"The swinging pendulum" — the evolution of (Orthopaedic) trauma care. (An explanation of the controversies & analysis of the evidence.)

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Abstract

Serious trauma affects 48 000 individuals each year in England, of whom 20 000 have an injury severity score greater than 15. Annual mortality rates are reported at 5400, and 3000 for all those admitted to hospital.

Orthopaedic surgery accounts for over 50% of major trauma operating, and has seen changes in trends with time, from 'Early Total Care' (ETC) in the 80's, to 'Damage Control Orthopaedics' (DCO) at the turn of the century, and now 'Early Appropriate Care' (EAC). These changes have been driven predominantly by an enhanced understanding of the individuals' physiological response to trauma. Timing of surgery for the more severely injured is best guided by physiological parameters with the goal of providing definitive stabilisation of the axial skeleton or long bones within 36 hours provided there has been an adequate physiological response to trauma and resuscitation, otherwise damage control is sought.

The introduction of major trauma networks in England in 2012, each with a major trauma centre, has seen a new multidisciplinary approach to trauma management. The result of which has been an improvement in complication profiles, reduced hospital stays with reduced use of resources, and an overall reduction in mortality rates by between 15 and 20%.

Keywords fracture fixation; time factors; trauma physiology

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Introduction

Major trauma describes serious and often multiple injuries where there is a strong possibility of death or disability. The most common cause in England is blunt force, and the most common mechanisms are road accidents and falls. Penetrating trauma only makes up 2% of cases.[1]

The National Audit Office report in 2010 estimated 48 000 cases of serious trauma per year, of which 20 000 was classified as major trauma,[1] using the Injury Severity Score (ISS) >15 (Table 1). This leads to an estimated annual mortality of 5400 with 3000 occurring after admission [Figure 1].

Introduction of major trauma systems or networks have shown to reduce hospital mortality by 15–20%[2,3] which, on the basis of 3000 deaths in hospital every year, would suggest an additional 450–600 lives could be saved annually across England.

To address this, trauma care in England was reconfigured and, in April 2012, the Regional Trauma Networks were first introduced to enable the rapid and safe transfer of major trauma patients to the designated Major Trauma Centres (MTCs) throughout the country to provide a comprehensive level of specialised care. The MTCs are supported by local Trauma Units (TUs) who also provide ongoing services and rehabilitation to patients once their care is no longer acute. This reorganisation of care in England is having a significant impact on survival [Figure 1].

Orthopaedic trauma

The major trauma patient is highly likely to avail themselves of orthopaedic care, with bony injuries in 75% of patients with blunt trauma and 90% of patients with multiple injuries, and, orthopaedics accounts for 50% of trauma operations.[4]

The debate of when and to what extent to stabilise fractures in a severely injured patient has been going on for over a century. In 1919, in an address to the American College of Surgeons, given as thanks for the loan of 25 of their young surgeons during war efforts in World War I, Sir Robert Jones described that using the Thomas splint in the field reduced mortality in soldiers with femoral fractures from 80% to 20%.[5] This was said to "minimise shock" and heralded the research into relationships between stability, timing and outcomes.

Early total care

In the 1980's, as fixation equipment and techniques improved, Early Total Care (ETC) was advocated, where definitive surgical fixation was achieved at the index operation, typically within the first 24 hours after injury. This was thought to offer better pain control and allow for early mobilisation and physiotherapy. Improved outcomes and decreased post-operative complications were reported, especially in those involving the respiratory system,[6,7] and in those more severely injured. It became apparent that unstable long bone fractures contributed to secondary lung injury. Seibel et al proposed that the fracture haematoma itself served as a metabolic organ stimulating mediator release which could lead to multiple organ failure.[8] They believed early operative fixation was technically easier and exposed patients to the

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How to calculate injury severity score

- Six ISS body regions
  - Head/neck including C-spine
  - Face
  - Chest/thoracic spine
  - Abdomen/pelvic contents
  - Extremities/pelvis
  - External
- An Abbreviate Injury Scale (AIS) is used to grade the injury in each of these regions
  - 1 — minor
  - 2 — moderate
  - 3 — severe but not life threatening
  - 4 — severe, life threatening but survivable
  - 5 — severe, critical, survival uncertain
  - 6 — maximal, unsurvivable
- Only the THREE most severely injured body regions are included in the calculations
- The ISS is the sum of the SQUAREs of the three highest AIS grades
- Max score 75
- Automatic score of 75 assigned if any area scores a 6

Table 1

operative stress when nutritional and immunologic reserves were at their highest level.

