

# Trauma Surgery and Acute Care Surgery: Evolution in the Eye of the Storm

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Once again, I have the honor to introduce this month's edition of the *Rhode Island Medical Journal* focusing on trauma surgery. Ten years ago,<sup>1</sup> in an article entitled "Care of the Trauma Patient: A Discipline in Flux," I wrote briefly of the developments affecting the management of injured patients as well as those who care for them. Since that time, the evolution of trauma surgery to Acute Care Surgery (ACS) continues and the ACS "model" has become the standard care model in most of the United States. The genesis of ACS is multifactorial and reflects a confluence of several external forces on the practice of trauma surgery.<sup>2</sup> As imaging technology and risk-stratified outcomes data became more refined, trauma surgery shifted away from routine operative interventions to treat most injuries to a more selective operative approach incorporating non-operative management (NOM). NOM was borrowed from pediatric surgeons who long ago established that children with some solid organ injuries, such as splenic lacerations, could be safely and effectively managed without surgical intervention.

Advances in medical imaging enabled trauma surgeons to better identify injuries and define populations of trauma patients who are appropriate for NOM.<sup>3</sup> Non-invasive CT angiography has by and large supplanted invasive angiography in the diagnosis of occult vascular injuries. Formal angiography is generally reserved for those patients in whom embolization will be necessary, particularly in cases of known solid organ injury where NOM is being attempted. Detailed risk-adjusted databases such as the Trauma Quality Improvement Program (TQIP) allow trauma surgeons to formulate data-driven treatment plans incorporating sophisticated outcomes data, which eliminates some of the uncertainty and variability that trauma surgeons routinely encounter.<sup>4</sup> TQIP is an essential component of trauma center verification and participation in the program is mandated by the American College of Surgeons (ACS), the national organization that accredits trauma centers. Unlike many administrative databases in healthcare, TQIP and several other surgical databases such as the National Surgical Quality Improvement Project (NSQIP) database, are risk-adjusted so that like patients can be compared across participating centers. These high-quality, risk-adjusted databases serve as the engine to drive quality improvement. The ongoing commitment to quality improvement attests to the fact that surgeons began the "quality movement" in healthcare more

than 150 years ago. At that time, Codman established his "end result system" that tracked patient outcomes as well as oversaw the first mortality and morbidity conferences, thus incorporating quality improvement into the practice of surgery.<sup>5,6</sup> Continuous quality improvement has been a vital function of the ACS Committee on Trauma for more than 60 years and it is often forgotten that the ACS helped create the Joint Commission on Accreditation of Hospitals.

One of the unintended consequences of NOM was that trauma surgery moved from a very operative profession to a more non-operative one, which led to an erosion of some of the surgical abilities of surgeons caring for trauma patients. Coincident with this development were changes in the practice of surgery with an explosion in sub-specialization, and less "old school" general surgeons, that adversely affected the ability of hospitals to staff their on-call schedules. Since all trauma surgeons are board-certified general surgeons, they quickly expanded their role to fill the void and many of them incorporated emergency general surgery into their daily practice. The majority of trauma surgeons are double-boarded in critical care, which empowers them to care for the sickest surgical patients, whereas some general surgeons may be hesitant to operate on critically ill patients. The incorporation of emergency general surgery into trauma surgery allowed many institutions to round out their call schedule and ensured that trauma surgeons maintained their sharp operative edge while also maximizing their clinical productivity. The burgeoning ACS movement became more solidified and had at its core three disparate but inter-related disciplines: trauma surgery, surgical critical care and emergency general surgery.

