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The Pendulum of Damage Control Laparotomy

Bishwajit Bhattacharya*

Department of surgery, Yale school of medicine, New Haven, Connecticut, USA

***Corresponding author:** Bishwajit Bhattacharya, Department of surgery, Yale school of medicine, New Haven, Connecticut, USA, Tel: (203) 785-2572; Email- bishwajit.bhattacharya@yale.edu*

The story of damage control surgery is that of a pendulum that has swung from one end of the spectrum to the other over the decades. Originally described in the early part of the nineteenth century by the forefathers of surgery Pringle, Halstead and Schroder as a measure to deal with liver hemorrhage [1-3], this concept was not embraced in the combat experience of World War II where definitive repair was the standard. Damage Control Laparotomy (DCL) was brought into the forefront of trauma surgery in the 1980's and 90's when the existing paradigm was challenged. An environment of inner city gun violence in many US cities provided the milieu for a large experience of liver and vascular injuries [4,5]. Rotondo et al. coined the term Damage Control laparotomy in 1993 by adopting a naval term that meant to compartmentalize and limit damage to a damaged ship so that it may continue with its mission [4]. DCL was not a unique operation in technique but a tactical approach that limited the surgeon to control bleeding and contamination first. The objective was to get the patient out of and avoid the triad of death of hypothermia, acidosis and coagulopathy by avoiding definitive repair till the patient was physiologically appropriate. The patient after resuscitation in the ICU would return to the operating room for definitive repair. The results from such an approach were impressive resulting in decreased mortality [4]. Similarly the concept of damage control was extended to orthopedic and thoracic trauma surgery [7-9].

DCL was also not only being applied to trauma patients but its use was extended to emergency general surgery cases where the indications and outcomes were less clear [10]. During this time resuscitation of surgical patients involved liberal use of crystalloids and a non-evidenced based use of blood product ratios. It was accepted among surgeon's a patient would 'swell to get well'. During this time overlapped the recognition of abdominal compartment syndrome physiology and the need for surgical decompression. This perhaps provided another catalyst to the embracing of DCL and increasing the number of open abdomens.

But is there too much of a good thing? The liberal use of DCL was not without its drawbacks. The improved survival was associated with open abdomens, complex ventral hernias and enterocutaneous fistulas. The repair of these complex hernias posed its own set of unique challenges and associated morbidity. Survivors experienced multiple repeat admissions and interventions and longer ICU stay [11,12]. In the midst of the widespread use of DCL were many instances of using DCL when not indicated, by some measures one in five patients did not meet criteria [13]. The philosophy of correcting the physiological derangements that warranted DCL were diluted and the window of opportunity to close the abdomen were lost.

The last decade also witnessed a massive shift in the approach to hemorrhagic resuscitation. The military's experience in Iraq and Afghanistan brought new understanding about a tighter transfusion ratio of RBC's plasma and platelets in a 1:1:1 ratio. The military experience showed improved survival [14]. The experience was soon adopted in the civilian world with trauma centers adopting a massive transfusion protocol. Also the war experience brought back the use of tourniquets, the application of topical hemostatic agents and a revisit to the use of permissive hypotension thereby decreasing crystalloid exposure [15]. Any fluid that does not carry oxygen or clot should be viewed with suspicion.

With improved resuscitation strategies resulting in less crystalloid infusion potentially avoiding the development of abdominal compartment syndrome [16] and move away from the DCL. When employed the physiological basis for DCL has to be kept in mind. The patient must return to the OR as soon as the physiological parameters that warranted DCL are corrected. Patient physiology must be the dictating factor in deciding the time to take back, arbitrarily selected times diminish the physiological rational behind DCL. The greater the duration of the open abdomen the less likelihood of primary closure [17].

Over the past few decades the pendulum has swung form definitive surgery all at once to the liberal use of DCL to a more conservative use of DCL with the use of damage control resuscitation. Trauma centers have shown a decrease in DCL use without compromising outcomes [18]. The result has been a shift to less open abdomens and a focus of avoiding this powerful adjunct unnecessarily.

Many questions remain unanswered. What is an appropriate massive transfusion protocol is yet to be clearly defined with great variability among centers [19]. The role of adjuncts such as TXA remains controversial [20,21]. The search for the ideal endpoint of resuscitation continues. There may be more opportunity for the pendulum to swing in the coming years. The

***Corresponding author email:** bishwajit.bhattacharya@yale.edu*

last decade demonstrated that the widespread use of DCL was itself in need of damage control.

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