Duplicate

SHOCK - THE COMMON DENOMINATOR IN BLUNT AND PENETRATING TRAUMA

R ADAMS COWLEY, M.D.
MARYLAND INSTITUTE FOR EMERGENCY MEDICAL SERVICES SYSTEMS
22 S. Greene Street
Baltimore, Maryland 21201

SHOCK - THE COMMON DENOMINATOR IN BLUNT AND PENETRATING TRAUMA

Most advances in trauma care have been learned through the hard experience of war. Unfortunately, during peacetime, many military trauma surgeons see few trauma victims and consequently face a degradation of skills. In fact, unused skills frequently are forgotten and have to be rediscovered and relearned at a great cost by the next surgical generation as new emergencies arise.

This weakening of trauma skills for military surgeons, during peacetime can be offset, however, by rotating military surgeons through trauma centers. In addition, trauma centers offer military surgeons a chance to pioneer in new treatment techniques. The success of military medicine in treating trauma patients with penetrating missile wounds can be attributed to the medical staff's ability to maintain a state of constant readiness. Through intelligent planning, the training of physicians, nurses, and medics, and anticipation of emergency needs, every trauma patient is assured of fast, efficient treatment according to the severity of his injury. But trauma centers are also built on the experience of the military that this "constant readiness" can reduce trauma mortality and morbidity. Although cases of penetrating missile wounds are relatively sparse at trauma centers, blunt trauma is highly evident. In viewing penetrating and blunt trauma, several comparisons can be made.

Missiles that penetrate the body, whether primary or secondary, cause bleeding and the dissipation of kinetic energy into the tissues, resulting in tissue damage. The same pathophysiological effects of penetrating missile trauma are produced by blunt trauma caused by automobile, farm, and industrial accidents. Due to blunt injuries, kinetic energy is dissipated into the tissues, leading to tissue damage. However, it is the experience at the Maryland Institute for Emergency Medical Services Systems (MIEMSS) that blunt injuries are usually more devastating because several anatomical or organ systems are damaged.

Additional similarities between blunt and penetrating trauma also should be emphasized. First, blood is lost whether there is a penetrating injury (caused by a knife, bayonet, or primary/secondary missile wound) or a blunt injury (with its lacerating or tearing effect on organs or tissues). Second, the metabolic effect of both injuries is the same. Third, shock is the most feared common denominator of non-lethal injuries and, if not controlled, can result in irreversible shock. Fourth, both penetrating and blunt trauma injuries require similar observation, surgery, and definitive care.

The key to successful trauma therapy consists of the following: (a) resuscitation, stabilization, and assessment; (b) early definitive surgery; and (c) followup supportive care. If a trauma surgeon is not involved in all of these phases on a continuing or rotational basis, skill decay will occur.

However, the methodology of maintaining trauma skills in a civilian setting does exist. Trauma center programs provide an environment to practice each step necessary for successful trauma therapy. In addition, they ensure that many patients with severe trauma can be cared for in a setting designed to meet their needs. As a result of the increasing number of accident victims, the number of trauma victims seen each year far exceeds the number of trauma victims during a twelve-month period of the VietNam War.

The injuries of civilian trauma patients and those of war victims are comparable in severity and in many of their effects. A trauma surgeon may encounter the penetrating wounds of missiles, thermal burns, or crush and blunt injuries, but often the common denominator for all trauma is shock. If this process can be controlled, the result is successful trauma management. Thus, the military surgeon and the civilian trauma surgeon are faced with the same problem -- controlling shock.

In injury where shock is a predominant clinical manifestation, the state of the body's biochemical reserves, particularly those associated with homeostasis, determines to a large extent whether or not the patient survives. If these reserves are adequate and maintained, recovery is enhanced; if not, biochemical failure at the cellular level ensues.

Shock is a severe pathophysiologic state associated with inadequate tissue perfusion and oxygenation at the cellular level. An abnormal metabolic state ensues that can ultimately prevent vital organ function.

The purpose of any shock classification is to facilitate rapid recognition of the underlying cause and to promote correct and specific therapy as quickly as possible. Shock may follow such diverse conditions as severe trauma, burns, major surgery, massive hemorrhage, dehydration, myocardial infarction, overwhelming infections, poisoning, and drug reaction. All of these conditions can decrease arterial blood pressure, cardiac output, arterial blood flow, and blood volume, which ultimately affect capillary blood flow and tissue oxygenation.

The classification used at MIEMSS suggests that a hemodynamic diagnosis be made as soon as possible and that cardiopulmonary resuscitation be started immediately, before a clinical diagnosis is made. This practice is contrary to standard medical training, which adjures that the diagnosis should precede treatment. However, if one waits for x-ray reports, a neurological assessment, and laboratory studies to be completed before resuscitation is started, the patient may be lost. Prognosis will therefore depend upon the rapid resuscitation and stabilization of the patient.

