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An Acute Care Surgery Model Provides Safe and Timely Care for Both Trauma and Emergency General Surgery Patients

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Background. **The impact by integration of emergency general surgery (EGS) with trauma in an acute care surgery model on the timeliness and quality of care in patients of each type at a high volume level I trauma center is still indeterminate. We hypothesized that trauma and EGS can be successfully integrated in an academic institution.**

Methods. **Retrospective review of prospectively collected trauma/EGS database was conducted at a high-volume, urban academic level I trauma center. Patients admitted to or requested consultation from trauma and EGS services were included. We explored the covariates affecting time to operating room (TOR), morbidity and in-hospital mortality rate.**

Results. **There were 1794 trauma patients and 1565 EGS patients identified over a 6-month period. Linear regression models failed to demonstrate a correlation between TOR and surgical team workload (WL), injury severity score (ISS), and caseload for the operating room staff and facility. While lower TOR, Glasgow coma scale, ISS and age were associated with an increased likelihood of complications, WL did not correlate with the occurrence of complications. TOR and surgical team WL had no association with death in trauma patients. The occurrence of complications was associated with a nearly 8-fold increase in the risk of death (odds ratio 7.56, 95% confidence interval [CI] 1.49–39.32, $P = 0.02$).**

Conclusion. **Increased workload during combined trauma/EGS call in an acute care surgery model did not affect the TOR nor worsen patient outcome. Implementation of a trauma/EGS model is justified even in high-volume academic institutions, if appropriately staffed and resourced.**

Key Words: **acute care surgery; trauma and emergency general surgery; workload.**

INTRODUCTION

The work life of trauma surgeons has changed dramatically over the past few decades in many academic centers. In the past, trauma surgery was considered a highly desirable specialty of surgery because of its significant high acuity operative volume [1]. However, in the 21st century, the number of both operative blunt and penetrating trauma cases has decreased. Furthermore, most blunt intra-abdominal solid organ injuries are now managed expectantly [2, 3] and complex thoracic or vascular procedures are often performed by surgical specialists [4, 5]. As a result, fewer applicants have been selecting careers in trauma surgery and existing trauma faculty often have been understaffed, while performing fewer operative cases [6]. Concomitantly, surgical super-specialization has resulted in a dearth of academic surgeons willing and able to participate in general surgery cases, particularly in emergent settings.

The recently described surgical specialty, "acute care surgery" consisting of trauma surgery, surgical critical care, and emergency general surgery (EGS) has been proposed as a remedy to the issues described above. Since the American Association of Surgery for Trauma (AAST) and other surgical societies have defined the

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curriculum of this specialty, the practice style of particularly academic trauma surgeons is presumed to be moving toward the combination of trauma and EGS [7]. Several reports from high-volume level I trauma centers have answered to the question, "Can this change make trauma surgery more attractive?" Their attempts have successfully increased trauma surgeon's operative experiences and improved their satisfaction [8–10]. Moreover, 2-acute care surgery fellowships are expected to function as models for the leaders of next generation in this area [11, 12].

On the other hand, academic medical centers will be challenged to safely staff and structure an acute care surgery service. The resultant workload increase by combining (trauma and general surgery) services could result in a potential adverse effect on patient care with limited human resources and operating room (OR) availability. Although prior studies focusing on trauma patients did not demonstrate an adverse effect of patient load on outcome in a busy level I trauma center, the effect of additional different types of patient load is still unclear [13].

The purpose of our study is to investigate whether an integrated acute care surgery style of practice negatively affects patient throughput and outcome at a high-volume academic institution. We hypothesized that a combined emergency general surgery (EGS) and trauma service at a high volume academic level I trauma center could be managed safely without negatively impacting patient throughput and outcome.

