



The Need for Transformation: A Challenge for Trauma Surgery

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With over 157,000 injury-related fatalities and nearly 11.5 million years of potential life lost in 2001,¹ traumatic injury remains a formidable challenge for medicine today. Fortunately, the field of trauma care has been rapidly advancing. Notable is the acceptance of nonoperative management of the trauma patient, which has become more prominent in the last decade.²⁻⁴ This changing standard of care has greatly impacted the surgical resident's experience in the field of trauma.^{5,6} The declining operative management combined with the newly enacted limitation of resident work hours and reimbursement deficits has raised concerns over the competence and recruitment of future trauma surgeons. To continue providing optimal treatment to the injured patient in the face of the rapidly evolving field of trauma care, a transformation is necessary in the training of future trauma surgeons. Several solutions have been proposed, and a consideration of the merits and limitations of each may serve as a catalyst for research and action regarding this need for transformation.

A Changing Field

Although organized civilian trauma systems have been developing throughout the second half of the twentieth century, only in the last twenty-five years have the benefits of organized trauma care been adequately recognized and implemented.⁷ Trauma surgery today is vastly different from the field at its inception. The recent changes in diagnostic modalities, reimbursement, and resident work hours are powerful contributors to the current state of trauma surgery.

As a result of innovations in diagnostic modalities, an increasing number of trauma patients with mild to moderate solid organ injury are being managed nonoperatively. The widespread availability of Computed Tomography (CT) scanning and ultrasound have replaced diagnostic peritoneal lavage (DPL) as the primary diagnostic tools in trauma.^{5,8} Previously, if DPL was positive the patient underwent an exploratory laparotomy. Many of these resulted in negative laparotomy findings and presented a host of complications in the guise of infection, wound management, and abnormal immune response with little benefit gained. Now, however, the non-invasive modalities of CT and ultrasound can detect free fluid, active hemorrhage, and the severity of injuries

sustained, allowing surgeons to discriminate candidates for nonoperative management.⁴ These patients are closely monitored and have a low risk of excessive transfusions, missed intestinal injuries, or delayed bleeding.⁴ Nonoperative management has since become the standard of care for stable patients with splenic, liver and renal injuries in the setting of blunt trauma.^{4,6,8} To provide perspective, the National Trauma Data Bank 2003 Annual Report shows that more than 80% of trauma patients from 1997 to 2002 presented with a blunt mechanism of injury. Furthermore, recent studies have suggested that nonoperative management is useful in specific subpopulations of penetrating trauma patients.^{2,3} Although not in widespread application, these studies, along with the field of interventional radiology, broaden the potential for nonoperative management of trauma patients with solid organ vascular injuries by utilizing pharmaceuticals to promote local and selective blood clotting and prosthetic intravessel devices that stabilize damaged vessel walls, known respectively as angioembolization and stenting.^{4,8} High frequency ultrasound has also shown promise as a method of vascular hemostasis in traumatic injuries.⁹ The increasing nonoperative management of trauma patients represents a major shift in the care for the injured and has emerged as a dominant and growing treatment strategy for trauma surgeons.

Trauma surgeons have experienced a decline in fiscal reimbursement in recent decades, due to the increasing involvement of subspecialties, particularly orthopedic surgery, neurosurgery, and radiology in the care of trauma patients. Despite the greater investment by trauma surgeons in terms of clinical time, a disparity exists between the reimbursement of subspecialty physicians and trauma surgeons.¹⁰ The discrepancy arises due to the greater time spent coordinating and delivering pre- and post-operative care, which is poorly or not at all reimbursed. In contrast, the involvement of subspecialties is almost exclusively spent performing procedures that are readily billable.¹⁰ These findings come from a sample consisting almost entirely of blunt trauma patients. In light of the commonly higher proportion of blunt trauma cases and the increasing nonoperative management of these patients, the inequity of reimbursement will only increase in the absence of rectification.

