PART FOUR: INJURIES AND MEDICAL INTERVENTIONS

Tactical medicine can be defined as both emergent and non-emergent care provided to victims of illness or injury related to law enforcement or military operations, often in a hostile environment. Tactical medicine in the early years was often referred to as tactical emergency medical support (TEMS). The emergency medical services (EMS) and prehospital community called it tactical EMS, and the U.S. military coined the phrase combat casualty care. Numerous law enforcement agencies now have tactical medical teams composed of on-call physicians andprehospital care providers. Because many law enforcement agencies and branches of the U.S. military have embraced this concept, it is now commonly known as tactical medicine.

Prior to 2001, there was a perception of professional separation between doctors in traditional medical practice and the tactical medicine physicians involved in law enforcement. This was probably related to what might be seen as competing priorities for physicians when dealing with sick or injured patients who are suspects in a police investigation.

No other subspecialty in emergency medicine has experienced the growth rate of tactical medicine. In the past 15 years, more than 170 publications addressing tactical medicine issues have been written. Tactical medicine educational programs have trained thousands of emergency medical technicians (EMTs), paramedics, and physicians, who have responded to the call to provide on-scene emergency medical care to members of the law enforcement community or active duty military. Tactical medicine is very similar for both military and civilian tactical providers. Techniques, strategies, protocols, and equipment are all virtually identical, with few differences. The military tactical medical provider must deal with long deployment times, therefore incurring a significant preventative medicine requirement. Although routine medical care and performance enhancement (e.g., conditioning, nutrition, rest) are important for both civilian and military tactical teams, they take on a longer-term function for the military tactical medicine provider. A civilian tactical operation typically takes hours to days. (The Waco and Ruby Ridge incidents were exceptions, more in concert with a military length of engagement). A typical tactical military operation may take days to months, and other aspects—disease and nonbattle injury—become as important as the tactical medical care (Table 23-1).

Tactical medicine has been a mainstay of military operations since the beginning of modern warfare. The hospital corpsman, or combat medic, was deployed on the front lines to provide basic medical care. This care was provided under fire, sometimes in the harsh environments of the jungle, the desert, high mountains, and underwater. As the science of medicine improved, the need to move higher levels of care further toward the forward edge of the battle area was recognized. Shock trauma platoons, manned by emergency physicians and support staff, were sent to the front lines to provide advanced resuscitative support. These units could be fully operational and seeing patients in less than 30 minutes. Mobile surgical teams and forward resuscitative surgical teams developed the technology to put trauma surgical teams within minutes of the location of a combat casualty. These teams are fully mobile...
and are able to set up or dismantle in 30 minutes, utilize tent shelters or shelters of opportunity within which to perform operations, and provide life-saving damage control surgery to multiple patients under the extreme conditions of modern warfare (Fig. 23-1).

Systems are designed so that staff can resuscitate, treat, and transport patients in extreme hot or cold temperatures, over rough terrain and hostile territory, while the patient is paralyzed and intubated, while wounds are still open, and while attempts are made to prevent the hypothermia, dehydration, and coagulopathy inherent in postsurgical patients (Fig. 23-2).

Tactical medicine has advanced to anticipate and react to changes in combat strategy. In Operation Iraqi Freedom, the initial injury patterns were primarily high-velocity penetrating wounds—that is, mostly gunshot wounds (Fig. 23-3 and Table 23-2). As the war has progressed, the weapon of choice of the insurgents has become the improvised explosive device (IED) (Fig. 23-4). This weapon produces significantly more trauma, including shrapnel, blast, and thermal injuries. It has also required a change in protective body armor as the injury patterns have changed to include more devastating extremity and head-and-neck wounds than torso wounds (Fig. 23-5). The IED has also continued to cause problems with torso injuries, as the blast patterns cause shrapnel to angle up under traditional body armor and through arm openings. This has promoted development of armor that helps better protect these areas.

The terrorist attacks of September 11, 2001, and events such as the 1999 Columbine High School shootings heightened our nation’s awareness of the real threats of terrorism and violence.

