Damage Control and Point of Injury Care: Extending the Care Continuum to Military Prehospital Providers

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ABSTRACT

Damage control principles are well founded, well proven, and have been incorporated into many specialties of clinical care in both military and civilian practice. Theories regarding hemostatic and hypovolemic resuscitation and preventing the Lethal Triad have had profound effects on the survival of wounded during the present conflicts.

As we continue to refine these practices, implementation of this theory should be extended to military prehospital providers. The impacts of damage control practices from those providing initial treatment could complete the continuity of care, prime patients for additional success, and affect overall morbidity and mortality.
The basic tenets of damage control theory are easily transferred to the Role I provider in the field and may even address their unique requirements more appropriately. Understanding the working concept of damage control would improve decision-making skills in both therapeutics and evacuation while managing casualties in the uncontrolled environment of combat. Military prehospital damage control differs greatly from in-hospital use, in that the principles must incorporate both medical and tactical considerations for care of the wounded. Introducing damage control principles to established casualty care guidelines will recognize and unite an often underappreciated level of care into a successful practice.

Introduction

Damage control (DC) has become the preeminent approach to acute trauma management in the last decade,[1] most measurably through its use in the present conflict. The damage control theory was initially developed by the civilian community in the 1990s from noted lessons of past success in war surgery. Valuable practices, such as gaining early surgical control of non-compressible hemorrhage, and minimizing hemodilution from fluid therapy were developed into effective treatment principles. The civilian community developed these practices by recognizing their effectiveness in blunt traumatic injuries[2] and soon after the military refined the methodologies to meet its unique requirements. Now well established and universally accepted, DC has recognized success and an application of principles in many different clinical disciplines of care.[3-5]

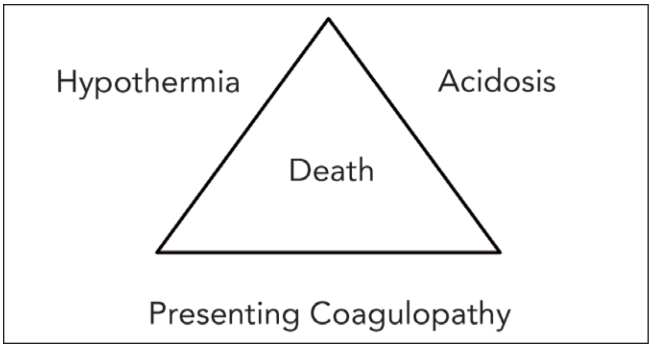
Damage control originally referred to actions taken by naval crews when their vessels had been damaged in battle. The damage is isolated and controlled, assets are redirected and focused, and in severe cases, decisions are made to sacrifice some loss to save the entire ship. This concept, and its name, is easily transferable into medical approaches in treating severe trauma based on the same basic doctrines and interlocking levels of care, all of which are especially applicable and effective in austere care environments.

The doctrines of hemostatic and hypovolemic resuscitation provide the foundations of care in treating war wounded and their role in DC is just as significant. Stopping blood loss in all respects, replacing volume loss with natural blood products, and minimizing the negative hypovolemic physiological effects assist in later care. By ensuring that volume replacement is not overcompensated for will avoid negating clotting effects.

Preserving homeostasis and preventing physiological loss to support normal body function in the face of significant injury is a vital aspect of hemostatic and hypovolemic resuscitation in damage control.[6-8] These actions provide results that can be capitalized upon in later care using the natural state of the patient to his or her own advantage. Preservation and prevention are parallel efforts in DC throughout the care continuum, although redefining this application outside of the hospital or clinical setting has yet to be explored fully. Recent recognition that resuscitation should begin earlier in combat casualty care has driven the further development and implementation of resuscitation at the point of injury.