During the transformation of trauma surgery into ACS, a similar evolution affected surgical training of both general surgery residents and critical care fellows. The American Council for Graduate Medical Education (ACGME) duty-hour changes of 2003 had unintended adverse effects on the training and ability of general surgery residents to treat many common surgical emergencies that were formerly in the domain of general surgeons.<sup>7</sup> It became apparent that most graduating chief residents, particularly those choosing trauma surgery as their career, required additional training in emergency general surgery. By design, most surgical critical care fellowships are heavily focused on intensive care medicine, and while there are some opportunities for

operative rotations and experience, this was not enough to address the growing deficiencies in graduating surgical chief residents. To fill this gap in training, many surgical critical care fellowships added an additional year of training beyond the ACGME-approved year in critical care training. This additional year was focused on trauma and emergency general surgery and grew into Acute Care Surgery fellowships. These fellowships include advanced surgical training in vascular, thoracic, and hepatobiliary surgery to round out some of the perceived weaknesses in graduating chief surgical residents, as well as to prepare ACS fellows to practice as fully capable trauma surgeons. The governing body of these ACS fellowships was not the ACGME but rather the American Association for the Surgery of Trauma (AAST), which is the premier academic society of trauma surgery. Like ACGME accreditation, AAST accreditation of ACS fellowships requires a diverse didactic curriculum addressing traumatic and general surgery emergencies, in-service examinations, case logs, requirements for scholarly activity as well as continued re-verification of ACS fellowship programs through a rigorous review process incorporating site visits by teams of experienced reviewers.

Presently, most chief surgical residents choosing a career in trauma seek an additional two years of training in ACGME-approved critical care residencies and AAST-approved ACS fellowships, which renders them well versed in treating a wide range of surgical patients.<sup>8</sup> The initial iteration of ACS fellowships sought to address some of the problems that institutions experienced as previously discussed, namely the lack of physicians willing or able to take call due to sub-specialization, fear of medico-legal liability, or simply being spread too thin and overworked. The founders of ACS envisioned that ACS surgeons would fill some of that void through training in basic orthopedic and neurosurgical interventions; however, this never came to fruition due to resistance of the governing bodies of those respective disciplines, as well as fear of litigation and concerns about maintaining competency for low-volume, high-risk interventions. Now, many trauma centers and ACS surgeons perceive a lack of clinical support from vascular surgeons as vascular fellowship training has steadily moved toward endovascular approaches. Consequently, experience in open vascular surgery becomes much less common in general surgery residencies as well as in vascular fellowships.<sup>9</sup> Unfortunately, few traumatic vascular injuries are amenable to endovascular approaches, especially when the patient is hemodynamically unstable, so most require open operative repair. This may create the uncomfortable scenario where the vascular consultant may have less experience in treating the major vascular injury than the ACS surgeon requesting their assistance. Some trauma centers have sent fully trained ACS surgeons for formal training in vascular surgery so that they may serve as the continual in-house consultant to the ACS surgeons, but this is cost and time prohibitive. Based on

similar needs in the past, it is possible that ACS fellowships may incorporate an additional year of training dedicated to vascular surgery, which, in effect, will require a three-year time commitment following a general surgery residency. While it is hard to argue against duty-hour restrictions from the point of the trainee's quality of life and wellbeing, it is apparent that there have been some unintended and adverse effects on the quality of surgical education and training.

Perhaps no recent development has changed the practice of trauma and ACS more than the aging of the US population. Injury is the 7th leading cause of death for patients > 65 years.<sup>10</sup> A tide of aging Baby Boomers has inundated most trauma centers across the US. The leading trauma mechanism requiring admission has shifted from interpersonal violence and motor vehicle collisions to falls. Most of these are falls from standing. The unique aspects of caring for geriatric patients are discussed by **DR. ERIC BENOIT**, et al, in his article, "Geriatric Trauma." Rhode Island is no exception; in fact, the Rhode Island Trauma Center (RITC) at Rhode Island Hospital has one of the highest average trauma admission ages in the US at 61.3 years. In 2018, the RITC admitted 1,000 patients over the age of 80, and 353 of these patients were 90 years old or older. In response to this development, the trauma service has a collaborating geriatrician who is part of the trauma team and is an invaluable resource in the care of these patients. Once again, trauma surgeons have to adapt in response to new realities. End-of-life care has taken on huge importance in the practice of trauma and emergency general surgery. Unfortunately, very few elderly trauma patients arrive at the RITC with advanced directives. Families often state that this issue has never come up, which represents an immense opportunity for primary care physicians to reduce unnecessary care, suffering and health care expenditures.