<table>
<thead>
<tr>
<th>PRIMARY ICD-9 DISEASE CATEGORY</th>
<th>n</th>
<th>% OF TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digestive</td>
<td>44</td>
<td>17.4</td>
</tr>
<tr>
<td>Symptoms ill defined</td>
<td>38</td>
<td>15.0</td>
</tr>
<tr>
<td>Mental disorders</td>
<td>29</td>
<td>11.5</td>
</tr>
<tr>
<td>Musculoskeletal</td>
<td>29</td>
<td>11.5</td>
</tr>
<tr>
<td>Genitourinary</td>
<td>21</td>
<td>8.3</td>
</tr>
<tr>
<td>Nervous system sense organs</td>
<td>17</td>
<td>6.7</td>
</tr>
<tr>
<td>Skin</td>
<td>15</td>
<td>5.9</td>
</tr>
<tr>
<td>Suppemental</td>
<td>15</td>
<td>5.9</td>
</tr>
<tr>
<td>Infectious and parasitic</td>
<td>10</td>
<td>4.0</td>
</tr>
<tr>
<td>Circulatory</td>
<td>10</td>
<td>4.0</td>
</tr>
<tr>
<td>Endocrine, nutritional</td>
<td>8</td>
<td>3.2</td>
</tr>
<tr>
<td>Neoplasms</td>
<td>6</td>
<td>2.4</td>
</tr>
<tr>
<td>Respiratory</td>
<td>5</td>
<td>2.0</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Congenital</td>
<td>3</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>253</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Navy/Marines Operation Iraqi Freedom from 21 March to 15 May 2003.
ICD, International Classification of Diseases.
on U.S. soil and diminished some of the resistance to medical providers being actively and closely involved in law enforcement special operations. Today, hundreds of fire and EMS agencies provide tactical emergency medical support to federal, state, and local law enforcement special operations teams.

**Law enforcement special operations, often referred to as SWAT (special weapons and tactics) teams, are intended to deal with a wide range of high-risk criminal problems and threats.**

These include, but are not limited to, hostage rescues, terrorist acts, barricaded suspects, violent and suicidal suspects, takeover bank robberies, high-risk warrant services, and active shooter situations.

Patient advocacy, with priorities of ensuring the best possible quality of care and patient confidentiality, can be at cross purposes with a police officer trying to gather important facts in

**TABLE 23-2. Battle Conditions Encountered by Tactical Medical Personnel (Spring 2003)**

<table>
<thead>
<tr>
<th>MECHANISM OF INJURY</th>
<th>n</th>
<th>% OF TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gunshot wound</td>
<td>76</td>
<td>24.1</td>
</tr>
<tr>
<td>Shrapnel/fragmentation</td>
<td>65</td>
<td>20.6</td>
</tr>
<tr>
<td>RPG (handheld antitank grenade- launcher/grenade)</td>
<td>39</td>
<td>12.4</td>
</tr>
<tr>
<td>Motor vehicle accident</td>
<td>28</td>
<td>8.9</td>
</tr>
<tr>
<td>Fall</td>
<td>17</td>
<td>5.4</td>
</tr>
<tr>
<td>Explosion</td>
<td>16</td>
<td>5.1</td>
</tr>
<tr>
<td>Unknown/not recorded</td>
<td>16</td>
<td>5.1</td>
</tr>
<tr>
<td>Landmine</td>
<td>14</td>
<td>4.4</td>
</tr>
<tr>
<td>Blast</td>
<td>11</td>
<td>3.5</td>
</tr>
<tr>
<td>Mechanical/machinery</td>
<td>13</td>
<td>4.1</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>3.2</td>
</tr>
<tr>
<td>Multiple (NOS [not otherwise specified])</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Blunt</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Debris</td>
<td>3</td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>315</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Navy/Marines Operation Iraqi Freedom from 21 March to 15 May 2003; wounded in action.

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![Figure 23-4](image1.png)

**Figure 23-4.** An example of an improvised explosive device (IED): A hand grenade wired to the undercarriage of a vehicle. (Courtesy Lawrence E. Heiskell, MD.)

![Figure 23-5](image2.png)

**Figure 23-5.** Anatomic location of injury (wounded in action [WIA] only). (Courtesy Naval Health Research Center.)
an investigation to ensure public safety and justice. Tactical medicine must respect both patient rights and mission goals. SWAT teams are found in most midsize and larger law enforcement departments. In some areas, a number of small departments have banded together to form multi-jurisdictional or regional SWAT teams. Harsh environmental conditions, including what many regard as wilderness, will increasingly provide a backdrop for incidents requiring tactical efforts.

> **HISTORY OF COMBAT CASUALTY CARE**

Much of the training and tactics of civilian SWAT teams are based on the experience of military special operations teams. Such military teams have their origins in the U.S. Office of Strategic Services and the British Special Air Service during World War II (WWII). Some of the earliest military special operations teams incorporated tactical medical components.