The limitation of resident work hours by the Accreditation

Council for Graduate Medical Education is a controversial change in the field of trauma surgery. When first suggested, the American College of Surgeons denounced the limitation of resident work hours in the field of surgery.¹¹ The movement began in the mid 1980s with the highly publicized death of Libby Zion, when the Bell Commission cited sleep deprivation and excessive work hours as a significant source of physician error—a conception that has since been severely challenged by the surgical community.^{12,13} Despite the debate, the limitation of resident work hours represents one of the most sweeping changes not only for trauma surgery, but also for medical education in general.

Implications

The implications of these changes have raised serious concerns in the trauma community. The emergence of nonoperative management and work hour limitations has led to decreased operative experience for surgeons in training. Citing this decline in experience, some have called into question the competency of future trauma surgeons. Others are concerned that as a result of low reimbursement rates the recruitment of future trauma surgeons will suffer.

Due to the diminishing exposure of operative trauma, concern regarding the technical competency and confidence of future trauma surgeons has spread.^{8,14,15} Engelhardt and colleagues found that general surgeons experienced a sixty percent decrease in thoracotomies and laparotomies over the last decade at their institution.¹⁶ This decrease represents not only a large decline in overall procedures, but more importantly, a lost opportunity to educate residents on techniques and pitfalls during these procedures. The Residency Review Committee for Surgery has recognized this shift in trauma management by decreasing the number of index operative trauma cases from sixteen to ten, and by requiring an additional minimum of twenty cases managed nonoperatively, under a new category of Major Organ Trauma No Operation Required (MOTNOR).¹⁷ Furthermore, a survey of residents by Barden et al. found that nearly half believed that the work hour limitations decreased their operative time.¹² Lewis suggests that trauma operative experience will be negatively impacted because of its non-elective nature, and argues that the institution of more didactic instruction is inadequate in addressing this problem.¹³ As surgical trauma patients become rarer, valid concern over the competency and confidence of future trauma surgeons, who are only required to manage ten trauma patients with major operative injuries during their residency, is raised. Will the trauma surgeons of the future, who have a background of primarily nonoperative management and less overall exposure to operative cases, be able to provide optimal care to the catastrophically injured patient requiring immediate and substantial surgical intervention?

While the technical capability of trauma surgeons cannot be underestimated, it may be irrelevant if current trends continue. As a result of the changing field of trauma surgery, there is a significant lack of interest in trauma as a career. The entire field of surgery has suffered a lack of new recruits. With the issues of lifestyle and the push for more generalists, the number of unfilled general surgical programs has risen from five in 1997 to twenty four in 1999.¹⁸ The field of trauma has borne the brunt of this problem, evidenced by only 58% of



Liver injury secondary to a stab wound to the lower chest on CT Scan.

trauma fellowship positions filled in 2002, a decline from previous years.^{14,19} The lack of operative experience has been a lament for many authors. In 2003 a multi-institutional study noted that the laparotomy rate for trauma admissions is near 5%, and may be less in centers that receive primarily blunt trauma.²⁰ Low operative experience combined with a high inpatient admission rate is cited as a major deterrent to a career in trauma.^{10,21} Similarly, the low reimbursement rate when compared to the high workload and numerous on-call hours makes trauma surgery an unattractive career choice in its current state.²² This myriad of factors threatens the field of trauma surgery with a troubling shortage of talented surgeons, thus jeopardizing optimal care to the injured.

Proposed Solutions

To address the legitimate concerns regarding the future of trauma surgery, several solutions have been proposed to maintain operative competency and increase the appeal of a career in trauma to young surgeons. These propositions all aim to transform the field of trauma surgery and have taken the form of new models and new training techniques, each with distinct merits and limitations. Highlighting these advantages and disadvantages may serve to catalyze further investigation into the need for a transformation in trauma surgery. One of the most popular models that have been suggested is that of the Trauma/Emergency Surgeon. Under this model, which reflects the current functioning of trauma surgeons in some institutions, the role of the trauma surgeon would be expanded to include care of all general surgical emergencies.¹⁴ The underlying principle is to increase the operative procedures performed by trauma surgeons, thereby maintaining their operative skills. Further, it is hoped that this increase in operative procedures will make the field more attractive to residents and result in better compensation rates.

