Care of the Trauma Patient: A Discipline In Flux

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It is an honor to introduce this month's *Medicine & Health/ Rhode Island*. Trauma and traumatic injuries are commonplace, yet most physicians fail to recognize the truly devastating impact of trauma. Trauma is the number one killer of Americans from ages 1 to 44 and accounts for 150,000 deaths and 3 million injuries annually. More Americans succumb to trauma over this period of time than die due to cancer, heart disease, HIV or pulmonary problems *combined* and more years of potential life are lost to trauma than to any other disease in the nation. Additionally, trauma is an indiscriminate killer, cutting across racial, ethnic, socioeconomic and cultural lines. Indeed, the trauma service at Rhode Island Hospital admits a true cross-sectional representation of the population of Rhode Island from all walks of life. This is in stark contrast to the mental image that many have when they hear the word "trauma."

Trauma surgery has experienced tremendous growth over the last few years, driven largely in response to the evolution of the basic structure of the health care system of the United States. An aging population, coupled with a graying cadre of medical providers, a shifted focus to 'lifestyle" issues by most young physicians, a worsening medico-legal environment, along with changes in the financial climate all have served as powerful motors of change. Perhaps the biggest elements of change are the burgeoning medical and surgical sub-specialties combined with a dramatic increase in diagnostic technologies leading to non-operative management of many injured patients.

Previously, trauma surgery could be considered "general surgery" of the injured patient and reflected the diverse and varied practice of general surgery of that time. This practice was an extension of the training that general surgeons received in residency and covered thoracic surgery, head and neck, vascular, hepato-biliary, and gastrointestinal surgery, as well as basic plastic surgery. The trauma surgeon was regarded as the "master surgeon" who could operate effectively on the neck, chest, abdomen or any injured blood vessel.[1] Over time, the radical growth in new technologies, techniques, and concepts in these surgical subspecialties, coupled with a shift in training to post-graduate subspecialty fellowships, made it exceedingly difficult for general surgeons to be facile in all these areas. This changing practice was eventually codified as more subspecialties granted certificates of added competencies or additional board-certification. This is not to say that trauma surgeons were merely providing basic general surgery by default since their field also experienced the same tremendous growth in new technologies and techniques that impacted all of surgery. Some of this evolution in trauma surgery was bitterly earned in response to the devastation wrought by military and civilian, drug-related conflicts. In time, the concept of the "golden hour" or that crucial first hour following injury when timely medical interventions dramatically saved lives became recognized.[2] The American College of Surgeons declared that "trauma is a surgical disease" in order to entrench the central role of the trauma surgeon in the care of the injured patient.[2]

The changing face of trauma surgery coincided with changes in surgical critical care. Nearly 85% of surgical critical care surgeons are trauma surgeons. The basic philosophy of surgical critical care is that all aspects of critical care, both medical and surgical, are rendered by a surgeon with added training in critical illness. This surgeon manages the derangements in all organ systems and provides balanced care, never losing sight of what is best for the patient as a whole rather than what is best for a particular organ system. This management also recognizes the radical changes in human physiology that occur in response to surgical interventions and injury. Here too the new technologies demanded that the surgical critical care practioner embrace all these changes in order to render state of the art care. Trauma surgery became increasingly linked to surgical critical care because in no other practice of surgery did derangements in physiology occur with such frequency or severity. The practice of trauma surgery also became more of a continuum of care beginning in the emergency room, continuing through the operating room into the **intensive care unit (ICU).** This continuum became even more pronounced with the emergence of bedside surgery in the ICU and staged or abbreviated laparotomies or "damage control surgery."[3]

Damage control surgery grew out of the realization that staying in the operating room until all injuries were definitively repaired often led to the death of the patient due to irreversible hemorrhagic shock, coagulopathy, hypothermia and acidemia. This cycle of bleeding leading to acidosis and hypothermia, compounding dilutional and consumptive coagulopathy, resulting in more bleeding, etc, became known as the "death spiral" and the presence of hypothermia, acidosis and coagulopathy as the "deadly triad."[4] The deadly triad must be avoided at all costs even if that meant having to return to the operating room in a day or two to complete the operation. Staged laparotomy or damage control became the "law of the land" in trauma surgery and led to a dramatic reduction in mortality of the most seriously injured patients. The goals of damage control are: first control hemorrhage, second limit contamination and third, preserve function and prevent further injury. The practice of damage control surgery had such a profound impact on operative mortality that it has now extended into all of general surgery whenever a patient's physiology has become so deranged that spending any additional time in the operating room would jeopardize the patient's life.

Perhaps no development has had a greater impact on trauma surgery than advanced radiological imaging. Previously the abdomen of the bluntly injured trauma patient was best considered a "black box." Physical exam of the patient who was inebriated or altered due to closed head injury was of little value. Plain x-rays were of limited utility and intravenous pyelograms, tomograms, and the like were seldom helpful. "Exploratory laparotomy" was commonplace; accordingly, trauma surgery was very heavily operative in nature. The development of **diagnostic peritoneal lavage (DPL)** by Root, et al in 1965 represented a quantum leap forward in the evaluation of the abdomen of the blunt trauma patient.[5] This technique, consisting of a peritoneal aspirate through an intra-peritoneally placed catheter followed by a lavage of the abdomen with a liter of saline that was then analyzed for a red blood cell count, became a highly sensitive test for intra-abdominal hemorrhage. DPL

reduced the number of true abdominal exploratory laparotomies but led to many non-therapeutic laparotomies due to its high sensitivity to detect intra-abdominal blood stemming from minimal injuries. Today CT scanning has largely replaced DPL in stable patients, and ultrasound has replaced DPL in unstable patients.