German Fallschirmjäger (paratroopers) incorporated a well-organized medical support team with physicians. Dr. Heinrich Neumann jumped with the unit during the invasion of the island of Crete in 1942. During the Normandy Invasion of June 6, 1944, at Pegasus Bridge on the Orne River, the British, led by Major R. J. Howard, landed with medical support accompanied by a physician, Captain J. Vaughan of the Royal Army Medical Corps. The U.S. Armed Forces during WWII also incorporated physicians in their assault on fortified Europe. Dr. Robert Franco and Dr. Daniel B. McIvory both parachuted into Sicily with the 82nd Airborne Division in April 1943 and jumped into Normandy in June 1944.

During the 1950s, the Army Special Forces (77th Special Forces Group) was formed. As U.S. special operations teams evolved, other specialized teams, such as DELTA, America’s elite counter-terrorist force, were formed. Each of these special operations units has a plan for tactical medical support. The growth of terrorism in the 1970s resulted in the formation of other special operations groups worldwide. The Germans established a special unit within their border police, later presented to the world as GSG9 (Grenzschutzgruppe-9). This unit emerged after the 1972 tragedy at the Olympic Village in Munich, Germany. The French formed the Groupe d’Intervention de la Gendarmerie Nationale in 1974, and many other countries have since developed similar units.

Medical providers in the combat environment were traditionally taught to perform with the principles of ATLS (advanced trauma life support). Although this training was instrumental in decreasing the morbidity and mortality of trauma victims in the noncombat scenario, it fell short of providing appropriate care for the patient and the combatant team members on the field of battle. Numerous reviews of past and recent conflicts have noted the inadequacies of this approach to battlefield medical care.

Nine percent of battle deaths occur in the field, prior to any medical intervention. Bellamy did a landmark review of wounds and death in battle. In this study, he noted that 31% of battlefield deaths resulted from penetrating head injury, 25% from surgically uncorrectable torso trauma, 10% from potentially correctable torso trauma, 9% from exsanguinating extremity wounds, 7% from mutilating blast trauma, 5% from tension pneumothorax, 1% from airway obstruction, and 12% from various wounds (sepsis and shock off the battlefield) (Fig. 23-6A). Potentially preventable battlefield causes of deaths include bleeding to death from extremity wounds, tension pneumothorax, and airway obstruction.

These statistics have proven true in today’s Global War on Terrorism conflicts and in most tactical medical scenarios. They gave rise to questions about the pure application of the basic advanced life support precepts of airway, breathing, and circulation (ABC) for battlefield and tactical situations. In 1993, led by the Naval Special Warfare Command, a multi-agency working group (Committee on Tactical Combat Casualty Care), including special operations physicians, medics, corpsmen, and operators, began a 2-year study of this issue. This led to the guidelines titled Tactical Combat Casualty Care in Special Operations. The committee meets regularly and reviews new equipment, practices, and current operations for lessons learned, and then revises the guidelines as appropriate. These guidelines, which evolved from the special operations community, are currently being evaluated and implemented in most combatant units of the U.S. military, and of many other countries.

The need for civilian SWAT teams in the United States evolved from high-profile criminal acts that resulted in shocking losses of human life. The seminal incident involved a sniper at the University of Texas at Austin. On August 1, 1966, Charles Whitman shot and killed 15 people and wounded 31 others.

In the midst of this tragedy, it became apparent that the law enforcement agencies called out were ill equipped to deal with the threat, hampered by inadequate weaponry and not trained to respond in a timely and optimal fashion. After this incident, many law enforcement agencies began developing specially trained and equipped tactical units to respond rapidly to such threats to public safety. The Los Angeles Police Department and the Los Angeles County Sheriff’s Department were among the first law enforcement agencies in the United States to organize and develop full-time tactical units specifically trained to handle high-risk incidents.

Before 1989, there existed great diversity in the ways emergency medical care was provided during law enforcement tactical operations. Early on, most law enforcement agencies relied on regular civilian EMS providers staged at a safe location removed from the area of operation, or they simply called 911. Although this took advantage of an already established prehospital care system, care for injured officers was delayed.

Other agencies trained full-time SWAT officers as EMTs or paramedics. This concept of getting medical care “close to the fight” was also realized in the Gulf War, and the military put this new concept in place during Operation Iraqi Freedom. Information obtained from interviews with military emergency physicians who served in Iraq has suggested success of the new model of battlefield care.