Scherer et al. found that this model, when applied in a large urban trauma center, more than doubled the operations performed by trauma surgeons.²¹ However, to achieve this growth in operative experience, trauma surgeons had to admit twice as many patients as general surgeons with an elective practice, had to perform nearly a fifth of their operations at night, and had a significantly poorer payer mix than elective surgeons. This raises concern that while increasing the



A team approach is essential in complex operative trauma.

operative experience in favor of increasing surgeon competency, the increased workload, high nocturnal activity, and poor reimbursement remain as deterrents to young surgeons. The authors advocated pay for on-call time to offset the poor payer mix. They further argued that the increase in operative experience is sufficient to expand the number of trauma surgeons on staff, thus reducing on-call time for individual surgeons. This model is best served by urban academic centers where there is a steady supply of trauma and general surgical emergencies.²¹ In a rural hospital the volume of trauma and surgical emergencies may not be sufficient to warrant the trauma/emergency surgeon. This model successfully increases the operative experience and competency of trauma surgeons; however, if the high workload and poor reimbursement are not addressed, it does little to increase the attractiveness of the field.

A second model proposed is that of the trauma specialist. This model purports to focus interested residents narrowly into trauma, and includes surgical critical training, creating super-specialists in the care of critically injured patients.¹⁴ It is designed to reduce the number of trauma positions by further concentrating trauma care in regional trauma centers, creating a smaller group of elite trauma surgeons. In theory limiting trauma positions and further concentrating trauma admissions would reduce trainee competition for operative experience in trauma. The further hope is that the identification of trauma and critical care as a distinct practice would increase the attractiveness of the field as with the subspecialties of vascular and colorectal surgery. This is seen as an approach for attracting talented and competitive surgeons to a limited number of positions.

Support for this model comes from the acknowledgment of over-designation of trauma centers and the success of

the R. Adams Cowley Shock Trauma Center in Baltimore, Maryland.²³ The American College of Surgeons (ACS) verifies trauma centers based on in-hospital resources rather than regional needs, resulting in lower trauma admission rates for centers in areas of over-designation. In contrast, the Shock Trauma Center is a truly regionalized dedicated trauma center. Receiving more than 5000 trauma admissions annually from Maryland and surrounding states, surgeons are exposed exclusively to a high volume of trauma patients. This results in greater operative trauma experience and fosters committed leaders and researchers in the field of trauma surgery. Furthermore, although controversial, the appropriate regionalization of trauma systems has been implicated in improving patient outcomes.^{7,23} Despite these arguments, there are several drawbacks to this model. Reducing the number of positions in trauma will not necessarily translate into competition between talented surgeons, as evidenced by the high percentage of unfilled fellowship positions discussed above. Differing regional needs across the country may render this regionalization of trauma care inappropriate. The success of Shock Trauma suggests that such regionalization is suitable in densely populated areas with a well developed emergency medical system to support it. To achieve such regionalization would require significant logistical, political, and fiscal commitments. Moreover, the decrease in trauma positions and concentration of critically injured patients in regional centers would necessitate greater time commitment on the part of the training surgeon, thus becoming a potential barrier because of lifestyle concerns and resident work hour limitations. Finally, the trauma population tends to be a poor payer mix, as discussed above, and this model makes no attempt to rectify the reimbursement problems for trauma surgeons. While this model contains some attractive aspects for the field of trauma

surgery, it more likely represents a long term goal with limited areas of application that can adequately support it.

A third model proposed is the so-called European Model. In this model, trauma surgeons would have the credentials in performing orthopedic and neurosurgical procedures common in trauma patients.¹⁴ Trauma surgeons would spend an additional year of training in each subfield learning procedures such as external fixation, intracranial monitor placement, and burr holes.^{10,14} In doing this, trauma surgeons will be performing more operations, which would result in an increase in attractiveness and reimbursement rates for the field. Further benefits of this model include the continuity of care associated with a single surgeon operating on the patient and the ability to loosen ACS verified trauma center availability requirements on orthopedic and neurosurgeons. This appeals to some of these surgeons who have expressed dissatisfaction in caring for trauma patients.¹⁰

