management, prolong recovery, or affect mortality
8. Any patients with burns and concomitant trauma, in which the burn injury poses the greatest risk of morbidity or mortality. In such cases, if the trauma poses the greater immediate risk, the patient may be initially stabilized in a trauma center before being transfered to a burn unit.
9. Burned children in hospitals without qualified personnel or equipment for the care of children
10. Burn injury in patients who will require special social, emotional, or long-term rehabilitative intervention

Basic descriptive statistics were calculated on all abstracted variables for patients meeting ABA referral criteria according to treatment location, VBC versus NBC. Continuous variables are reported as either mean ± SD or median, and they were compared by using Student *t* test. Categoric variables are reported as counts with percentages and were compared using the chi square test. All univariate statistical analyses were performed using 2-sided tests, with a p value of <0.05 determining statistical significance. Appropriate univariate analyses were done on the abstracted variables to identify factors individually associated with treatment at a VBC versus NBC.

Using propensity score techniques to account for missing percentage of total body surface area (%TBSA) burned data (ICD-9 codes 948.00–948.99), a multivariate regression model was constructed to more rigorously analyze those variables associated with the probability of being admitted to a VBC. Briefly, propensity score techniques are