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- EFFECT OF ORGANIZED SYSTEMS OF TRAUMA CARE ON MOTOR-VEHICLE CRASH MORTALITY
- RELATIONSHIP BETWEEN TRAUMA CENTER VOLUME AND OUTCOME
- TRAUMA PATIENT IN AN URBAN COUNTY HOSPITAL: BENEFIT OR BURDEN?
- EFFECT OF PRE-HOSPITAL TRIAGE TO A LEVEL I TRAUMA CENTER VS. A LEVEL III/IV TRAUMA CENTER
- PROSPECTIVE RANDOMIZED CONTROLLED TRIAL OF ANTIOXIDANT THERAPY IN CRITICALLY ILL SURGICAL PATIENTS

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Effect of Organized Systems of Trauma Care on Motor-Vehicle Crash Mortality

During 1976 through 1995, 22 states developed organized systems of trauma care with the intent of reducing injury-related mortality. Despite calls for wider national implementation, the effectiveness of an integrated approach to trauma care at a regional or state level remains unproven.

This study was designed to assess the impact of trauma system implementation on mortality due to motor-vehicle crashes across the United States between 1979 and 1995. The primary endpoint was the rate of death of front-seat occupants of passenger vehicles aged 15 through 74. Crash rates were compared before and after trauma system implementation in states with

crash mortality of 13% (95% CI, 9-16%) while relaxation of state speed limits increased mortality by 6% (95% CI, 3-9%). These data suggest that implementation of an organized system of trauma care reduces deaths due to motor-vehicle crashes. The effect takes several years to manifest, a finding that is consistent with the maturation and development of trauma triage protocols, inter-hospital transfer agreements, organization of trauma centers, and ongoing quality assurance.

Relationship between Trauma Center Volume and Outcome

The premise underlying regionalization of trauma care is that optimal outcomes can be achieved at greatest efficiency if care is restricted to relatively few dedicated trauma centers. Implicit in this premise is that higher patient volumes will lead to greater experience and this

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organized systems of trauma care. After controlling for secular trends in crash mortality and implementation of traffic safety laws (restraint laws, maximum posted speed limits, laws designed to limit drinking and driving), trauma systems had a significant impact on deaths due to traffic crashes. Eight years following initial trauma

system implementation, mortality due to traffic crashes began to decline; about 15 years following trauma system implementation, mortality was reduced by 9% (95% CI, 2-15%) (Figure 1).

By contrast, legislative initiatives geared toward enforcing restraint laws result in an early reduction in

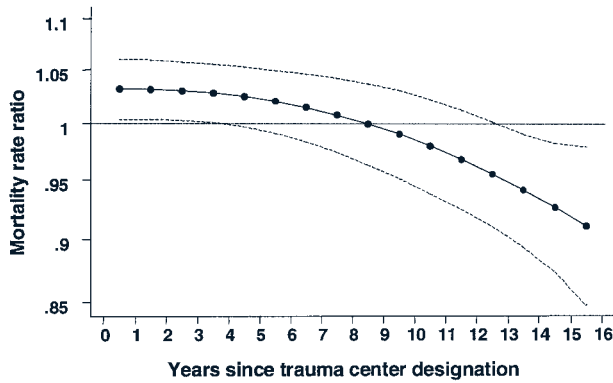


figure 1: Adjusted mortality rate ratio attributable to a trauma system as a function of time from first trauma center designation. The dashed lines represent upper and lower bands of the 95% confidence interval.

experience translates into better outcomes. This study evaluated the effect of trauma center volume in two distinct cohorts of patients admitted to one of 31 academic trauma centers across the country. These cohorts included patients with isolated penetrating abdominal trauma and patients with a combination of lower extremity long bone fractures and closed head injury.

The relationship between trauma center volume and outcome depended on the severity of illness. For example, there was no association between volume and outcome in penetrating abdominal trauma patients without shock or in blunt multisystem trauma patients without coma. However, in patients with shock or coma there was a marked reduction in the risk of death (Figure 2).

Similar advantages were also evident when hospital lengths of stay were assessed. The greatest benefits to these high-risk patients occurred when they were cared for in centers with greater than 650-700 major (ISS \geq 15) trauma admissions per annum.

In summary, these data provide further support emphasizing the importance of regionalization of trauma care, and provide guidelines for estimating the number of trauma centers required per unit population. Trauma system care should ensure triage of the most severely injured patients to relatively few dedicated trauma centers. Consideration should be given to consolidation of urban trauma programs to maximize institutional volume. Further work is needed to identify differences in the process of care, the impact of individual surgeon volume, the role of fellowship training programs, trauma research activities and other factors that may be contributing to the observed outcome benefit at high volume trauma centers.

Trauma Patient in an Urban County Hospital: Benefit or Burden?

The high cost of uncompensated trauma care is the principal obstacle to trauma system development. Designation as a regional Level I trauma center may burden an institution with an unprofitable mix of uninsured patients with severe injuries. This burden may weigh heavily on an inner-city hospital already taxed by the payer mix of non-trauma patients and may undermine the sustainability of large urban trauma centers. To assess the potential burden of the trauma patient on an urban Level I trauma center, we evaluated the payer-mix of trauma patients relative to non-trauma patients at different levels of trauma care in a mature trauma system. Patients admitted to hospital in the state of Washington over a two year period were classified as either trauma (ISS \geq 9) or non-trauma and by insurance status as either commercial insurance (CI) (e.g. managed care) or non-commercial insurance (e.g. Medicaid or self-pay). Medicare patients were excluded from analysis.