> **PRINCIPLES OF TACTICAL COMBAT CASUALTY CARE**

Tactical combat casualty care (TCCC) varies from ATLS in several distinct ways, primarily because the victim and the medical provider are not in a safe environment. Additionally, medical care of the victim may not be the highest priority, and the team may be hours from higher levels of care and operating in the open under extreme environmental conditions.
The premise of TCCC is to do the right things at the right times. Underlying this basic statement is the suggestion that good hospital-based medicine is often not good battlefield medicine, as logically follows from these three statements:
1. Good medicine can be bad tactics.
2. Bad tactics can get everyone killed.
3. Bad tactics can cause the mission to fail.

The ultimate goals of TCCC are the following:
1. Treat the casualty.
2. Prevent additional casualties.
3. Complete the mission.

TCCC is divided into three main stages of care: care under fire, tactical field care, and combat casualty evacuation care. These are defined in the following paragraphs.

**Care under Fire**
Sometimes care is rendered by the medic or corpsman at the scene of the injury while he is still under effective hostile fire. The medical equipment available is limited to what the individual operator or the corpsman or medic can carry in the medical pack. The most effective medical care during this stage of TCCC is fire superiority—that is, winning the battle, or at least keeping enemy heads down and weapons ineffective. The medical provider (and the casualty if able) must work to suppress hostile fire and eliminate the threat as directed by the mission commander, and, if possible, to protect the injured fighter from further harm.

For many reasons, this is undoubtedly the most difficult phase of TCCC. First, the traditional provider, trained to be a "medic first," may find it hard to direct attention to the threat and not maneuver to respond to the casualty. Second, this phase usually occurs in the most exposed environment, where the provider cannot use his normal assessment tools. For example, during nighttime he cannot use a light, as it would draw more fire, and listening for lung sounds with a stethoscope in an explosion-rocked firefight is useless. In earlier conflicts, it was noted that...
many medics and corpsmen who responded to casualties instead of suppressing fire were wounded or killed, and that a significant number of the victims that they were trying to rescue were already dead. The priorities for the provider during this phase of care, therefore, are as follows:

1. Return fire as directed or required.
2. Try to keep yourself from getting shot.
3. Try to keep the casualty from sustaining additional wounds.
4. Stop any life-threatening external hemorrhage with a tourniquet.
5. Take the casualty with you when you leave.

Airway and breathing problems are not addressed during this phase. The key action is to stop exsanguinating hemorrhage. A tourniquet is the primary means to stop the bleeding on an extremity (Figs. 23-7 through 23-10).

The tourniquet can be applied and left in place by the injured operator or medic, who can then return fire in support of the team. If a tourniquet cannot be placed because of the location of the wound, then direct pressure and a hemostatic dressing are recommended as the appropriate actions.

As soon as possible, the casualty is moved to a safer location, and the next phase of TCCC is instituted. This movement is performed with techniques dictated by the tactical situation. It can be done by, for example, vehicles, pack animals, buddy lifts, or dragging. Another departure from traditional ATLS teaching is that cervical spine protection is not routinely provided in this phase of care. Studies of penetrating neck injuries in Vietnam demonstrated that only 1.4% of patients with penetrating injuries would have benefited from cervical spine immobilization. Although not all combat-related injuries are penetrating, the complexities of moving a patient in an environment where the patient and provider are under fire often preclude even rudimentary cervical spine immobilization.

**Tactical Field Care**

The tactical field care phase consists of care rendered once the medic or corpsman and the casualty are no longer under effective hostile fire. It also applies to situations in which an injury has occurred on a mission but there has been no hostile fire. Available medical equipment is still limited to that carried into the field by mission personnel. Time prior to evacuation to a medical treatment facility may vary considerably.

In this phase, the medic has a short time to evaluate and treat the wounded. The medic assesses injuries, performs medical...
care as able (equipment still limited to what was carried onto the battlefield), and then informs the mission commander of the findings. The mission commander then determines what action will be taken (evacuation, abort, continue). This again may be a major departure from nonmilitary medical care, in that the medical provider is not the ultimate authority on patient disposition. The mission commander decides how much time is taken to care for the casualty in any phase of the operation, if and when MedEvac will occur, and what assets will be allocated from the primary mission toward care of the injured.

During this phase, the provider must assume not only that hostile fire may occur at any time but also that any injured team member with altered mental status may become a threat. The provider must therefore disarm the team member, an action that most warriors resist. This is the first step in the tactical field care phase.

