Damage Control Resuscitation in Adult and Pediatric Traumatic Patients

Essay

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List of Abbreviations

ACS	Acute Compartmental Syndrome
ADH	Anti Diuretic Hormone
AIS	Abbreviated Injury Scale
AKI	Acute Kidney Injury
APACHE	Acute Physiology And Chronic Health Evaluation
APTT	Activated Partial Thromboplastine Time
ATLS	Advanced Traumatic Life Support
AVP	Arginine Vasopressin
BCI	Blunt Cardiac Injury
COP	Cardiac Output
CPP	Cerebral Perfusion Pressure
CVP	Central Venous Pressure
DCR	Damage Control Resuscitation
DCS	Damage Control Surgery
DIC	DisseminatedIntravascular Coagulopathy
DPL	Diagnostic Peritoneal Lavage
EDM	Esophageal Doppler Monitoring
EVLW	Extra Vascular Lung Water
FAST	Focused Assessment with Sonography in Trauma
FBC	Full Blood Count
FFP	Fresh Frozen Plasma
FRC	Functional Residual Capacity
GCS	Glascow Coma Scale
GDT	Goal Directed Therapy
GEDV	Global End Diastolic Volume
GVHD	Graft Versus Host Disease
HBOC	Haemoglobin based oxygen carriers
HES	Hydroxy Ethyl Starch
HR	Heart Rate
HS	Haemorrhagic Shock
HtEE-ECHO	Continuous Trans Esophageal Echo
HTS	Hyper Tonic Saline
IAP	Intra Abdominal Pressure
ICP	Intra Cranial Pressure
ICU	Intensive Care Unit
LV	Left Ventricle
LVOT	Left ventricle Outflow Tract
MAP	Mean Arterial Blood Pressure

MOF	Multi Organ Failure
MTP	Massive Transfusion Protocol
NE	Nor Epinephrine
NO	Nitric Oxide
PAC	Pulmonary Artery Catheter
PAOP	Pulmonary Artery Obstruction Pressure
PCA	Patient Controlled Analgesia
PCC	Prothrombin Complex Concentrate
PEG	Poly Ethylene Glycol
PPV	Pulse Pressure Variation
PT	Prothrombin Time
RAP	Right Atrial Pressure
RR	Respiratory Rate
RTS	Revised Trauma Score
RV	Right Ventricle
RVEDP	Right Ventricle End Diastolic Pressure
RVEDV	Right Ventricle End Diastolic Volume
SBP	Systolic Blood Pressure
Scvo2	Central venous oxygen saturation
SI	Shock Index
SPO2	Saturation of peripheral oxygen
SS	Septic Shock
SVV	Stroke Volume Variation
TACO	Transfusion Associated Circulatory Overload
TBV	Total Blood Volume
THR	Titrated Hypotensive Resuscitation
TIC	Traumatic Induced Coagulopathy
Tp	Temperature
TRALI	Transfusion Related Acute Lung Injury
TRIM	Transfusion Related ImmunoModulation
TTE	Trans Thoracic Echo
TXA	Tranexemic acid
VTi	Velocity Time Integral

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Abstract

Damage control surgery (DCS) is a concept of abbreviated laporotomy, designed to prioritize short-term physiological recovery over anatomical reconstruction in the seriously injured patient. Over the last 10 years, a new paradigm has emerged, referred to as Damage Control Resuscitation (DCR). This focuses on initial hypotensive resuscitation and early use of blood products to prevent lethal triad of acidosis, hypothermia, coagulopathy. This article aims to present evidence behind DCR and its current application. In particular DCR may allow borderline patients, who would to undergo early definitive surgery as their physiological derangement is corrected earlier.

