Managing trauma: The evolution from ‘early total care’/ ‘damage control’ to ‘early appropriate care’

90% of multiply-injured patients will have a bony injury, orthopaedics accounts for 50% of the operations undertaken, orthopaedic services are very much in the forefront of delivery.

The aim of the multidisciplinary approach is to identify the seriously injured patient and navigate them through their surgical needs without delay while adding as little as possible to their injury burden in terms of complications, particularly pulmonary problems. The term ‘early appropriate care’ was coined by Vallier et al [3] and is the practical voice of reason that supersedes the decade long debate over the place of ‘early total care’ and ‘damage control’ orthopaedics and is the method by which the MDT achieve their goal. This article outlines the chronology of the terms ‘early total care’ and ‘damage control orthopaedics’ and reinterprets the debate in the face of the latest studies.

A Tasker MB BS, MRCS
MB Kelly MBBS, MD, MRCS Eng, FRCS(Tr&Orth)

Background

The 70s and 80s saw the popularisation and success of fracture fixation. Early fixation of femoral fractures appeared to lead to better outcomes and decreased pulmonary complications [4]. Throughout the 80s multiple studies described better outcomes from early operative stabilisation of femoral fractures, resulting in the adoption of what became known as ‘early total care’ [4-8]. It was apparent that unstable long-bone fractures contributed to secondary lung injury. Early stabilisation offered the benefit of minimising on-going tissue damage, inflammatory activation and haemorrhage (‘stabilising the haematoma’) with the benefit of early mobilisation and reduction of the secondary lung problems. Most of the studies were retrospective until the publication of Bone’s landmark prospective randomised study of 178 patients [9]. Bone reported markedly reduced rates of fat embolism, respiratory distress and sepsis related mortality in patients who underwent definitive fracture stabilisation within 24 hours of admission. Delay in stabilisation after that time resulted in a five times greater risk of adult respiratory distress syndrome (ARDS). The argument became “patients are too sick not to have an operation to stabilise their long bone fractures” [10]. However during the following decade it became apparent that early stabilisation might be deleterious in a sub-group of patients, those that were haemodynamically unstable, or had concomitant chest or head injury [11, 12]. In 2000, Scalea et al [12] coined the term ‘damage control orthopaedics’ (DCO), borrowing from the general surgeons’ transduction of the military term [13]. The aim was to prevent exsanguination and death, rather than to definitively treat the broken bone. Stabilisation rather than fixation became the operative aim of the orthopaedic surgeon when faced with a severely injured patient in extremis. Pape et al [14] in his 2002 tribute to the lifetime achievements of Professor Tscherne then tried to better define groups of patients. The paper outlined an observed change of practice from 1981 to 2000 and identified a group that lay between the stable patient and the patient in extremis, named the ‘borderline’ patient in whom prolonged orthopaedic attempts at definitive care, particularly of the femur may lead to a ‘second hit’. This is where the inflammatory cascade is further activated by the surgical ‘insult’ resulting in...
Measuring Injury

Throughout the early total care and damage control era of orthopaedic management of the multiply-injured patient, quantifying the severity of the injury in terms of decision making remained problematic. Injury Severity Scores help to quantify the trauma ‘dose’, facilitate research and could correlate with morbidity and mortality. The injury Severity Score (ISS) is now the most commonly used and defines the criteria for transfer within the trauma networks in England. However, it is not specific enough to guide the orthopaedic decision making. Other more specific markers have been sought. Inflammatory cytokines, in particular Interleukin 6 (IL-6), appear to be robust in interpreting the trauma ‘dose’ in terms of the pathophysiological response [16]. The European poly-trauma study on the management of femur fractures (EPOFF) group have shown that levels differ with different severities of injury and in response to the surgery undertaken to treat those injuries [17]. However, measurement of cytokine levels is not readily available in the vast majority of trauma centres. Therefore other more readily available markers have been sought.

