

Trauma and anesthesia care

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The Anesthesia Care Team is an essential component in trauma care, being involved in many steps along this chain of care, starting with Emergency Medical Services (EMS) from the injury site through transport to the facility-based surgical site, and again at various points in the continuing surgical care of the patient in the aftermath and rehabilitation from trauma. We, therefore, as perioperative physicians, need to understand the medical problems of trauma, be expert in anesthesia care for trauma victims in all phases of care, including critical care, supporting failing organ systems, where failure is engendered by the inflammatory lesion accompanying trauma and resuscitation. This lecture will attempt to review some of these aspects in light of my own practice at Detroit Receiving Hospital, Detroit, Michigan, a major Level 1 Trauma Center for our region of our state serving a population of around 5 million in Southeast Michigan.

THE PROBLEM

Worldwide there are 5.8 million deaths annually from traumatic causes. Trauma causes 10% of all deaths in the world and is the sixth leading cause of death. 90% of trauma deaths are seen in low and middle income countries, where in trauma deaths may exceed 275 deaths per 100,000 inhabitants. Deaths from trauma in more advanced economies are less than one tenth of this figure, around 25 deaths per annum, per 100,000 inhabitants. Why is this disparity present⁽¹⁾?

The World Health Organization (WHO) held a forum in 2000 to form a global alliance to promote violence and injury prevention and essential care. They then promoted a model trauma system policy incorporating four major elements: Oversight, Pre-Hospital Care, Facility-Based Trauma Care and Surveillance⁽²⁾. The American College of Surgeons has for many years promulgated an Advanced Trauma Life Support training program for trauma team members, and there has

fairly recently been the publication of a multi-disciplinary text dealing comprehensively with these issues^(3,4). An absence of such an organized system for dealing with trauma is an obvious cause for a disparity in outcome.

In Mexico, Arreola-Risa and colleagues in 2006, evaluated the trauma care capabilities of your nation against the standards set by the WHO in their «Guidelines for Essential Care». Having identified some deficiencies and areas needing improvement, they further identified low-cost ways to strengthen trauma care in Mexico, and highlighted the usefulness of the WHO guidelines in providing a standardized template by which to assess national or regional trauma care capabilities. Continuing efforts are obviously needed worldwide, particularly in low and middle-income countries, excluding Mexico and most of South America^(5,6). The other major cause for disparity in outcomes is, of course, the level of violence within a community.

TRAUMA SYSTEMS—PHASES AND STEPS

The WHO in 2004 provided a Trauma System Maturity Index, Levels I – IV, addressing:

- Pre-Hospital Trauma Care – going from no map of these resources nor formed EMS or communication system at Level 1 up to a fully developed regional EMS, with a national universal access phone number and legislative support for sustainability at Level IV.
- Education and Training of Medical and Paramedical Personnel – going from Level I, no identified health personnel to provide primary trauma care in the community, up to Level IV with standards for, training in and licensure of renewal mandated for paramedics and teams in the community, providing primary trauma care.
- Facility-Based Trauma Care – going from Level I with no secondary or tertiary medical facilities nor staff clearly

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accountable for trauma care; going up to Level IV, wherein there is a clear regional plan, which accredits and verifies hospitals and their medical staff as capable for providing advanced trauma care at levels designated within that community.

Finally,

- d) Quality Assurance – with Level I showing no attention to outcomes and Level IV having formal CQI in place, to not only report outcomes but to initiate FOCUS–PDCA cycles to permit continuous improvement.

We, as anesthesiology leaders in our medical communities, must continue to urge that our local communities all achieve Level IV competencies in trauma care. One of my personal heroes in this regard is Dr. Roger D. White, an Anesthesiologist at the Mayo Clinic in Rochester, Minnesota, who has focused a large part of his professional effort as an active Cardiac Anesthesiologist on advancing Emergency Medical Technician (EMT) training in his own community, improving first responder care.