Mitigating the Lethal Triad of hypothermia, acidosis, and presenting coagulopathy further constructs an effective formula against mortality (Table 1). These three

Table 1 The Lethal Triad of Trauma



elements are physiological results of trauma and are mutually supportive for normalcy within the body. When acute trauma occurs, deficits of the same can become both codependent and independent causes of mortality. Each risk can kill a patient on its own, or, due to their reliance on each other, can contribute to death due to a domino effect of their dependency. This triad can easily be compared to a tripod—if one leg fails, all collapse.

Specific principles of damage control surgery (DCS) include immediate surgical control of hemorrhage and early debridement of wounds and burns, and correcting physiological imbalances before definitive interventions. Recognizing that surgery is a traumatic event in itself, minimizing surgical interventions should be appreciated to prevent additional harm to the patient. These efforts promote a judicious surgical approach to the patient ensuring early effective measures, while reducing physiologically costly interventions.

Damage control resuscitation (DCR) drives early efforts to replace natural components and reverse physiological loss. Clinically, these interventions can include the identification of key resuscitation endpoints and effective timelines, the use of physiologically comparable blood products and coagulosupportive agents, and an effective multidisciplinary approach to trauma care. Early resuscitation builds foundations for later success through simple preparatory and preventative actions by the military prehospital provider.

Accepting and implementing DC principles continues to challenge norms, but its success as the dominant methodology to severe trauma care in the military setting and in the civilian sector has proven its effectiveness against mortality.[9-12] Integrating prehospital damage control into the clinical and surgical care continuum will continue to decrease rates of those killed in action and died of wounds.[13] Applying DC principles from the first moment trained hands are laid upon a patient provides the best groundwork for success in the operating room 3, 12, or 24 hours later. Although each level of military care is unique and requires separate scopes of practice, all settings should integrate to maximize patient outcomes. The continued fusion of patient care theory promotes the efficacy of the continuum throughout all care levels (Table 2).

Table 2 Defined Military Medical Levels of Care

Role I – Self aid, buddy aid, and initial medical care provided by combat medics and corpsman to the battalion aid station
Role II – Forward resuscitation and surgical assets (IIa)
Role III – Combat Surgical Hospital providing receipt, resuscitation, surgery and stabilization of casualties until evacuation from theater
Role IV – Care outside of the operational theater but en route to the continental United States
Role V – Definitive and rehabilitative care in the United States

The concept of damage control for the medic and corpsman provides the same blueprint for success as it does for the emergency doctor, intensivist, or surgeon. Understanding the intertwining effects of trauma, blood loss, and acid-base balance provides the confident decision-making in treatments and evacuation. This, in turn, will drive more effective treatments, incorporate resuscitation into all aspects of care, and allow the medic to accomplish more successful care on the battlefield.

This article recommends initiating DC at the point of injury (POI) and provides a concept in theory and therapeutics for the combat medic and corpsman. Most importantly, this involves proper education and understanding of the theories of hemostatic and hypovolemic resuscitation and reducing the threats of the Lethal Triad within their scope of practice. Armed with the knowledge of DC goals, decision making by medics would likely be improved in such aspects as knowing when, and even more importantly when not, to make lifesaving interventions and when, and how fast, to recommend evacuation. Further appreciation would include when benefit would outweigh risk in supportive therapeutics, and that the patient care they provide has implications beyond casualty handoff to evacuation or to a physician.

This article will present a unique approach to the primary survey of a casualty, which better addresses the characteristics of war wounds and the intent of DC. It will propose point of injury (POI) therapeutic goals for those requiring immediate surgical intervention to facilitate speed and reduce time to the OR. It will also encourage the medic to consider presurgical, versus prehospital, decisions in the field when appropriate. All of these efforts are aimed at providing the surgical team with a more hemodynamically stable, physiologically balanced, and surgically supported patient. Appropriate training is central to this continuum of care, and this article will highlight training priorities throughout. Further integration of DC methodologies will increase the efficiency of current POI care, and develop specific points of continuity that support synergistic efforts at all care levels and assist in the refinement of present practices.[14-17]