The second step is to address airway compromise. Airway actions are usually rendered as follows: if the victim is unconscious without obstruction, utilize a nasopharyngeal airway (better tolerated and less likely to become dislodged with movement)\(^1\) and a rescue position if able. If airway obstruction is present and cannot be alleviated with these maneuvers, the next recommended treatment is to move directly to a surgical cricothyrotomy. Endotracheal intubation is not recommended at this level of care for several reasons: (1) It requires the medic to carry onto the battlefield, equipment that has no other purpose, (2) the medic must practice regularly to maintain his skills, (3) success rates under austere conditions are believed to be significantly less than those done in a controlled or semi-controlled setting, and (4) the laryngoscope light may compromise team safety on the field.\(^2\) Emergency cricothyrotomy is the best option in this phase of TCCC. Because of distorted anatomy, it is the best way to protect the airway of a patient with maxillofacial wounds. Blood and tissue in the airway preclude visualization of the cords and make endotracheal intubation difficult or impossible.\(^3,4,5\)

The third step is to treat breathing difficulties. Any severe progressive respiratory distress is assumed to be due to a tension pneumothorax (the number-two cause of preventable battlefield deaths). One cannot wait for the classic signs (which are unreliable at best and most often impossible to ascertain on the battlefield) of diminished breath sounds, hyperresonance, and tracheal deviation to make this diagnosis.\(^5\) Therefore, faced with victims in increasing respiratory distress and with unilateral penetrating chest trauma, the medic will go directly to a needle thoracostomy. This is the definitive procedure in this phase. A chest tube is not usually needed, it is difficult to perform on the battlefield, and it would only further complicate patient care, transportation, and mission completion.\(^14,52\)

The fourth step is to readdress bleeding. The medic rapidly locates uncontrolled hemorrhage and any wounds where a tourniquet has been placed. If possible, a hemostatic dressing is placed; the tourniquet may be discontinued if the wound and tactical scenario permit. Even if the bleeding appears controlled, further “tough” evacuation may necessitate keeping a tourniquet in place to prevent rebleeding. Each action that the medic takes is designed to save life with minimal further care by the medic. For example, a medic who is holding pressure on a bleeding wound cannot return fire, take care of other casualties, or perform other procedures on this patient. The patient is not optimally prepared for transportation, which may consist of being thrown over someone’s back and carried out. Thus, a tourniquet that would be a last-ditch effort in a noncombative environment becomes the method of choice in the tactical combat situation. Each operator in the field carries, and knows how to use, at least one tourniquet that can be self-applied. This allows the operator to self-administer life-saving bleeding control and then continue with the fight until treatment by the medic is possible.

The fifth step is for the medic to determine whether an intravenous (IV) line or a saline lock is beneficial. The advantages would be that the patient could receive fluid resuscitation and IV antibiotics. Disadvantages include a probable delay in transportation, the additional equipment required (and the bulky apparatus that could become dislodged or tangled during evacuation), and difficulty in placing a line under austere tactical conditions. If an IV is deemed necessary but cannot be expeditiously placed, the intraosseous route is utilized. Several devices can be used to achieve this, including large-bore hypodermic needles, traditional intraosseous setup, or devices such as the FAST-1 (fast access for shock and trauma) and BIG (bone-injection gun), which quickly and accurately place the needle in the sternum or in another appropriate location.

The medic's sixth step is to determine whether fluid resuscitation is required. In general, if the patient is not in shock (the best indicators of shock in the field are altered mental status in the absence of head injury, and weak or absent pulses), then no IV fluids are necessary. If the patient is conscious, oral rehydration is permissible and preferred in many tactical scenarios. If the patient is in shock, the medic can give Hextend\(^6\) as a 500-mL bolus and reassess after 30 minutes. If the victim is still in shock, the Hextend is repeated once. Usually, no more than 1000 mL of Hextend is given, and further efforts at resuscitation are determined by the tactical scenario. If the patient has a traumatic brain injury and is unconscious and pulseless, fluid resuscitation is given to restore the pulse. This protocol maximizes survivability of the patient and limits the amount of equipment necessary to be carried onto the battlefield.