ANESTHESIA CARE FOR TRAUMA

In approaching the facility-based phases of trauma care for the Anesthesia Care Team, I wish to address three questions:

- 1) What is essential or what matters most? 2) What's new? and 3) What's coming in the near future?

WHAT MATTERS?

Three things kill quickly. These are the lethal triad of hypoxemia, hypovolemia and hypoperfusion secondary to cardiac pump failure. One must address these in all aspects of care, and are ours as the poisoner/protector during surgical repair. Also in the realm of the Anesthesiologist are the major issues complicating immediate recovery: Multiple Systems Organ Failure and Inflammation engendered by sepsis; the hypercoagulable state with increased risk for venous thromboembolism; and, finally, the sequelae from uncontrolled pain or its overtreatment – with limitation of mobility, inhibited or depressed breathing and coughing efforts and lack of sleep.

WHAT'S NEW?

Dr. Thomas Scalea from the Shock Trauma Center in Baltimore provided an excellent summary of advances in the «past» 10 years from 1992 to 2002. He listed Hypotensive Resuscitation prior to definitive control of bleeding, maintaining a mean blood pressure of 50 mm Hg, limiting rapid transfusion in this phase first, use of ultrasound in evaluating blunt abdominal trauma, the FAST exam came second, with use of ultrasound in evaluating penetrating trauma third, and CT scanning for

Aortic Injury fourth. Fifthly, he placed Non-operative Management of Blunt Solid Visceral Injury and finally, he addressed Geriatric Injury and its special considerations⁽⁷⁾.

These considerations have not changed markedly in the second decade to the present and his remarks remain highly relevant. His outline of five phases in Damage Control from injury remains absolutely current.

This five phase protocol has been adopted by our own group of trauma surgeons in Detroit Receiving Hospital, leading to a recent ranking by the AARP as one of the safest hospitals in America. Phase I involves control of hemorrhage and rapid ED Assessment. Phase II is damage control to stop bleeding and control any gastrointestinal contamination. Phase III allows secondary resuscitation for 24 to 48 hours in an ICU setting with full supportive care capability. Phase IV is definitive surgical repair which may require multiple teams and surgeries. Phase V is reconstruction and rehabilitation directed again by expert teams, but usually in a Specialized Facility apart from the Acute Hospital.

WHAT'S COMING?

The risks of Acute Lung Injury (ALI) and multiple systems organ failure (MSOF) and/or of hypercoagulability and VTE are markedly increased in the trauma patient. Recent studies have focused on the inflammatory lesion associated with trauma. One study of note has suggested that antiplatelet therapy is associated with decreased transfusion associated risks of ALI, MSOF and Mortality in trauma. A second study has attempted a genomic metric that can possibly be used to predict outcome in severely injured trauma patients. 63 genes were identified whose leukocyte expression differed between complicated and uncomplicated clinical course over the 28 days following trauma. These lesions creating this complicated course with morbidity and mortality associated are inflammatory in origin, often involving both platelets and leukocytes and thus this area is ripe for new therapeutic regimens, which may favourably affect outcomes in the future^(8,9). Pain control is a key also in this arena.

SPECIAL PROBLEMS

Traumatic Brain Injury (TBI) deserves special consideration because of its prevalence and potentially devastating effects. TBI is involved in and causes ~ 30% of all trauma related deaths. Reduced death rates from TBI have been noted largely related to prevention, with widespread use of seatbelts, airbags, child safety seats and motorcycle helmets, all leading to reduced rates of head injury in motor vehicle accidents. Falls however remain the major cause for TBI worldwide, and violence is also a factor. Improvements in management for TBI relate to use of standardized regimens based on outcomes data and Cochrane's methodology⁽¹⁰⁾.

PEARLS AND CONCLUSIONS

Focus on outcomes and continuous quality improvements in regimens of care, together with continued basic research on the genesis and management of the inflammatory response,

with control of infection, are the hopes for future improvements in trauma care.

Better modalities for pain management and their appropriate application through all five phases of care for the trauma victim may also be a key for improvement into the future.

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