

Chapter 4

CONDUCTING A COMPLEX TRAUMA ANESTHETIC

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“Train hard, fight easy.”
—Attributed to General Aleksandr Vasil'evich Suvorov (1730–1800)

INTRODUCTION

Over the past 11 years of conflict in Iraq and Afghanistan, the severity of injuries has increased, yet combat fatality rates are declining. This is due in part to the improved capability of frontline medical personnel and evacuation assets. In both the civilian and combat casualty care arenas, there has been improved application of damage control techniques, more effective rewarming, and more aggressive correction of coagulopathy.¹

A unique pattern of injuries has emerged these conflicts termed “dismounted complex blast injury.” This injury pattern consists of traumatic lower extremity amputations, penetrating abdominal/pelvic trauma, and urogenital injuries. These patients often arrive in hemorrhagic shock, requiring emergent damage control surgery and resuscitation.² These casualties have significant injury severity scores,³ including injuries requiring a massive transfusion following hypovolemia. The devastating clinical injury scenarios that have characterized the conflicts in Afghanistan and Iraq underline the need for complex anesthesia capabilities on the modern battlefield.

The anesthetic management of military trauma is directed at restoring physiology by reversing or mini-

mizing the “lethal triad” of acidosis, hypothermia, and coagulopathy. Coagulopathy, independent of injury severity score, surgical intervention, or blood product transfusion, is strongly associated with early death following major trauma. Abnormal coagulation, reflected by an increased prothrombin time and partial thromboplastin time, is present in 25% of trauma patients with major injuries upon presentation. Coagulation is an integral part of the inflammatory system, and activation results in systemic inflammatory response syndrome and increased susceptibility to infections and sepsis.⁴ Avoiding the lethal triad requires a thorough understanding of damage control philosophy,^{5,6} whose clinical features are summarized in Exhibit 4-1.

In the majority of these patients the immediate surgery is limited to definitive control of hemorrhage, wound debridement, and prevention or limitation of contamination.⁷ Only in selected cases will definitive restoration of function be undertaken. In such procedures the patient must be physiologically stable and deemed healthy enough to sustain a prolonged intraoperative course. These are conditions better attempted following repatriation from the deployed setting and will not be discussed further here.

DECISION-MAKING

In the early stages of casualty reception, careful time sequencing and communication are critical to success. The anesthetist is an integral member of the emergency department team. Casualties can be classified into those who are physiologically stable and those who are unstable. The primary decision in respect of the unstable group is whether they require immediate surgery. If immediate transfer to the operating room is required, current practice in

the NATO hospital facility in Afghanistan is for the emergency department team to escort the patient there. “Control” is handed over to the anesthesia/surgical team only when a definitive airway and intravenous access have been established and an initial surgical plan agreed upon. Those casualties who do not require immediate surgery will have their injuries more fully characterized with a computerized tomography scan.

CLINICAL MANAGEMENT

Airway management is the first critical step in caring for the severely injured combat casualty. This may present unique challenges for the anesthesiologist. Vascular access will often be performed concurrently, a procedure that has popularized the use of large-bore central venous access. Initially, intraosseous access may be required, especially in the prehospital phase. Early attention to ventilation strategies to promote oxygenation while limiting potential lung damage requires the early involvement of established intensive

care principles, especially in respect of blast casualties. Appropriate blood product resuscitation in a targeted manner, preferably guided by thromboelastographic testing technology at Role 3, and a thorough understanding of the pathophysiology of coagulopathy, is necessary to ensure optimum clinical outcomes while minimizing the risks of transfusion.

As resuscitation progresses, interactions among the surgical, anesthetic, and nursing teams become increasingly complex. Maintaining situational aware-

EXHIBIT 4-1

CLINICAL FEATURES OF DAMAGE CONTROL PHILOSOPHY

- Anesthesia and surgery are contemporary; surgery is part of resuscitation.
- Physiological control is directed at restoration of tissue oxygenation.
- Management of the “lethal triad” includes the use of massive transfusion protocols.
- Surgical episodes may be abbreviated depending upon the patient’s physiological status.

ness is paramount to ensure good Crew Resource Management (CRM) practice throughout. In particular, the secondary survey including imaging identifies all significant injuries to ensure long-term morbidity is minimized. Postoperative care starts in the operating room and includes the early involvement of intensive care, acute pain management, and aeromedical evacu-

EXHIBIT 4-2

THE STAGES OF A COMPLEX MILITARY ANESTHETIC

1. Secure or confirm a definitive airway.
2. Establish appropriate intravenous access.
3. Obtain laboratory investigations.
4. Control ventilation, respecting the possibility of lung injury.
5. Restore tissue oxygen delivery by reversal of hypovolemic shock.
6. Treat coagulopathy.
7. Ensure a full secondary survey is completed.
8. Maintain good CRM principles throughout.
9. Initiate appropriate postoperative care including attention to pain management.

CRM: Crew Resource Management

ation teams. The key clinical steps for anesthesia are summarized in Exhibit 4-2.

TRAINING FOR WAR

The workload imposed by the severely injured military patient is intense and demanding of logistics both within and outside the operating theater. The United Kingdom (UK) Defence Medical Services specifically trains and exercises their operational and

CRM capabilities prior to deployment.⁸ The critically injured casualty will often require the attention of two anesthetists while a team of as many as ten surgeons operate. Anesthetist and surgeon must be in constant dialogue so each is aware of the evolving clinical plan

EXHIBIT 4-3

THE DEPLOYED MILITARY ANESTHESIA SYSTEM

- Appropriately trained and experienced anesthetists, and allied anesthesia support staff.
- Equipment “fit for purpose,” including near-patient testing such as thromboelastometry, blood gas analysis, and ultrasonography for regional anesthesia.
- Large and small team training, eg, CRM and the horizontal team approach.
- Integrated laboratory support particularly for transfusion and blood products, including the facility for a donor panel to collect fresh whole blood and platelets.
- Coordinated intensive care to manage staged damage control procedures and for stabilization prior to aeromedical evacuation.
- An acute pain service.
- Facilities for data collection and audit of all anesthetic activity.
- Academic support to promote evidence-based initiatives for current and future conflicts.

CRM: Crew Resource Management

and the patient's temporal physiology. Clinical teams and hospital management must communicate effectively to ensure that overall situational awareness is maintained. There may be further incoming casualties as well as a need to consider the onward movement of casualties already admitted.

Military trauma teams are consultant lead on a 24-hour basis (in contrast, only 3% of UK's National Health Service hospitals offer this level of care); however,

clinical care is delivered by a team of all ranks and specialties, and constant communication and situational awareness is emphasized. Exhibit 4-3 lists the essential elements of the deployed military anesthesia system. To improve the system for successful deployed clinical teams, there must be an active ongoing collection of data and audit. The results are processed by academic clinicians and fed back into the system to improve current protocols and inform future generations.

CONCLUSION

The technical details of the components of damage control are discussed in depth by a series of authors in the chapters following this introduction. As this chapter's title implies, a successful outcome

relies upon orchestration of the parts. In comparison to many civilian trauma care systems,⁹ this is a requirement that historically the military manages extremely well.

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