Considerations

Combat trauma requires unique and specific approaches, considering the mechanisms of injuries, wound patterns, and the nature of medicine when providing care under fire. Civilian definitions of hemostasis, resuscitation, and critical care must be redefined when applied to the combat environment. Expectations of conventional assets, access, referrals and mentorships do not exist for the Role I care provider. While treating life-threatening priorities, medics will also have to react to tactical situations. The aid provided must be flexible enough to allow interruption, but easily readdressed when the situation permits. Field medicine alone is not in question here, but the use of field medicine while reacting to, and in concert with, the tactical situation is.[18]

The environments in which combat medics operate and practice needs to be understood. Unlike hospital-based practitioners, medics provide care while also incorporating the tactical requirements of the commander and the enemy situation, all of which directly impact battlefield casualty care in every occurrence. POI care is subordinate to the tactical situation, which contrasts significantly from clinical or civilian settings. In combat, the priority goes to the success of operations in the field and casualty care comes second to achieving tactical and operational goals.

Battlefield dynamics are unpredictable, unexpected and uncontrollable. For those reasons, planning and preparing for worst-case medical scenarios should drive patient care at the POI. The medic in the field does not control the situation as a provider in a controlled clinical setting does, yet the medic still has to be thorough, efficient and flexible enough to modify treatment and evacuation decisions based on tactical situations. Other influences include changes to asset availability, weather, noncombatant concerns and casualties, rules of engagement, commander's intent and future mass casualty possibilities. To be clear, the patient care actions of the field provider must be based on tactical priorities.

War wounds generate different dynamics and requirements than those in the civilian or clinical setting.[19-21] Most often, urgent casualties sustain multisystem trauma with overpressure or high velocity penetrating wounds. These mechanisms of injury frequently involve multiple patients requiring simultaneous care. The medical care required by these wound patterns is unique and demanding in terms of type, amount, and empiric actions that are independent of tactical considerations. The medic is also responsible for treating and protecting the patient while simultaneously managing tactical requirements and commonly delayed evacuations.[22]

Effective casualty care is a multidisciplinary process from initial first aid until return to duty. Integration is necessary to provide a complete continuum of care. The success of damage control is not just incumbent on the medic and his or her care; it should be the sum of contributions from all levels.[10]

Ultimate success in treating battlefield wounds often occurs surgically, but it should begin at the point of injury. Extending damage control principles out of the emergency room (ER) and operating room (OR) will prime patients for later success. This may include more effective initial interventions if damage control is fully understood at all levels.[19] By incorporating DC principles, the medic will recognize surgical patients earlier to provide the commander with appropriate care and evacuation recommendations based on sound judgment. Achieving a greater understanding of the role of the surgeon will develop a more integrated approach to preparing the patient for the necessary interventions. The battlefield is the first opportunity to prepare the patient for surgical success.

To integrate DC at all levels, we must first appreciate the combat medic and corpsman as well as their duties, responsibilities and challenges. They provide trained medical care at "lower" levels, but should also provide the most competent interventions possible. Arguably, they are the most trusted provider as they eat, sleep, live, and fight alongside their potential patients. Medics also maintain the standard of *primum non nocere* (first, do no harm). Doing less harm may be assisted with a thorough understanding of damage control theory.

A Front Line Damage Control Approach

Damage control paradigms developed for the combat medic will serve to preserve, protect, and prepare the casualty for success. All must be accomplished while also managing the unforeseen challenges of combat and efforts would include both tactical and therapeutic decisions. One component is to provide proactive, versus reactive, interventions at the point of injury or en route to a surgical facility. Therapies should also be simple, retainable, and practical under stress to ensure their successful application. The simplicity and logic of damage control combined with the success of its theory provides the rationale for extension to the Role I care providers and is a noted recommendation.[23-25]

Preservation and prevention should be the primary approach in DC for the medic and corpsman. Prevention, versus treatment, should be simple, effective, and safe at the POI. Damage control can allow for proactive care at the point of injury, but may limit other interventions due to the scope of practice and field limitations.