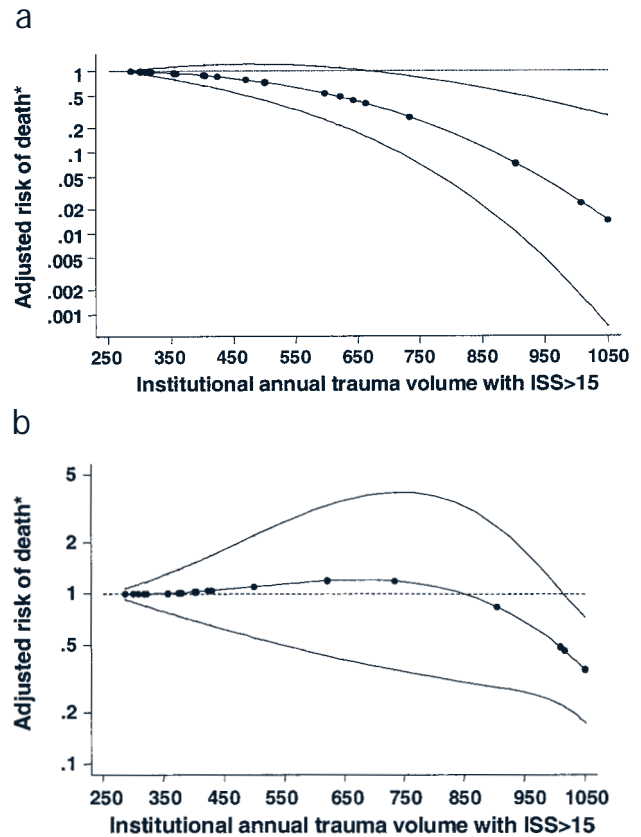


figure 2: Relationship of the risk of death to trauma center volume in patients admitted in shock with penetrating abdominal injury (A) and in patients with coma and multisystem blunt trauma (B). Lines without • represent 95% confidence bands for the estimated odds ratio.

*Adjusted risk of death compared to the lowest volume institution.

There were 10,386 trauma admissions and 474,944 non-trauma admissions to 87 centers. Trauma patients were less likely to have commercial insurance than non-trauma patients (69% vs. 74%, $p < 0.001$). The proportion of trauma patients with commercial insurance treated at the urban Level I trauma center was significantly less than at other centers. However, trauma patients treated at the Level I trauma center were far more likely to have commercial insurance than non-trauma patients treated at this same center (52% vs. 30%, $p < 0.001$). By contrast, there was no relationship between payer and trauma status at other levels of care.

These data suggest that referrals from across the state result in a disproportionate number of trauma patients with commercial insurance relative to non-trauma patients at this urban Level I trauma center. In this environment, designation as a Level I trauma center may actually improve care for inner city non-trauma patients by ensuring the ready availability of acute care services that follows designation as a trauma center and by means of cross subsidization of non-trauma care through trauma care reimbursement.

Effect of Pre-Hospital Triage to a Level I Trauma Center vs. a Level III/IV Trauma Center

Little is known about the effectiveness of regionalized, tiered trauma systems and whether clinical outcomes of trauma patients differ by the initial destination of the trauma patient. Level I trauma centers are designed to handle the most complicated and severe trauma patients, and Level III/IV facilities are designed to admit less severely injured patients and to stabilize severely injured patients before transfer to a Level I center.

The purpose of this population-based retrospective cohort study is to determine if injured patients who receive uniform care by pre-hospital advanced life support in the field, and who are transported directly from the field to a Level I trauma center, have better

outcomes than those who are transported from the field to a Level III or IV center, and then transferred to the Level I center. The cohort will be restricted to all patients injured in King County transported by an Advanced Life Support crew to one of 8 trauma centers in the county (4 Level IV, 3 Level III, 1 Level I) during the years 1995 to 1998. It is anticipated that the results and conclusions derived from this analysis will identify subgroups of patients who are best served by direct transport to a Level I as well as those in whom optimal outcomes are achieved by triage at the Level III/IV prior to transfer.

Prospective Randomized Controlled Trial of Antioxidant Therapy in Critically Ill Surgical Patients

Oxidant-mediated tissue injury induced by activated neutrophils or following ischemia-reperfusion injury is thought to be one of the key mechanisms leading to Acute Respiratory Distress Syndrome (ARDS) and multiple organ failure. This project was designed to evaluate the effectiveness of antioxidant supplementation in critically ill surgical patients admitted to the intensive care unit.

Patients were randomized to receive either standard care or administration of alpha-tocopherol (3000 units daily) and ascorbic acid (3 gms daily) for the duration of their ICU stay. Primary clinical endpoints are the development of ARDS and pneumonia. A subset of these patients underwent bronchoalveolar lavage to assess the impact of antioxidant supplementation on markers of alveolar injury (alveolar fluid protein and neutrophil content, and F_2 isoprostanes, a marker of oxidative tissue injury), the alveolar inflammatory response including alveolar cytokine levels, and markers of alveolar macrophage activation. Enrollment for this study has recently been completed after enrolling over 300 patients. Once available, the results should provide further insight into the role of oxidant-mediated tissue injury in the manifestations of critical illness.

RELATED PUBLICATIONS:

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