MATERIALS AND METHODS

Data were prospectively gathered on consecutive trauma and selected EGS patients over a 6-month period at a high-volume, academic urban trauma center. Parkland Health and Hospital System consists of a 685-bed hospital serving greater Dallas County and is a level I trauma center admitting, on average, 5000 trauma patients annually. The on-call trauma and EGS services share an attending and an acute care surgery fellow/chief resident staff coverage and have 24-h OR access. A back-up attending surgeon takes home call for 24 h. Additionally, there are at least three on-call postgraduate year (PGY) 1, 2, and 3 residents dedicated to the trauma service and three PGY 1, 2 and 3 residents for EGS. Additional midlevel practitioners provide daytime staffing. Both trauma and EGS patients are managed in the surgical ICU (SICU) as needed. This 40-bed, closed-type SICU is run by dedicated intensivists (who include trauma surgeons) and residents who provide staffing without additional OR or ER duties. ICU attending surgeons were available for consultation from ICU if on call trauma/EGS attending was occupied. While acute limb ischemia was dealt by vascular service, gangrenous limb, which required amputation, was taken care by EGS service. Thoracic surgery service managed complex thoracic emergency case.

Only EGS consults for appendicitis, acute cholecystitis, bowel obstruction or perforation, and abscesses/necrotizing soft tissue infections were selected for study of TOR and complications, as these were most likely to benefit from urgent operative intervention. For example, we excluded patients with biliary pancreatitis as we intentionally delay these cases while laboratory values correct. In addition, we excluded all ICU procedures/consultation as this care is provided by a dedicated team of residents and faculty without the additional patient care responsibilities as described above.

Data for the trauma, EGS patients and complications are gathered in separate registries by dedicated registrars and monitored by physician process improvement (PI) directors. In addition to these data, the operating room registry was cross-referenced to confirm operative cases for the trauma and EGS services and to determine daily operative caseload for the OR. Data for demographics, time to OR from emergency department (ED) presentation (TOR) and complications were compared between trauma and EGS patients. The trauma patients were also characterized with injury severity score (ISS) and initial Glasgow Coma Scale scores, (GCS). Workload (WL) was defined as the number of combined trauma and EGS consults and operative cases per day. For example, each consultation counted as a workload value of one and each operative case also counted as a value of one. Thus, if a patient was seen in the ED and taken to the OR, they represented a workload value of two.

Differences between groups for dichotomous variables were compared using the Fisher's exact test, while those differences for continuous variables were compared using Student's t-test for unequal variance. Time to the OR was explored in a multivariate linear regression model. In a similar fashion, the occurrence of a complication or death was analyzed in a multivariate fashion using logistic regression modeling. Differences with P values less that 0.05 were considered significant.

RESULTS

From November 2007 through May 2008, we gathered data on a total of 3359 patients as described above. There were 1794 trauma patients of whom 411 required immediate operative intervention by the trauma team and 1565 EGS patients. A total of 635 EGS patients who did not meet admission diagnostic criteria were excluded, leaving 930 EGS patients for further study, with the above listed diagnoses of whom 537 required operative intervention. The mean GCS for the trauma patients was 13.4 (95% CI 13.2–13.6) and the mean ISS was 11.2 (95% CI 10.7–11.7). A total of 80 trauma patients died. Among the EGS group, 98 patients underwent surgery for appendicitis, 203 for acute cholecystitis, 71 for bowel obstruction/perforated viscus, and 165 for abscesses; no EGS patient died in the time period surveyed. The mean workload per day was 21.9 consults and operative cases, (95% CI 21.6–22.1, range 7–36 per day). The total number of cases for the OR per day for the institution averaged 34.2, (95% CI 33.6–34.8, range 2–58). The back-up surgeon was not deployed during this study period.

There were significant differences between the EGS and trauma patients with regard to age, gender, rate of operative intervention, complication rates, and mean span of time from presentation or consult to the operating room (Table 1). The EGS patients were older on average, (41.5 *versus* 39.8 years, $P = 0.008$) than the trauma patients.

Linear regression models were developed to explore the phenomenon of time span from presentation to the operating room. The contributions of surgical team workload, trauma injury severity, and caseload