Initial treatments at the point of injury should be more definitive and confident as compared to civilian or present military protocols. The durability of battlefield interventions is essential to their overall success. There are many intangible circumstances on the battlefield that can endanger care already provided. Early care delivered to minimal standards or that does not appreciate the risks of the environment can have maximal negative consequences. Continuous tactical movements, geographical isolation, multiple casualties, and the effects of multisystem trauma all require reliable and quality interventions far above minimum standards for care. Evacuation itself is multifactorial. Threats of time, distance, unknown medical capabilities, and enemy influences all pose significant risks. Effective interventions that are lost due to circumstances equates to lost time and negative effects. Addressing these risks may increase Role I skill levels in some areas, but would meet later requirements more thoroughly.

Obtaining the earliest possible hemostasis is critical. Although maintaining and conserving red blood cells is vital to proper aerobic metabolism and therein acid-base balance, conserving clotting components is equally important. This ensures the most natural hemodynamic status to maintain normal systemic function while wounded, and allows inherent preservation of the patient by conserving and maintaining factors essential to survival.

The most optimal time to control hemostasis in the prehospital setting is at the POI when the patient is at his or her most natural state. Effective management of compressible hemorrhage and immediately identifying non-compressible wounds and surgical candidates, such as penetrating truncal wounds, can prepare for an expedited evacuation and deliver a potentially more stable patient to a surgical facility.[26] Establishing and training on hemostatic strategies that are applied easily under stress will arm the medic with essential skills. The medic must have a thorough understanding of the tourniquet, considerations for evacuation and the distance and times involved, proper wound packing and pressure practices, and appropriate hemostatic dressing use when indicated. Desensitizing medics to these aptitudes and ensuring success under extreme conditions require the appropriate instructional models and realistic methodologies.[27,28]

Hypovolemic resuscitation requires an understanding of hemodynamics and associated findings. These are critical skills in resuscitation at any level.[29,30] The medic must perfect the very basics of vital signs such as understanding, for instance, that a radial pulse alone does not ensure a systolic blood pressure of 90mmHg, rather that strong and bounding pulse characteristics most often indicate minimum perfusion.[31] When medics comprehend that the brain is the organ most sensitive to decreased oxygen perfusion directly reflected in altered mental status they may better understand the underlying causes that will be critical to them in the field. Medics and corpsmen should be able to recognize early central hypovolemia through more than one method of assessment or vital sign.[32] Additionally, the continued development and utilization of new vital sign measurements with increased sensitivity such as pulse pressure, tissue oxygenation saturation (StO_2) or muscle oxygen tension (PmO_2) using near infrared spectroscopy (NIRS), and ultrasound could assist and update POI care with more accurate diagnostics for decision making.[30,33-36]

Coagulopathy can be negated with effective hemostasis and recognizing the need for pharmacological adjuncts, surgical intervention and rapid evacuation. These skills and support are invaluable at the point of injury. The loss of critical blood components, in all forms, is the medic's initial and most important priority, whether through personal intervention or by cross-training and preparing members in his assigned unit. Preservation of clotting capabilities, or replacement of the same, is an essential early intervention. Understanding field resuscitation with judicious fluid selection and volume administration will ensure that hemodilution is minimized and that advanced volume replacement is anticipated. The recent recognition of acute traumatic coagulopathy further complicates our challenges and drives earlier action.[37-41]

The value of addressing coagulopathy as early as possible has been proven.[25,42] The research and availability of coagulosupportive products are limiting factors with most forces, while some nations have already fielded these interventions to the front line. Addressing coagulation at the POI is an imperative in the future of combat casualty care. More aggressive and universal study is essential to determine the effectiveness of all intravenous coagulosupportive agents at this level. If these studies prove valid then expanding the scopes of practice of front line providers should be promptly reconsidered. Further, but more rapid, research and debate is required for earlier use of lyophilized plasma and specific agents.

