

DAMAGE CONTROL RESUSCITATION

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Introduction

Conflict has historically driven advances in military medicine. Sustained casualty rates since 2003 for UK military personnel on Operation Telic (Iraq) and Operation Herrick (Afghanistan) have been the stimulus to develop new paradigms of care [1] and structured practice guidelines [2], to accelerate the introduction of technological advances [3,4], to dynamically enhance supporting curricula [5,6] and to take a total quality system audit approach to combat casualty care [7].

The concept of damage control resuscitation (DCR) was introduced into the UK Defence Medical Services in 2007 to draw a range of advances in pre-hospital and hospital-based trauma care together into a coherent doctrine. In turn, the DCR concept has been used as a tool to assist planning the tactical medical lay down for contemporary operations.

Definition

DCR is defined as a systemic approach to major trauma combining the <C>ABC (catastrophic bleeding, airway, breathing, circulation) paradigm [1] with a series of clinical techniques from point of wounding to definitive treatment in order to minimise blood loss, maximise tissue oxygenation and optimise outcome [8].

Specifically, DCR encompasses haemostasis techniques from point of wounding (topical haemostatic agents; tourniquet); BATLS interventions [6]; advanced in-flight intervention by a primary retrieval team (including induction of anaesthesia, thoracostomy and administration of blood); a consistently consultant-based trauma team at the field hospital (with rapid decision making); an aggressive approach to coagulopathy, hypothermia and acidosis in the Emergency Department (also

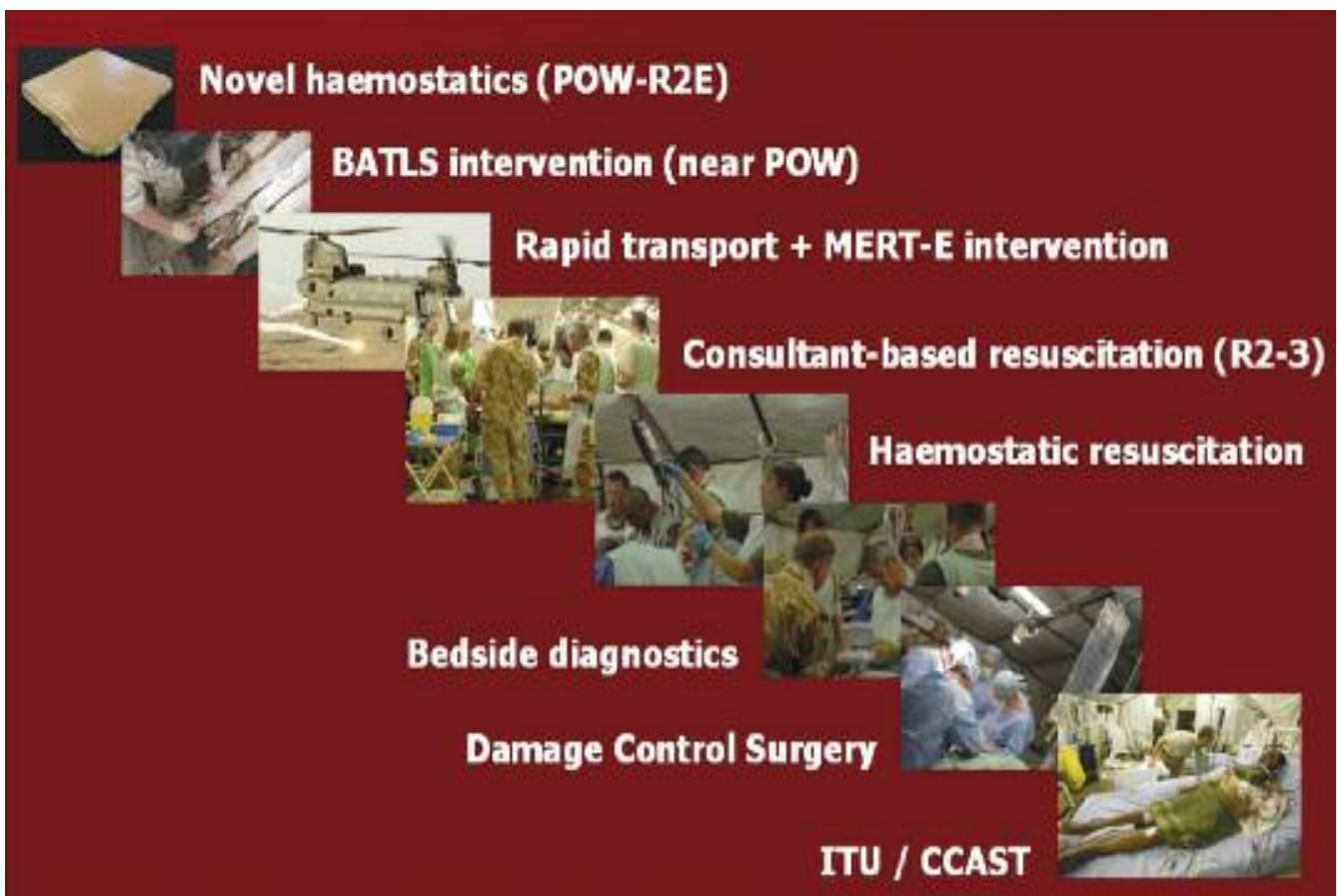


Figure 1: The DCR Process

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referred to as “haemostatic resuscitation”); diagnostic imaging support (FAST; digital radiography in ED; CT); and the three phases of damage control surgery.