The ‘new’ focus - resuscitation

In 1999 Blow et al reviewed their trauma patients with ISS>20 and introduced the concept of end-organ occult hypoperfusion [18]. They noted a higher infection and mortality in those with occult hypoperfusion [19]. They applied these observations to their femoral fractures and reported a two-fold higher incidence of post-operative complications (50% versus 20%) in patients with normalised haemodynamic parameters whose serum lactate remained greater than 2.5 mmol/L at time of primary intramedullary nailing [20]. They concluded that adequate resuscitation reflected by a normalised lactate could act as a guide to the timing of surgical intervention. Focus therefore changed from seeking quantitative markers of tissue injury, which were proving difficult to implement at a practical clinical level, to markers of resuscitation. The orthopaedic literature had become too focused on fracture management techniques and overlooked the contributions from intensive care and anaesthetic resuscitative techniques applied to trauma which had also evolved hugely [17, 19]. In addition, experience...
Early appropriate care

Vallier et al. reported on a retrospective study of 1442 patients with pelvic, spinal and/or femoral shaft fractures in 2013 [21]. The aim was to define the injury or clinical parameters that warranted delaying definitive fracture fixation in relation to resuscitation and to determine the optimal timing of surgery. Statistical modelling was performed to develop cut-off values beyond which the probability of a complication diminished to an acceptable level (below 20%). In a patient responding to resuscitation measures, a lactate < 4.0 mmol/L, pH ≥ 7.25 or a base excess (BE) ≥ -5.5 mmol/L was indicative that they could proceed with definitive fracture care. They also found that the greatest predictor of pulmonary complications was chest injury. Failure to respond to resuscitation and normalise acidosis resulted in increased morbidity and mortality with lactate the most specific predictive measure. Presenting pH was lower, base excess worse and lactate levels higher in those that subsequently developed pulmonary and non-pulmonary complications. In their centre, DCO is reserved for those who fail respond to resuscitative measures within the first eight hours and definitive management timed for when these parameters normalise.

Vallier et al. concluded that the focus should be on ‘Early Appropriate Care’ (EAC) with definitive management of mechanically unstable fractures of the axial skeleton and long-bones within 36 hours of injury as long as the patient has demonstrated response to resuscitation as based on improvement of acidosis with lactate < 4.0 mmol/L, pH ≥ 7.25, or BE above 5.5 mmol/L.

Resuscitation and economics

On the basis of their findings, Vallier et al. instituted a standardised protocol to expedite definitive fracture fixation once patients are physiologically optimised. They compared the performance of multiple surgeries in one sitting to a staged approach over several days [21]. Although the complication profiles were no different; so long as they had been adequately resuscitated; those undergoing multiple sessions stayed an average of 1.4 days longer in the trauma centre. In an allied study, they undertook a prospective cost analysis study. In adequately resuscitated patients, those undergoing single session surgery were more efficiently treated and generated better incomes for the institution [22]. The implementation standardised protocol to expedite definitive fracture fixation reduced costs and enhanced the profitability.

Conclusion

It is no longer a question of ‘camps’. The duality of the traditional discussion has been superseded by ‘early appropriate care’: a more consistent focus on the physiological state of the patient and in particular the success of the resuscitative effort. No single physiological parameter or blood marker can as yet be used to guide intervention, but the accepted level of 2.5 mmol/L for lactate is likely too conservative and is being superseded by a more comprehensive and patient centred approach, focusing on physiological improvement and reversal of acidosis reflected by a lactate < 4.0 mmol/L, pH ≥ 7.25, or BE above 5.5 mmol/L.

By monitoring and maintaining the resuscitative effort, multiple injuries can be dealt with in one session in most of these patients. This results in an improved complication profile, shorter hospital stay, improved hospital income and much better use of hospital and operating theatre resources. At its core is a multi-disciplinary approach that evaluates the success of the resuscitative effort. No single physiological parameter or blood marker can as yet be used to guide intervention, but the accepted level of 2.5 mmol/L for lactate is likely too conservative and is being superseded by a more comprehensive and patient centred approach, focusing on physiological improvement and reversal of acidosis reflected by a lactate < 4.0 mmol/L, pH ≥ 7.25, or BE above 5.5 mmol/L.

Correspondence:

andrewtasker@doctors.org.uk
Michael.Kelly2@nbt.nhs.uk

References can be found online at www.boa.ac.uk/JTO or by scanning the QR Code
References

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