Acidosis, although seemingly intangible at the point of injury, can be mitigated by the combat medic. Lifesaving interventions that are properly provided and capable of surviving evacuation support the basics of oxygenation, metabolism and normothermia. Effective pain management also assists in maintaining a balanced pH level by decreasing pain-induced catecholamine release. Delivering a more physiologically balanced patient to the hospital provides a foundation for success during more advanced interventions or early surgical care.

The concurrent effect of acidosis on coagulopathies is well established and interventions at the POI should be synergized with later care to improve patient outcomes. The cumulative physiological effects of both trauma and resuscitation are the result of many factors that result from specific interventions. The use of acidotic, hyperchloremic legacy fluids, such as normal saline and Ringers lactate, could adversely affect patient pH in large quantities, they can disrupt the natural clotting order, and contribute poorly to the intent of resuscitation with an inability to maintain intravascular volume due to abnormal osmolarity.[43] Replacements are overdue for colloids and crystalloids used historically for resuscitation considering recent research and other choices now available. The fielding of naturally identical, all-encompassing fluids in the proper packaging will have a significant impact on both patient care and tactical considerations.[26,44-46] Fluid therapy should only include those fluids that are advantageous and physiologically comparable in terms of acidosis, coagulopathy, and normothermia.

Preventing hypothermia is likely the easiest in-field intervention in averting the Lethal Triad, but one that also provides significant contributions to homeostasis. This intervention is integrated into the proposed combat survey and should be task organized so that it can rely on the actions of a trained unit, not solely on the medic alone.[47] The difficulty and actions taken in returning a patient to normothermia should also be trained on and established when a medic receives a patient that was outside of his care.

Early hypothermia prevention and proper temperature maintenance assists in weakening the linked effects on coagulation and acidosis. The proven negative effects of hypothermia should reinforce the need for immediate warming intervention at the point of injury when patient temperatures are at their most normal. Recent studies support rigorous hypothermia prevention, but this simple and effective therapy should be universally automatic and routine.[48-50]

Important to interdicting hypothermia at the POI will be the fielding of a simple, effective and rugged fluid warmer that can be employed out of the aid bag. Equipping every medic on the line with this capability will bring a significant capability to the battlefield and proactively challenge the defined threat of hypothermia. Our medics should understand that warming fluids in the face of trauma should be the norm, and therefore they should be equipped to provide that standard.

Point of Injury Goals

Examining some facets of prehospital care as presurgical care is worth consideration in treating the combat wounded. An essential principle of point of injury damage control should be to deliver the patient to the surgical team in the best physiological state possible to increase the odds of surgical success. POI treatments and therapies should keep this in mind when providing continuity and efficacy of care into the OR. This theory may also assist in decreasing the additional efforts of Role II and Role III personnel in stabilizing the received patient before surgical intervention.

Trauma is a surgical disease, and front line care should focus on improving medics' care for surgical eventualities.[51] Recent research finds that the majority of evacuated casualties will undergo surgical intervention to some degree.[21,52] Damage control in the field is often about the speed of action. To create speed throughout all aspects of care, some minimal presurgical therapeutic goals considered at the POI may conserve physiology and negate risk to care while still remaining within the Role I scope of practice (Table 3). These goals anticipate surgical intervention, provide optimal care at the point of injury, and ensure no harm. Incorporating DC at the point of injury also means minimizing risk to treatments during handling and supplying key interventions that can be

Table 3 Minimum Point of Injury Goals

• Make your evacuation recommendation based on the combat survey and the situation
• Achieve hemostasis to your scope of practice
• Definitively manage the airway as required
• Maintain a normothermic patient
• Obtain Intravenous or Intraosseous access
• Provide antibiotic therapy
• Record and communicate all trending vitals to the next level of care

Note: Minimum Point of Injury pre-surgical goals that may be provided if time and situation permit. These actions will support care and be utilized from the POI, through the evacuation process and into the operating room.

used in the ER/OR. These efforts, when delivered at the point of injury, can be of benefit to higher echelons of care while still preparing for the worst case scenario on the ground.