Mortality was also shown to be improved with ETC, with Meek et al publishing a striking difference from 28.5% in their conservative group to 4.5% in their stable fixation group.[9]

The findings of previous studies, most of which had been retrospective, were consolidated by Bone's prospective, randomised paper[10] in 1989 who reported markedly reduced rates of fat embolism, respiratory distress and mortality in patients who underwent definitive stabilisation within 24 hours. Because of the study design and statistical analysis, this was felt to have provided a definitive answer [Figure 2].

Damage control orthopaedics

However ETC did not provide positive results in all cases. When subdividing the multiply injured patient cohort, certain subgroups of multiply injured patients had poorer outcomes with early surgery including those who also had severe head injuries[11,12] or those with severe chest injuries.[13] Additional patient populations at particular risk for complications from major operative procedures include those who were hypothermic, coagulopathic or haemodynamically unstable. Reynolds et al reviewed 424 of their patients who had a femoral nail and demonstrated that delaying operative treatment for several days did not seem to affect the patient's outcome including patients with ISS >18.[14] They theorised that any negative effects secondary to a fixation delay were offset by improving haemodynamic stability over that time.

In 2000 Scalea introduced the term "Damage Control Orthopaedics (DCO)"[15] where, in multiply injured patients whose physiological reserve may be exceeded, external fixators were used to temporarily stabilise long bone fractures (especially in the lower limb and pelvis) to: minimise operative time, heat and blood loss — potentially reducing secondary injury, especially to brain and lung, and rapidly transferring the patient to the Intensive Treatment Unit (ITU). Once physiologically stable they could return to theatre for conversion to definitive stabilisation.

Pape et al chronicled the changes from early total care to damage control surgery in their paper in 2002.[16] Over different time periods, different strategies of fixation were favoured in their centre, and the paper compared outcomes in the different time

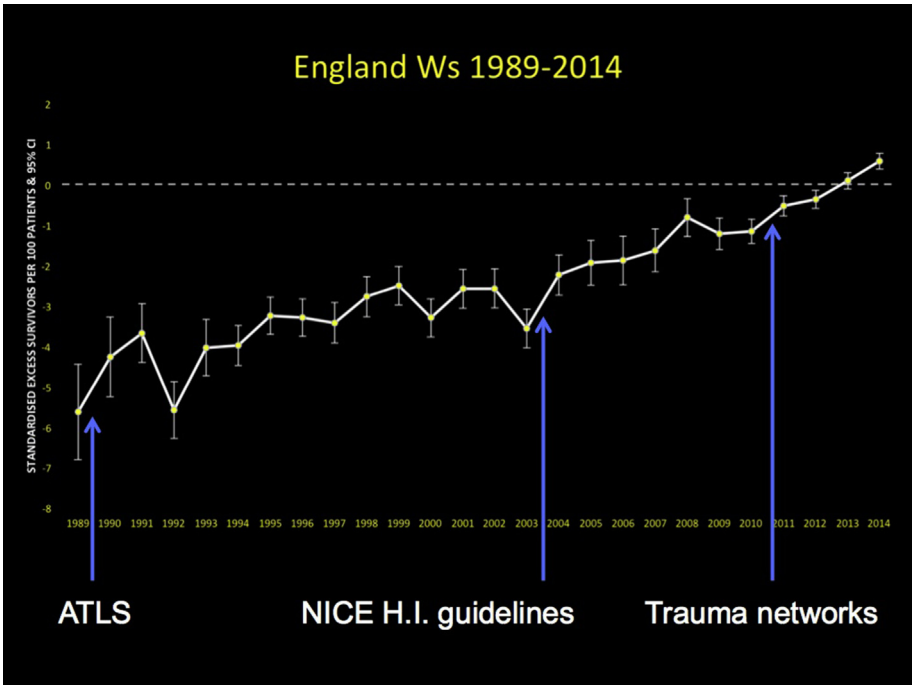

Figure 1 Odds ratio of survival in England following major trauma. Arrows showing introduction of guidelines and reconfiguration of trauma services. (TARN data from Prof C Moran, National Clinical Director for Trauma).

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