After exsanguinating hemorrhage, airway compromise, and breathing difficulties have been addressed, the seventh step in the tactical field care medical plan is to inspect and dress known wounds. The medic locates and appropriately treats wounds already identified but not yet treated because of tactical considerations and then proceeds with a quick but thorough head-to-toe assessment for additional wounds. This is analogous to the secondary survey of ATLS, with a couple of notable exceptions. First, the patient is not exposed. This is because the patient may have to be moved quickly if the tactical situation changes, and because the patient must be kept warm and protected from further injury for a much longer time than in an urban setting. The medic often does this examination by feel in order to avoid using white light, to keep the victim's body armor as intact as possible, and to avoid cutting off protective clothing that may be required during evacuation.

Step eight is to assess for pain control. Analgesia is administered in this phase of care with the following considerations. If the victim is able to fight, non-narcotic preparations are used. These do not affect mental status, allowing the victim to remain armed and responsive. If the victim is unable to fight, morphine and promethazine, IV or intramuscular (IM), are given as needed. Step nine: If not already done, fractures are splinted and neurovascular status is rechecked.

Step ten, the early administration of antibiotics for open combat wounds, significantly reduces the rate of infection.\(^12\)
1. Casualty evacuation care is as follows:

After these measures have been taken, or if medical evacuation is now available, the last phase of TCCC, combat casualty evacuation care, is entered.

**Combat Casualty Evacuation Care**

This phase of care is rendered once the casualty (and usually the rest of the mission personnel) has been picked up by an aircraft, land vehicle, or boat. Additional medical personnel and equipment that have been prestaged in these assets should be available at this stage of casualty management. The management plan aligns closely with that of the tactical field care phase, with the addition of more equipment and perhaps higher levels of medical providers. This phase is also the phase most similar to ATLS, although it may occur in the back of a moving conveyance and is still somewhat limited by available equipment and the tactical scenario. The basic medical plan for combat casualty evacuation care is as follows:

1. **Airway management:** Same as for tactical field care, with the addition of laryngeal mask airway (LMA)/Combitube/endo-tracheal intubation for definitive airway management prior to cricothyrotomy if the operators are trained and the patient can be intubated (e.g., has no midface injuries). Spinal immobilization is still not deemed necessary for casualties with penetrating trauma for the reasons stated earlier.

2. **Breathing:** Same initial considerations as for tactical field care. A chest tube can be placed if needle thoracostomy has produced no improvement in breathing, or if long transport is anticipated. Most combat casualties do not require oxygen, but its administration may be of benefit in the following situations: low oxygen saturation by pulse oximetry, injuries associated with impaired oxygenation, unconscious patient, and traumatic brain injury (to maintain oxygen saturation >90%). Sucking chest wounds should be treated with petroleum jelly applied during expiration, covering it with tape or a field dressing, placing the victim in the sitting position, and monitoring for development of a tension pneumothorax. Asherman seals are also ideal for quickly securing chest tubes and for sucking chest wounds.

3. **Bleeding:** Same as for tactical field care.

4. **IV:** Same as for tactical field care.

5. **Fluid resuscitation:** Same as for tactical field care, with blood and/or lactated Ringer’s solution possibly available.

6. **Monitoring, wound care, re-inspection for additional wounds, analgesia, re-assessment of fractures, antibiotics:** All the same as for tactical field care.

The following scenario exemplifies the concepts of TCCC and the various phases of care. Consider a Special Forces team on a night mission. They jump from an aircraft at night into hostile territory. They are then to travel by foot over 1 mile of rocky, mountainous terrain to secure the objective, and then move to the shoreline for a waterborne extraction. On the initial jump, one of the operators sustains an open femur fracture. The medic and the team leader must consider (at a minimum) the following issues:

- How to treat the injured member with the equipment they carried in (keeping in mind that a potentially long evacuation wait time precipitates the need to minimize injury, control pain, prevent infection, avoid shock, defend selves, and maintain concealment)
- How or whether to continue the mission

**Option 1.** MedEvac the injured member, breaking operational security and calling for helicopter extraction.

**Option 2.** Commandeer a local vehicle and driving to a pickup site, taking the patient to the planned extraction site, and continuing with the mission.

**Option 3.** Aborting the mission and leaving the injured member and possibly some of the team behind to provide security until they return with help.

Thus, a single injury throws a lot of variables into the mission commander’s decision tree. Preplanning for medical situations is essential, and the medical member of the team is essential in the planning and execution of the mission.