The first step in damage control at the front line is the immediate recognition of those wounds that require surgical intervention the fastest. Hemorrhage is the primary cause of combat death; wounds that cause non-compressible hemorrhage are those most likely to lead to death.[53,54] It has been noted that in recent military experience, approximately half of the potentially survivable hemorrhagic deaths are from non-compressible penetrating truncal trauma.[26,55] Identifying these wounds by assessing location, mechanism of injury, or observation of hypotension can provide essential decision making at the POI. Non-compressible truncal hemorrhage, head wounds and unconsciousness, massive bleeding, and traumatic amputation are wound patterns that require rapid surgical intervention and immediate evacuation. Recognizing this and appreciating the requirements in caring for these traumatic injuries will prioritize confident decisions to evacuate earlier. This facilitates the faster "knife to skin time" that these wounds require.[19]

Evacuation in combat begins with recommendations to the commander, who, in turn, must make those decisions based on the situation and risk assessments considering all aspects of his responsibilities and tactical influence. When a medic recognizes the need for rapid surgical intervention, the actual ability to move the patient is dependent on many other factors in a combat environment. The medic must train and be trained for this. He must be able to not only recognize and react to an urgent casualty himself, but all members of his unit should be able to identify surgical requirements as well. Any Soldier that is capable of identifying an urgent casualty can immediately initiate contingencies and standard operating procedures to expedite evacuation for the benefit of the patient. Making evacuation recommendations based on DC theory should not always require a medic.

Figure 1 Point of Injury Damage Control

Note: The concept of damage control must begin at the point of injury to maximize the potential of patient success

In concert with recognizing an Urgent evacuation status, the medic must have planned for and be able to transport patients to the closest surgical capability in the least amount of time. The ease and speed of a plan to move casualties to surgical intervention is in itself part of damage control. Establishing and disseminating that plan is a unit responsibility from the unit clinician, to the operations officer, to the commander and medic on the front line. Understanding that speed is essential, the medic must thoroughly know all evacuation platforms and capabilities available to him.

As previously mentioned, hemostasis within the scope of practice of the care provider must be absolute. This directly influences the metabolic activity supported by red blood cells, as well as maintaining the essential clotting components vital to trauma.

Improper airway management is a cause of battlefield mortality and should be thoroughly addressed at the POI, regardless of the status of the patient. Every patient needs a sufficient and definitive airway as it supports oxygenation and metabolic processes, negating acidosis. The airway should be large enough to provide proper ventilation and must be secure enough to survive the rigors of transport. Early safeguarding of the airway may be economical for the OR by saving time and effort while also protecting the patient against the threats of battlefield evacuation.

Hypothermia prevention has been discussed at length and its contribution to the Lethal Triad is clear. Ensuring that core temperature is preserved negates acidosis and provides the proper environment for optimal clotting processes. Supporting normothermia through passive and active measures is essential during transport to the OR and supports physiology before surgery.

Having patent and durable intravenous or intraosseous access should be accomplished early in order to provide care at all levels.[56] The requirements for analgesia, sedation and fluid therapy exist within any evacuation and upon arrival to surgical assets. Additional requirements for natural blood products and clotting therapeutics such as tranexemic acid,[57] calcium, or fibrinogen demand access at the surgical and resuscitative levels.

Hypovolemic resuscitation is presently based on mental status and a systolic blood pressure of 90mmHg for the medic. More accurate readings that are later assessed, and more importantly recorded, will then determine the need and intervention required. Thorough understanding of trending vital signs and their implications will guide a medic's decisions and actions.

Prophylactic antibiotic therapy at the point of injury or within one hour of insult has been postulated to decrease infection rates later in later stages of care, including post operatively.[22,58-60] This proactive intervention has positively influenced outcomes of surgical patients and again primes the patient for later success.

