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PERSPECTIVE

Damage control surgery: Trauma

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Introduction

The damage control approach to severe injury has been adopted by most trauma practitioners. The concept is borrowed from naval warfare and is one that promotes rapid or temporising measures in the battlefield (i.e. damage control operation) to keep a ship (the patient) afloat such that the vessel can "limp" to safety or back to port (ICU), and thereafter definitive repairs can be planned and undertaken (relook operations). It was first described in Stone et al. in 1983, and replaced the technically correct but physiologically flawed approach of exposure, resection and reconstruction/repair of exsanguinating injuries, with the modern approach focused on temporary haemostasis, peritoneal pack tamponade, and rapid abdominal closure.[1,2] This new approach allowed for correction of the "deadly triad" of hypothermia, coagulopathy, and acidosis (since updated to include hypocalcaemia), such that the patient was in a physiologically better condition to withstand further operations for repair of all injuries.

Damage control principles, including both haemostatic resuscitation and damage control surgery (DCS), have been readily accepted by trauma practitioners worldwide. Senior colleagues cite many examples of patients bleeding "pink saline" whilst on astronomical doses of vasopressors, during prolonged operations where every possible injury was dealt with to completion, only to be followed by the inevitable "natural progression to death" after the completion of said operation. The status quo has improved since then. However, given the ethical challenges around randomising such acutely sick patients to a study arm for research purposes, and the difficulty in retrospectively assessing the appropriateness of a particular resuscitative or operative approach, there is little high-quality evidence to assist us in refining this new approach. As such, there is a need to actively consider the advantages and disadvantages of our practice, which will be attempted in the forthcoming sections.

Advantages of DCS

The predominant advantage of the damage control approach to severe injury is improved survival. This benefit is due to several reasons, both inside and outside the operating room. Two distinct concepts emerge, being damage control resuscitation and DCS. Although the two are not identical, for simplicity they are often combined into a single overarching concept. First, damage control resuscitation embodies several core principles – permissive hypotension, early resuscitation with blood and blood products guided by rotational thromboelastometry, prevention and treatment of hypothermia, and local measures to arrest external haemorrhage. A cross-over therapy between the emergency department and the operation room is resuscitative endovascular balloon occlusion of the aorta (REBOA), which although recently has been the subject of much debate, certainly offers the possibility of limiting non-compressible infra-diaphragmatic blood loss. Secondly, operative interventions include gauze packs, organ resection in selected circumstances, shunts for major vascular injuries, topical haemostatic agents, and a "clip-and-drop" approach for most enteric injuries, followed by temporary abdominal closure. Thirdly, ongoing resuscitation in ICU is aimed at guiding the patient back toward a state of physiological competence. Measures include mechanical ventilation, vasopressors, guided fluid therapies, correction of disorders of coagulation, management of electrolyte abnormalities, active warming, as well as supplemental nutrition. From this point forward, the process becomes more individualised, and comprises various permutations of relook operations for definitive repair of injuries, return to the ICU, and ultimately abdominal closure. These measures as a whole improve survival rates following major trauma, although severely injured patients still suffer high levels of mortality, with rates ranging from 11% to over 50%.[1-7]

Additional benefits of the damage control operative approach lie in the opportunity to check for injuries missed during the first operation and to facilitate further peritoneal lavage in the case of enteric spillage. Furthermore, in some patients a planned relook may detect an anastomotic leak early, prior to widespread enteric contamination and the accompanying peritoneal signs.

Disadvantages of DCS

Perhaps the most obvious disadvantages of the damage control approach to major trauma are increased workload and increased cost (ICU demand, repeated surgeries), and challenges surrounding the open abdomen. When considering these, we must remain cognisant of the reality that these factors are only a problem because the patient is alive to require care, and any misgivings must be viewed through that lens.

By design, all damage-controlled abdomens are closed temporarily, either by a commercial or a homemade system

depending on local practices. An in-depth discussion regarding open abdomens is outside of the brief for this discussion but suffice to say that the risk of ventral hernias, enteric fistulae and tertiary peritonitis are ever present and must be actively guarded against wherever possible. Local studies have confirmed international data that the best chance of achieving delayed primary sheath closure post damage control is with a combination of fascial traction and vacuum-assisted closure, and as such this should be our intention wherever resources allow.[8,9] One of the most effective methods to avoid enteric fistulae is by achieving sheath closure.

The repeated operations often required for definitive repairs, sepsis management, or sheath closure have certain benefits as mentioned above, but come at a cost. The patient must endure repeated anaesthetics, which is physiologically expensive in and of itself. In addition, they incur pain, discomfort and feed interruptions with each procedure. Additional operations place demand on surgeons, anaesthetists, nursing staff, and ICU staff, which, in most settings, places cumulative pressure on a system already under strain.

The costs of major trauma are significant, and much of this can be attributed to those patients who demand damage control measures. These are high demand patients who require significant man-hours, blood products, advanced feeding options, surgical consumables, and theatre time. Again, this must be viewed through the lens of decreasing mortality, however, we cannot ignore the reality of these pressures in our healthcare system.

Prolonged ICU admissions generate a whole slew of complications. While they do not necessarily arise directly from the damage control measures themselves, we cannot ignore them. These issues include nosocomial sepsis, decubitus ulcers, critical illness weakness, electrolyte and fluid issues, adverse events from invasive lines or mechanical ventilation, blood transfusion related morbidity, and the under-appreciated psychological and cognitive effects of and ICU admission on both the patient and the patient's family.

To be effective, damage control must be properly applied. Merely claiming to have done damage control is not enough; the procedure must be undertaken appropriately. In the author's opinion, damage control is too frequently used as an excuse to avoid making a decision or, worse, to deliver a half-hearted effort at the dreaded 3 am trauma laparotomy. Without doubt, well applied damage control measures in the appropriate patient improve survival outcomes, however, poorly indicated or inadequately applied damage control measures only serve to increase morbidity.[5,10] The indications for DCS are not always easy to delineate. While all trauma practitioners would agree that DCS is indicated when definitive surgery is ill-advised, the exact indications are challenging to define. It is imperative that surgical training repeatedly highlights that DCS is not a way to dodge doing a proper operation, but rather a deliberate strategy in select patients to allow the definitive relook operation to be a possibility.

Having considered the above advantages and disadvantages of DCS, one final aspect remains. The improved survival rates following major trauma which we so cherish must surely be followed by an uncomfortable question – how many of these survivors become re-integrated into society? Whilst it is certainly a success to avoid death, we need to acknowledge the burden generated on rehabilitation facilities and families in caring for patients who do not recover to their former selves. It is not up to us to determine if this is a success or a failure but is indeed undeniably an aspect of trauma care we would be remiss to ignore.

Conclusion

Damage control principles undoubtedly feature prominently in the severely injured patient cohort and should continue to do so. Improved survival rates bear this out. However, given that damage control resuscitation and surgery is not without drawbacks, the trauma community needs to continue to refine the indications by which such an approach is triggered. At attitude of introspection and retrospection is potentially our most powerful tool to do so.

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