Keywords

Resuscitation surgery abdominal trauma coagulopathy blood component transfusion wounds and injuries] acidosis

Introduction

Trauma remains a leading cause of death world wide. Thirty to forty percent of trauma patients die secondary to hemorrhage. Damage control resuscitation “DCR” requires early and aggressive management. Multidisciplinary team consisting of trauma surgeon "trauma leader”, emergency medicine physician, anesthesiologist, trauma nurses, respiratory therapist, radiology technician, surgical subspecialties and other team members of social workers and transport personnel to develop, implement, maintain and continue to improve trauma patient care ***(Stewart et al., 2003)***

Damage Control as a “naval term” was first used during World War II to describe emergency measures for control of loading that threat to sink a ship. The central goal to ensure survival of the ship until it reaches a port where definitive repairs can be safely performed ***(Hodgman et al., 2012).***

Rotondo and Schwab in **1992** coined the term DCR and outlined 3 phased approach:

Part 1”DCRI”: consists of immediate exploratory laparotomy with control of bleeding and contamination, abdominal packing and abdominal wound closure.

Part 2 ”DCRII”: consists of ICU resuscitation, immediate end points include physiological and

biochemical stabilization, tertiary exam should be performed at this time to identify all injuries.

Part 3"DCRIII": consists of re-exploration and definitive repair of all injuries ***(Howell and Silva, 2013).***

The central observation behind the philosophy of DCR is the adverse effect of hypothermia, acidosis, trauma-induced coagulopathy and hypovolemia, all of which lead to adrenergic stimulation with vasoconstriction exacerbating any organ hypoperfusion ***(Bickell et al., 1994).***

Principles of DCR include:

1. Rapid physical control of hemorrhage.
2. Adequate tissue oxygenation.
3. Recognizing the risk of uncontrolled hemorrhage and principles of permissive hypotension.
4. Traumatic-Induced Coagulopathy "TIC"
5. Massive transfusion protocols and optimal amount of plasma, platelets, cryoprecipitate and other coagulation factors in relation to RBCs transfusion ***(Kawalenko et al., 1992).***

DCR MUST start in ER and continue through the OR and ICU until resuscitation is complete.

DCR used during initial phases of damage control "DC" has further been associated with improved mortality rates and incidence of complications in major trauma

patients. It may reduce requirements of damage control surgery ”DCS” as patient`s better physiological condition after DCR allow them to better withstand early definitive surgery ***(Ball et al., 2011).***

Main elements of damage control resuscitation

History

In the last few years, there has been a paradigm shift in the management of the severely injured trauma patient. As our understanding of the nature of trauma-related coagulopathy evolved, and with the recent combat trauma experiences in Iraq and Afghanistan, the concept of DCR "Damage control resuscitation" in trauma was born. The term "damage control" itself originated from World War II description of the US Navy's strategy to salvage sinking ships. The new strategy avoided immediate definitive repair of the damaged vessel, and focused instead on preserving only what was needed to return the ship safely back into the port for eventual definitive repair ***(Stewart et al., 2003).***

Definition

DCR is a systematic approach to the management of the trauma patient with severe injuries that starts in the emergency room and continues through the operating room and the intensive care unit (ICU). It is designed, along with damage control surgery, to promptly and aggressively reverse the lethal trauma triad of coagulopathy, acidosis, and hypothermia **(*Duchesne et al., 2010).***

The use of DCR" damage control resuscitation" and DCS" damage control surgery" have been associated with

improved outcomes for the severely injured and wider adoption of these principles where appropriate may allow this trend of improved survival to continue. In particular, may allow borderline patients, who would previously have required DCS, to undergo early definitive surgery as their physiological derangement is corrected earlier.

The main elements of DCR:

- ABC resuscitation
- Permissive hypotension
- Limitation of crystalloid with early use of blood and blood products
- Early use of TXA "Tranaxemic acid"

DCS limits the goals of the initial operation to control of hemorrhage and limitation of contamination rather than definitive repair of all injuries; prioritizing physiology over anatomy **(*Rotondo and Zonies, 1997)*.**

DCS was originally described by **Rotondo and colleagues** in **1993** as a three-phase technique. This was later modified by **Johnson and colleagues** in **2001** to include a **four phased approach:**

- Part zero (DC 0) Rapid-sequence induction (RSI) of anesthesia and intubation, early rewarming, and expedient transport to the operating theatre are the key elements.