One of the simplest, but most important contributions a medic can make to a surgical patient is by recording and communicating all attainable vital signs, clinical assessments, and neurological status.[61] This information is critical to the surgeon who may be making intervention decisions, or choosing priorities for treatment in the face of a mass casualty incident. Trending vital signs serves as actionable intelligence for the surgical and intensive care teams seeking to exercise their best clinical judgment. Conversely, receiving physicians and nurses should always look for and use field casualty cards or any data provided with the patient. Too often this documentation is overlooked by medics and clinicians alike.

Table 4 The Combat Survey

M – Massive Bleeding • Immediate and durable control of hemostasis or the recognition of uncompressible hemorrhage and surgical requirements
A – Airway • Manage a definitive airway adequate to patient needs and sustainable throughout evacuation
R – Respiration • Evaluate respiration rate, rhythm and character • Thorough assessment of the torso and abdomen, and provide proper interventions
C – Circulation • Conduct a head to toe detailed inspection • Assess hemodynamic status and decide appropriate action • Document and trend vital signs • Obtain early systemic access for therapeutics
H – Head • Assess for neurological deficits • Evaluate and record trending AVPU, A & O, and Glasgow Coma Scale
H – Hypothermia • Immediate preservation of body temperature, definitive prevention of heat loss, and provide active or passive rewarming methods

Note: The Combat Survey may address the characteristics of combat trauma and integrate damage control principles more appropriately while providing flexibility for the battlefield environment.

Arming Our Medics

An alternative primary survey to the ABC's of trauma care has recently evolved into the mnemonic 'MARCH.' Massive bleeding, Airway, Respiration, Circulation, and Head and Hypothermia make up the initial combat survey of war wounded (Table 4). MARCH replicates the ABC (Airway, Breathing, and Circulation) format in all respects; however, the refined methodology is more practical in addressing the priorities and characteristics of war wounds. MARCH also integrates several key factors of DC such as early hemostasis and hypothermia prevention into initial care. This approach to primary evaluation has been adopted and developed by various units for almost ten years now, and has gained recognition worldwide. This article recommends further evaluation, implementation, and refinement of this already productive format.

The first point to MARCH is massive bleeding, which recognizes the most immediate priority and the greatest threat in combat trauma—hemorrhage. Controlling massive bleeding, or identifying uncontrolled or non-compressible hemorrhage, meets early DC and resuscitation requirements at the Role I level. The immediate identification of life threatening or wounds that require immediate surgery, such as penetrating wounds to the torso, abdomen and pelvis, should hasten the evacuation decision and process whenever possible. Conserving natural blood volume and homogenous blood products assists in maintaining metabolic balance and serves to optimize clotting processes, which is inherent to hemostasis.

Airway management, when necessary, should be definitive in application and provide sufficient ventilation and oxygenation to support ideal respiratory processes.[62] Medics' competencies in airway management should range from simple use of the lateral recumbent rescue position to the knowledge, understanding and proficiency in advanced airways. Definitive airways should be visually placed, anchored by a fixed anatomical structure, allow for adequate ventilation, able to support positive pressure and protect against harmful aspiration. In supporting and maintaining proper respiratory function, field medics can prevent acidosis and hypoxia.

Respiratory assessment begins with ensuring a patent airway, observing the rate, rhythm and character of respirations, and maintaining proper ventilation. Completing a thorough evaluation of the chest and the abdomen will identify any threats to the breathing process. Applying secure occlusive dressings to open wounds and definitively treating traumatic insults that survive to the operating room will reduce risk and protect the patient. Lastly, appropriate management of tension pneumothoraces must be executed to the level of the situation and training.

Circulation may be the most comprehensive step of MARCH. Initially it concerns the calculation of the hemodynamic state of the patient by palpation of pulses and evaluating mentation. If time and equipment permit, this can allow for the first assessment of diagnostics with pulse oximetry and comparison of vital signs to earlier findings such as character and rate of radial pulses and neurological status of the patient. Circulation continues by deciding the necessity of a fluid challenge, the type of fluid, and selecting its access route. Then scrutinizing the patient from head to toe allows proper exposure for examination while preparing the patient for transport.