A main precept of TCCC is to move the medical care from the sole responsibility of the combat medic, to involve each operator and each level of leadership. Each fighter carries a tourniquet that can be self-placed. Each fighter is trained in basic combat lifesaving skills so that the effects of wounds can be minimized (within defined limits) and fire can be returned until the medic can arrive and perform the appropriate advanced medical care. Each leader, from the squad level up, is trained to evaluate medical concerns as an integral part of the mission execution and is able to decide when to abort the mission, when to continue, and when to alter the plan, based on the mission objective and the issues that the injured team member or members bring to the fight.

**PRINCIPLES OF TACTICAL MEDICINE**

The tactical environment presents unique challenges to law enforcement officers, and the same is true for personnel providing EMS in that environment. Tactical medical care providers must have an understanding of and consideration for law enforcement tactics and mission-specific objectives when planning and providing medical support (Fig. 23-11). Traditional EMS doctrine maintains that rescuer and scene safety are first priorities, and that patient care is a secondary concern. The nature of tactical operations requires that law enforcement officers and tactical medical personnel operate in unsecured environments and situations with significant potential for violence and injury (Fig. 23-12). Tactical scenes are...
rarely safe from the civilian standpoint, but tactical medical personnel are trained to conduct concise and limited medical evaluations and interventions in potentially threatening areas.85

What sets tactical EMS apart from standard EMS is the ability to render immediate care in an environment that may not be completely secured from threats (Fig. 23-13). When a SWAT team relies on traditional EMS to provide medical care and an operator or civilian is acutely injured during the mission, the EMS unit must wait until either the victim is brought out to the safe (“cold”) zone (Fig. 23-14) or for the entire scene to be secured by law enforcement before moving to the patient. When a tactical medical unit is present, care can generally be rendered to the victim in a timely manner, and when the injuries involve acute airway issues or life-threatening hemorrhage, lives may be saved by faster access to care.

Other differences between tactical EMS and conventional EMS include limitations in medical equipment at hand, performing in adverse or austere environments (e.g., while maintaining light or sound discipline), and performing patient assessment from remote locations.90 “Medicine across the barricade” involves remote evaluation and management of patients, such as when a hostage has become ill or injured and the provider attempts to assist the victim by using the eyes, ears, and hands of someone closer to the situation.35 The tactical medical provider must use skills not unlike those of an EMS dispatcher handling an emergency over the radio. In addition, standard EMS medical care performed in specific clinical scenarios may require a different approach when the same situation is encountered under tactical conditions.34

Tactical medicine can be provided by EMTs, paramedics, registered nurses, mid-level providers (physician assistants, nurse practitioners), or physicians who serve on police tactical teams.47 Mid-level providers and physicians traditionally have training in advanced surgical and medical procedures beyond what is normally allowed for traditional EMS personnel.22 The primary goal of tactical medicine is to assist a tactical team in accomplishing its mission. This is achieved through team health management—keeping the tactical team members healthy before, during, and after operations.21 A full tactical medicine program encompasses the provision of preventive and acute medical and dental care, and for some teams even canine support veterinary care.50 Ready access to such care has a positive effect on team morale.

One of the most important roles of the provider is to create a formal medical threat assessment for each training and operational deployment. This includes consideration of issues such as environmental conditions (heat, cold, wind) (Fig. 23-15), fatigue (and the possible need for rotating operators), nutritional issues,23 plant and animal threats, and a plan for extrication and transport of patients.11 When operational, this medical plan should include any medical intelligence that can be gathered prior to or during the mission, including issues such as who is involved, ages of those involved, medical history and
background, preexisting medical conditions, geographic location, and even the weather.20

SWAT teams and their tactical medical teams are important community resources not only for their response to major emergencies (e.g., weapons of mass destruction) but also in planning for them. Tactical medical operators, in conjunction with local medical control, EMS, and public health officials, should take a leadership role to ensure that aggressive, proactive planning for these future threats is completed before the resources are needed.17,105

Although no one doubts that some terrorists, outlaw states, and even organized criminals have the capability to produce or access chemical and biological agents, the question is whether they will use them.39 The use of explosive devices is on the rise worldwide. The potential for terrorist acts against the United States is immeasurable. As a result, domestic preparedness and proper training for blast injuries is essential.27,32,38,75,98

It is advantageous to have more than one provider as a part of a tactical team. In the event of a serious injury or when multiple casualties are involved (e.g., in a raid on a clandestine drug laboratory),48,61 one of the team’s responsibilities is to lessen the agency’s liability exposure with adequate written, photographic, diagrammatic, or video documentation.66 Another benefit of having multiple providers is the ability to send a provider to the hospital with an officer who becomes ill or injured during a mission. This provider can serve as a concerned advocate for the officer and as a go-between with hospital personnel, which provides significant reassurance to the entire tactical team.44,46,71

Team Health Management

Tactical medical providers ensure that everyone on the team is healthy and optimally fit for duty.45 The team’s medical officer is responsible for the team’s physical fitness, diet, exercise, sleep, stress management, and preventive medicine. The tactical unit can be viewed as a group of elite operators who are “occupational athletes.”