A tentative diagnosis of shock is <u>commonly based</u> on the following measurements: arterial blood pressure, pulse rate, central venous pressure, urine flow, cardiac index, the partial pressure of oxygen in the arterial blood, the partial pressure of carbon dioxide, pH, and the hematocrit. A systolic blood pressure of less than 90 mm Hg. with evidence of poor tissue perfusion, oliguria, and metabolic acidosis, indicates that a patient is in shock. Since poor tissue perfusion and hypoxia are clear indicators of the shock phenomena, means of evaluation are worthy of notice.

Tissue perfusion can be evaluated grossly by the "thumb/big toe" technique. If both feel equally warm, peripheral perfusion may be considered adequate. If one digit is cooler, a deficit in peripheral perfusion is present. For physicians trained in the microvascular system, the conjunctiva of the eye offers a superb means of evaluating tissue perfusion. Urine output is an indicator of visceral perfusion. At MIEMSS, serial lactate studies are the most useful gauge of general perfusion, especially when supported by other biochemical findings (pH, O_2 deficits).

Regardless of the etiology, the management of shock must be prompt, correct, and sustained. A preconceived plan of attack that can be implemented immediately upon a patient's arrival at the hospital is needed so that the progression of the shock process can be halted. Without a definitive plan, the outcome can be lethal. Even with a preconceived plan, procrastination in its implementation can be detrimental to the patient's survival. Accurate monitoring together with early, appropriate treatment can, in many cases, result in complete reversal of the fundamental disorder before permanent organ damage occurs.

A tentative diagnosis of shock, based on hemodynamic and clinical observations, should be made as soon as possible and cardiopulmonary resuscitation should be started <u>immediately</u>.

At the time when medical treatment is initiated, a patient can be in any phase of the pathophysiological continuum of shock. Hemodynamic stability can be achieved in many patients with severe or prolonged shock. With aggressive therapy, the process can be reversible, even when there is some degree of organ failure. However, it may be impossible to generate an adequate blood pressure and perfusion level in some patients. Such patients are in a state of "refractory" shock and usually die within minutes to hours.

There are some patients who, despite the restoration of hemodynamic stability, gradually deteriorate and expire days to weeks later, usually as the result of sequential multiple systems failure or sepsis. In this case, physiological disruption has occurred beyond a critical level in which an irreversible process has been initiated. Since it cannot be determined when a patient passes from a state of reversible to irreversible shock, all patients with shock need maximal observation, and pulmonary and cardiovascular support.

The goal of the physician treating shock is to maintain vascular expansion, optimal cardiac filling, and adequate oxygenation to provide optimal micro-circulatory blood flow. Packed red blood cells must be given early in the course of shock to provide optimal oxygen-carrying capacity. An adequate number of vascular lines above and below the diaphragm must be inserted to infuse volume rapidly and reverse the hemodynamic instability associated with hypovolemic and septic shock. Early surgical intervention is necessary to promptly control hemorrhage and prevent early death or multiple system deterioration. If the patient has evidence of left ventricular failure, inotropic and chronotropic support is indicated. The specific cause of shock should be identified and reversed.

In addition to the monitoring of cardiovascular and pulmonary function, other biochemical parameters must be monitored frequently to detect insult to vital organ systems and to assess the effectiveness of therapy. For example, liver enzymes, creatinine clearance, coagulation parameters and blood gases should be followed sequentially. If there is progressive deterioration in these systems, the clinician must assess cardiovascular performance as the origin of the systemic dysfunction.

A patient in shock has the best chance for survival when the causative factor is corrected and subsequent therapy is based on (1) following trends in serial biochemical and physiological measurements, and (2) evaluating the patient's response to therapy. Relapse is not uncommon and, therefore, judicous monitoring and observation during and after shock therapy is of paramount importance if relapse is to be avoided.

SUMMARY

Military surgeons, as well as civilian trauma surgeons, are concerned with controlling shock. The management of catastrophic injuries (especially those of a multiple system type) that a surgeon encounters during peacetime, is similar to the management of penetrating injuries caused by war missiles. Shock is the most important common denominator.

This supports the view that the etiological factor -- whether a gunshot wound, a blast injury, an automobile accident, or injuries resulting from some other sudden stress phenomenon, particularly rapid deceleration -- should also be considered in determining skills training for a military surgeon during times of peace.

A shock trauma setting -- although a civilian setting -- could be used as a resource for a military training program to better understand injury caused by missiles and to keep the skills of a military surgeon intact during times of peace. In this way, if a national emergency or disaster occurred, the important lessons gained in time of war would not have