A detailed inspection at this point in the sequence broaches slightly on the secondary survey; however, it ensures that a lethal wound is not missed providing ownership of the patient to the medic. Surveying the extremities for wounds and fractures, the torso, abdomen and pelvis for insults, and then rolling the patient over to visually and physically assess the back provides a very high level of confidence for the medic in the status of the patient. It is here where the efficiency of action results in creating speed. Once circulation is ensured, the patient is then ready to be simultaneously protected against hypothermia and packaged for transport.

Head assessment involves the mentation status of the patient and trending and recording these findings for the ER/OR. It should include not only the patient's response to alert, verbal, pain, or unresponsiveness (AVPU), but if conscious, alert and oriented findings and a Glasgow Coma Score, if time permits. These early findings are critical to the surgeon that may be forced to make diagnostic decisions in the face of limited assets, time, or evaluation.

Hypothermia assessment is intended to preserve body heat, prevent further loss and optimally ensures continuous monitoring and maintenance of a core temperature of 37.5 °C throughout the evacuation process. The minimum goal in the field is to maintain a core temperature greater than 36 °C to negate adverse effects on clotting.[63] As mentioned before, an efficient time to address hypothermia is during the circulation and inspection process. Exposing the patient to ensure that no wounds are missed also involves removing wet and dirty clothing, and then rolling the patient into the proper heat retention material whether it is manufactured or makeshift. Addressing hypothermia within an initial assessment automatically preserves normothermia and prevents passive heat loss.

Additional hypothermia prevention and recognition can come from commercially manufactured temperature dots or bars placed on the patient's forehead; these give sufficient awareness of the patient's body temperature during treatment and transportation. This simple device also serves to continuously remind any care provider of hypothermic concerns and provides the receiving facility with an immediate hypothermic status.

Medics must be able to recognize shock and categorize their evacuation status properly. The military patient population initially compensates well in the face of shock, then harshly decompensates with little warning. In order to manage shock, the medic must be proficient in recognizing and limiting time spent in compensated shock and react to findings that indicate decompensation. They must be competent in interpreting trends in vital signs, understanding their implications, and properly documenting the findings.

Even in the civilian environment there is a fine decision point between initiating immediate transportation and treating trauma on site.[64] Providing the proper lifesaving interventions without delaying transportation with unnecessary care is important, but understanding that combat evacuation is affected by factors other than medicine will likely demonstrate a delayed evacuation and prolonged care for Role I scopes of practice.[65] While recognizing the efficacy of faster evacuation times for urgent casualties, the medic should also ensure he is providing appropriate care before transportation. Optimal care when time, situation and supplies permit will anticipate

Figure 2 Integration of Comprehensive Evacuation Care

Note: Integration of comprehensive evacuation care must be accomplished in order to support damage control theories and provide continuity of care.

later requirements and assist in guaranteeing continuity of care in transport.

Conclusion

Battlefield casualty care provides a recognized opportunity to further develop strategies against, and affect the mortality of war. The extension of damage control theories to medics and corpsman could optimize established casualty care guidelines and impact overall success. The evolution of casualty care and the lessons from a decade of conflict should be extended to the front line to complete the care continuum. Elevating the Role I environment should afford equal attention and effort when compared to other levels of care, and not be neglected due to the challenges of the environment or a perceived glass ceiling in military prehospital care.

In summary, DC methodology at the point of injury will preserve, protect, and prepare the patient for success, maximize care, and decrease mortality. More precise and improved decision-making is enabled by identifying wound patterns, mechanisms of injury, and more efficient physiological markers to mitigate non-compressible hemorrhage. Proactive consideration of presurgical therapies will preserve the patient, prevent physiological loss and deliver a more prepared patient for surgery. Lifesaving interventions should be chosen for their simplicity, effectiveness, durability and definitive results. Further understanding of shock by the medic and corpsman and developing resuscitation and nursing skills within the Role I scope of practice will improve management of extended evacuations and optimize the patient for surgical success.

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