This model dominates trauma care in Europe, with noted success.¹⁴ However, there are several challenges that face the implementation of this model in the United States. This model adds operative skills to the inventory of the trauma surgeon instead of preserving skills in the staple of the trauma surgeon: abdominal surgery. This leaves unaddressed the concerns over trauma surgeon competency. Another issue is validation and accreditation for this extra training. With both orthopedics and neurosurgery under the direction of individual boards, care must be taken to respect the autonomy of the distinct specialties. Additionally, it is questionable that trauma surgeons could reach an acceptable level of proficiency in these fields with only an additional year of training in each, when compared to the residency length for orthopedic and neurosurgical residents. This presents the possibility for increased legal action in an arena where competency would potentially be controversial. Further, the additional two years of post-graduate training would be a deterrent to some. It is also conceivable that implementation of such a model would meet some resistance to established trauma surgeons who have no interest in expanding their practice. Although this model raises overall operative experience and serves the field of trauma surgery well in Europe, the specialties of neurosurgery, orthopedics, and trauma surgery have developed in the United States such that implementation of this model would be drastic and meet considerable resistance, requiring significant political and professional support.

In addition to the three models proposed, there has been support for new training techniques to boost surgeon operative competency and confidence. The value of interactive training in the management of trauma patients has been recognized since the advent of the Advanced Trauma Life Support course. Recent advancements in simulator technology have made possible the application of sophisticated computerized simulation modules in the field of trauma surgery. This often includes a lecture review of management principles followed by computerized human patient simulation scenarios, which several authors have supported as valuable training tools.²⁵⁻²⁸ In addition to identifying training weaknesses, these simulator courses have been shown to increase the confidence and knowledge of residents. While thus far restricted to initial patient management and critical care scenarios, it is possible to expand these simulators for use in operative management

scenarios for trauma, increasing operative knowledge and confidence in future trauma surgeons. The major limitation of this method is the lack of actual technical experience in computerized simulations.

Another proposed training technique is a trauma operative management course. This also includes didactic portions and is then followed by a live porcine operative experience. Similar studies evaluating this type of course found that an operative management course increased the knowledge, skills, and confidence of trainees and experts during operative management of penetrating swine injuries.^{15,24} This method again increases knowledge and confidence of surgeons when managing operative trauma, as well as addresses the lack of technical experience cited in the simulation training. The swine confronts the participants with the best approximation of the human scale and anatomy, and most report that the laboratory experience is sufficiently analogous to operative management of human trauma.¹⁵ This suggests that the best training method may be a combination of simulation and laboratory experiences. While addressing the concerns of trauma surgeon competency, these are not transforming models for trauma surgery and do not address problems in reimbursement. It is also unlikely that implementation of such training techniques will greatly increase the appeal of trauma surgery as a career. The merits of these techniques warrant their inclusion as a component in the overall transformation necessary in trauma surgery, rather than a stand-alone solution.

Conclusion

The goal of trauma care is to provide optimal care to the injured patient. To achieve this, the field of trauma surgery must attract talented surgeons and equip them to treat any pattern of injury they may encounter in their practice. Without the changes in management, reimbursement, and work hours, trauma surgery in its current state is falling short of these requirements.

Although a recent study found no significant overall mortality difference between high and low volume trauma surgeons, the authors noted that the effect of experience on mortality may lie in the management of specific injuries, and indeed the greatest difference in mortality was seen in the subgroup of patients presenting in shock with abdominal gunshot wounds.²⁹ This trend suggests that the true effect of experience on mortality may lie with patients requiring operative interventions. In addition to the likely effect on mortality, there is a potential for even greater effects of operative experience on outcomes, such as length of stay and intensive care unit days that may be valuable in characterizing the significance of trauma surgeon competency.

The literature has suggested several solutions that address the problems of decreasing operative experience, interest, and work hours in diverse ways, creating unique advantages and disadvantages for each. This renders it erroneous to assume that any one solution can enact the transformation that the field of trauma surgery requires. Instead, it is the responsibility of the trauma community to combine, tailor, and refine the proposed solutions in an effort to preserve the delivery of optimal care to the trauma patient.

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