The concept of frailty is paramount in the care of elderly patients. Recent studies demonstrate that frailty is far more important to outcomes than chronologic age.<sup>11</sup> Admission of geriatric patients to the trauma service is now an opportunity to assess frailty and reconsider prophylactic therapies such as anti-coagulation or anti-platelet therapies, as well as living arrangements and the need for additional resources for these patients. Often, anti-platelet or anticoagulants are discontinued in frail patients and thoughtful risk-to-benefit analysis of these therapies is best conducted in the ambulatory setting after the patient has partially recovered from the effects of injury and hospitalization. The number of approved novel anticoagulants and anti-platelet agents coming to market occurs at a dizzying pace and it can be difficult for trauma surgeons, and many other physicians, to keep abreast of these agents. **DR. ANDREW STEPHEN**, et al, reviews these agents and their impact on the care of injured patients in the article, "Anticoagulation and Trauma."

Many blunt trauma patients, particularly the elderly, are susceptible to rib fractures. The RITC admits nearly 1,000

patients annually with rib fractures, which speaks to the fact that the RITC is a primarily a geriatric and blunt trauma center. Advances in radiographic imaging, particularly three-dimensional reconstructions of the chest, allow the trauma surgeon to fully visualize fracture patterns as well as estimate loss of thoracic volume, etc. and are invaluable in preoperative planning for chest-wall stabilization or rib "plating." Rib plating represents an advance in technology that unites better radiographic data with open reduction and internal fixation techniques borrowed from orthopedic surgery. The indications for rib plating are still being elucidated but include flail chest, crushed chest, loss of volume, intractable pain, and pulmonary embarrassment. Rib fractures are particularly deadly in the elderly and their sequelae are often misdiagnosed as pneumonia by providers not well versed in their management. The RITC employs a multi-modality, multi-disciplinary approach toward managing these injuries, including intensive care admission for geriatric patients with blunt chest trauma. This approach has paid dividends with lower than expected mortality.<sup>12</sup> **DR. MICHAEL CONNOLLY**, et al, reviews the management of patients with thoracic trauma and rib fractures in the article, "Practice Makes Perfect: The Evolution of Blunt Chest Trauma."

Advances in technology are also opening new avenues for hemorrhage control, which is critically important since exsanguination remains the leading cause of death following traumatic injury. Retrograde endovascular balloon occlusion of the aorta or REBOA, has emerged as a rapid, bedside approach to temporize intra-abdominal or pelvic hemorrhage. REBOA is performed by trauma surgeons percutaneously at the bedside and can buy time while resources are mobilized to undertake operative or angiographic intervention. Tourniquets have transitioned from the battlefield into every day civilian life as have other hemorrhage control adjuncts such as hemostatic gauzes and topical agents. Damage control surgery, one of the major advances in trauma surgery of the last few decades, is now accompanied by damage control resuscitation developed and refined on the battlefields of Iraq and Afghanistan. This new approach to hemorrhage control and resuscitation is reducing trauma mortality rates across the United States and worldwide. **DR. TAREQ KHEIRBEK**, et al, discusses some of these new approaches in the article, "Advances in the Management of Bleeding Trauma Patients."

Trauma surgery and critical care medicine are experiencing a bit of an existential crisis as clinicians are asking not how to care for critically ill and injured patients, but rather should we treat them at all. The basis for these questions is the emergence of long-term outcome data highlighting the often dismal and devastating effects of the Post-Intensive Care Syndrome (PICS). PICS can leave lifelong cognitive, physical, psychological and social deficits after critical illness, especially sepsis.<sup>13</sup> This area remains a hotbed of research and debate. **DR. STEPHANIE LUECKEL**, et al, touches upon this controversial topic, focusing on Traumatic

Brain Injury (TBI) outcomes in the article, "Predicting Outcomes in Acute Traumatic Brain Injury (TBI)."

Trauma surgery continues to evolve in response to a multitude of external and internal forces. Care continues to become more complex and challenging as technology and big data affords new opportunities to intervene. However, we must never lose sight of the dedicated professionals who devote themselves to the care of injured patients and hopefully we will reduce the burden of trauma, the number one killer of Americans aged 1 to 45.

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