(FAST) focused abdominal ultrasound for trauma (a.k.a. focused assessment with ultrasound for trauma) has largely supplanted DPL in evaluating the abdomen of the blunt trauma patient. FAST is readily available, can be done at the bedside, avoids ionizing radiation, is easily repeated and is non-invasive. Like all ultrasounds, it is largely operator-dependant and in some series has had a high incidence of false negatives; however, it has become an invaluable tool for diagnosing significant intra-abdominal hemorrhage as a source of a patient's hemodynamic instability. Dr. Daithi Heffernan discusses the impact of technological evolution in "Advancing Frontiers in the Care of the Trauma Patient." He expands upon DPL, FAST, latest generation CT scans and other diagnostic and therapeutic modalities as well as other new and emerging technologies.

Presently, most solid organ injuries in stable patients are managed without surgery; this has shifted the practice of the trauma surgeon away from a primarily operative specialty to a non-operative, critical care-based specialty. The high-resolution, multi-detector CT scans has changed trauma surgery to a less invasive, critical care oriented practice that is arguably more complex due to the many treatment options available beyond straightforward surgical interventions. Interestingly, pediatric surgeons led the way. In "Pediatric Trauma Surgery: Understanding When NOT to Operate," Dr. Jeremy Aidlen recounts the pediatric surgery experience with non-operative management of splenic injuries and alludes to the expansion of non-operative therapy to adults for nearly all solid-organ injuries as long as the patient remains hemodynamically stable. The paradigm shift from a heavily operative to a non-operative specialty continues to drive most of the recent changes in the field of trauma surgery and has led to a significant reduction in the number of surgical residents choosing Trauma/Critical Care as a career choice.

As I stated, many feel the specialty of trauma surgery is in jeopardy. A recent president of the **American Association for the Surgery of Trauma (AAST)** remarked in his presidential address that "The specialty of trauma is in trouble!"[6] He cited the long work hours, in-house call, negative "lifestyle issues," reduced reimbursement, high medico-legal risks, disruption of elective practices, and loss of prestige. Some anxious voices have called trauma surgeons "clearly an endangered species"[1], "gasping for air" and "in danger of becoming extinct."[7] While many of the factors affecting trauma surgery on a national level are at play in Rhode Island, the state is served by an institution, Rhode Island Hospital, committed to the care of critically ill and injured patients. Furthermore, the state has an effective trauma system, even though it is not a truly definitive, regionalized system for integrated trauma care. In "The evolution of the Rhode Island trauma system: Where do we stand?," Dr. Shea Gregg describes the Rhode Island trauma system. He discusses one of the darkest nights in the history of the state of Rhode Island: the "Station Nightclub" fire when the nascent Rhode Island trauma system was forced to respond to a mass casualty. Dr. David Harrington, Chief of Burn Surgery at Rhode Island Hospital describes the advances in burn care and burn surgery that led to that response in "Burn Injuries and Burn Care."

Lastly, in "Trauma Care in the Elderly," Dr. Matthew Kozloff offers practical advice for caring for elderly patients that all physicians should heed in order to minimize the risk of trauma in this vulnerable population. While many people imagine a "trauma patient" as a young male, caught in a violent altercation involving a knife or gun, in fact fall is the main mechanism of injury among patients admitted to the Rhode Island Hospital Trauma service. Falls in the elderly account for 70% of accidental deaths in persons 75 years of age and older.

Perhaps the biggest change in trauma surgery is the concept of **Acute Care Surgery (ACS)**. Conceptually, ACS is based on three broad concepts: Patients continue to need access to emergent surgical care in an era of decreasing availability of on-call surgeons, the costs of maintaining a full panel of on-call surgeons is becoming financially untenable and many institutions struggle to fill their panel of on-all surgical specialists. Furthermore, attracting residents to the field of trauma surgery and keeping their operative skills sharp in the face of ever-increasing non-operative management is difficult. In the fullest sense of the ACS model, the in-house trauma surgeon would be capable of a complete spectrum of surgical procedures including vascular, thoracic, abdominal surgery as well as provide critical care services but in addition would perform basic neurosurgical and orthopedic procedures.[8,9] Such a model would expand the operative volume of the trauma surgeon beyond the old boundaries and would spread into many new disciplines. A detailed discussion of ACS is beyond the scope or purpose of this article but it is indicative of the radical changes sweeping the field of trauma surgery.

In summary, trauma surgery is at the crossroads. The old mental images of the surgeon or trauma patients are no longer applicable. This series of articles should serve as a brief introduction to the many profound changes occurring in the field of trauma.

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