The DCR process is represented in Figure 1; the haemostatic components of DCR are encapsulated in the “haemostatic ladder” (Figure 2).

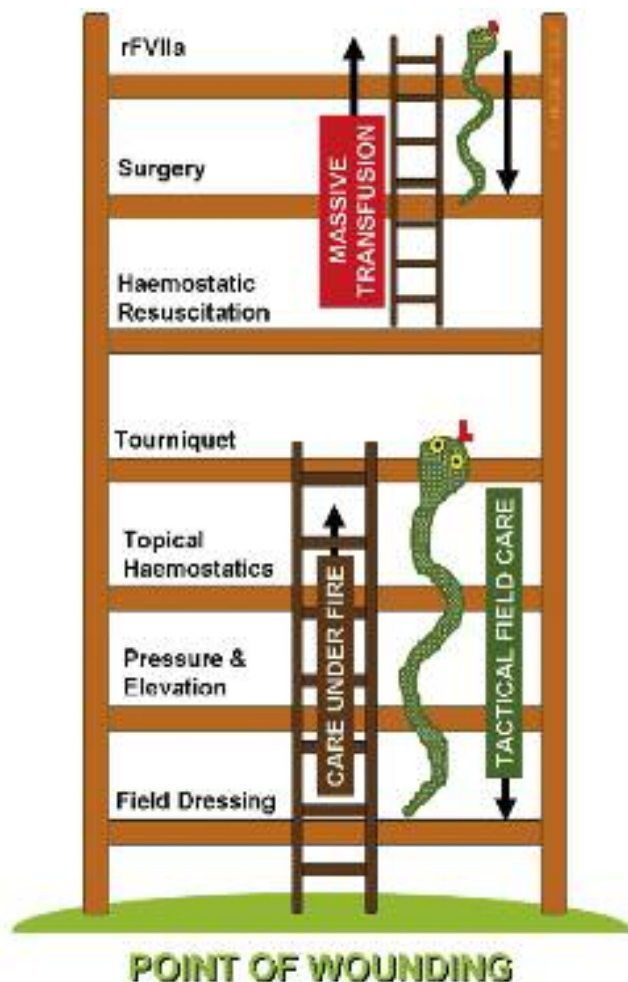


Figure 2: Damage Control Resuscitation (The Haemostasis Ladder)

Under normal circumstances there is progression from bottom to top of the ladder considering each intervention sequentially. However, during "Care Under Fire" effective direct/indirect enemy fire) it is appropriate for catastrophic limb bleeding to immediately apply a tourniquet BUT to reassess its requirement during "Tactical Field Care" (firefight won) the snake takes the user back to using a field dressing, pressure and elevation at this point. It is realistic that massive transfusion may be required prior to surgical intervention and in this case the user moves directly on the ladder to this intervention from "haemostatic resuscitation" with blood products. [From: Moorhouse I, Thurgood A, Walker N, Cooper B, Mahoney PF, Hodgetts TJ. A realistic model for catastrophic external haemorrhage training. *JR Army Med Corps* 153(2):99-101]

DCR vs DCS

Damage control surgery (DCS) is a well-established concept and consists of an initial time-limited operation to save life (theoretically less than 1 hour), a period of "haemostatic resuscitation" on the intensive care unit, then further definitive surgery. It has been stated that "Surgery does not follow resuscitation, it is part of resuscitation" [9] and DCS is a component of DCR.

An important development from the DCS concept is that a period of "haemostatic resuscitation" now precedes the initial life-saving surgery. This may begin in the pre-hospital phase with the administration of packed red cells by a specialist medical officer. The use of a secure satellite telephone link from the helicopter direct to ED has encouraged, where appropriate, the blood warmer to be primed with packed red cells and plasma for immediate administration on arrival at the field hospital.

US vs UK scope of DCR

The US military have also defined DCR, but with a more limited scope. In the US definition, DCR starts within minutes

of the patient's arrival in the Emergency Department and continues through the operating theatre into the Intensive Care Unit (ICU) [10] but excludes current or future pre-hospital intervention.

Regardless of the difference in scope of these definitions, the central tenet is proactive treatment to limit (or ideally prevent) early development of coagulopathy in the severely injured. DCR is targeted at the approximately 10% of trauma casualties who are severely injured, in shock and hypocoagulable on admission to the Emergency Department and/or who required massive transfusion [10].

In US military experience, DCR is largely complete in the operating theatre delivering a patient in an improved physiological condition into the ICU. Earlier, aggressive intervention in the Emergency Department has therefore intuitively reduced the requirement for the "catch-up" required on ICU in the traditional 3-stage approach to damage control surgery.

Balancing priorities

In the resuscitation of the severely injured trauma casualty the concept of haemostatic resuscitation is carefully balanced with that of hypotensive resuscitation [10,11].

In hypotensive resuscitation the aim is to achieve a systolic blood pressure of 90mmHg, in order to maintain tissue perfusion without encouraging re-bleeding from recently clotted vessels.

Haemostatic resuscitation uses blood components early in the resuscitation process, which contribute to the restoration of tissue perfusion as well as the coagulation function and limits the degree of dilution of coagulation elements in the blood that would otherwise occur with the use of asanguineous fluid. The current recommendation in the US military setting is FFP:PRBC in a 1:1 ratio [10,11], supplemented as necessary with recombinant activated Factor VII, although the whole process is dynamic and recommendations are being refined as evidence accrues

Summary

Damage Control Resuscitation (DCR) is a novel concept that draws together a series of technical and organisational advances in combat casualty care. It is consistent with and encapsulates the established concept of damage control surgery (DCS).

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