Strength training for many tactical operators consists of traditional bodybuilding exercises. However, this type of physical conditioning does not duplicate the actions needed to perform as a tactical operator. A SWAT team member never does a bench press on a tactical entry. Tactical operators, like professional
athletes, need a broad-based program of training and physical conditioning tailored to the specific actions they will perform. The team's medical officer should stress regular physical conditioning. A comprehensive plan of proper nutrition and exercise must be established and maintained. This should include a balance of aerobic and anaerobic exercises and stretching. Cardiovascular fitness workouts, such as running or swimming, are excellent for the tactical team. Full-body or resistance circuit weight training is excellent for strength training, but it must be a total body workout. Training some parts of the body but ignoring others can lead to costly injuries and a lower level of fitness than desirable.

Flexibility training is one of the best ways to prevent injuries in the field. Unfortunately, it is frequently ignored. Regular stretching or yoga has been long recognized as beneficial in athletic physical conditioning. In this respect, the tactical unit is no different from any other group of athletes. When the physical conditioning program encompasses all these points, the team operates at its peak potential with fewer injuries.

A sound diet should be stressed and maintained, but diet is often a controversial topic. In response to the obesity problem in the United States, the Food and Drug Administration (FDA) and many other researchers have looked at diets worldwide and their effects on the human body. Randomized clinical trials studying the risks and benefits of various individual diets are only recent works. The FDA studied the traditional food pyramid (based on four food groups and no longer considered a valid nutritional program), and Mediterranean, high-carbohydrate, high-fat, high-protein, low-fat, low-carbohydrate, Atkins, Zone, Weight Watchers, Ornish, and South Beach diets. They revised their food pyramid to a more balanced program designed for variations in age, sex, and level of physical activity, and containing five food groups: grains, vegetables, fruits, milk, and meat and beans. Fats, sugars, sodium, and total caloric intake are restricted. The FDA has an interactive website for the new food pyramid (www.foodpyramid.gov). Although our knowledge of diet and exercise is improved, data continue to be gathered, and the perfect dietary program for the tactical operator is not yet known. Nonetheless, fast foods and simple sugars should be deemphasized or eliminated from the tactical operator's diet.

The team medical officer essentially becomes the family physician for the tactical unit and should be prepared for this role. Regardless of the level of training, the team physician will be viewed as the medical advisor to the tactical unit. It is this relationship that fosters better team health overall, and better performance of the unit as a result. Preventive medicine should be stressed with regular physical examinations and treatment where appropriate. Smoking cessation, alcohol and drug counseling, and stress management are the responsibility of the team medical officer.

**Tactical Medical Equipment**

In general, tactical EMS equipment comes from other areas of emergency medicine and law enforcement and is combined into field-expedient, multifunction toolkits. Looking at the gear as a whole, a modular approach may be most helpful (Fig. 23-16A). The gear differs depending on the roles of the providers and the tactical unit. Basic equipment for the operator includes essential items. Typically, an operator has a duty uniform consisting of a battle dress uniform or jumpsuit. The uniform may undergo appropriate modifications depending on weather conditions. As with other areas of outdoor activity, it is wise to use a system of appropriate layers that can be easily adjusted to changing weather conditions. Waterproof and breathable outer layers may be a consideration, as are wicking underlayers. In addition to the standard duty uniform, a Nomex balaclava and gloves are worn to protect from exposure to pyrotechnic devices on many entries.

Because this is an environment where gunfire may be encountered, ballistic protection is needed. For the tactical medical
provider, levels I and IIa are not advised. Level II is the bare minimum if the body armor is concealed under a shirt or uniform, but levels IIIa to IV are better (Table 23-3, and see Figure 23-16B). These levels of protection have a good balance of bullet stopping power and ability to absorb blunt trauma. Many tactical operators combine body armor with ballistic plates made of metal or ceramic, which stop high-velocity rifle bullets. Body armor is chosen by the agency from a vast array of different types and styles produced by a host of manufacturers. Some tactical physicians also carry a Kevlar blanket or ballistic shield, which can be used to cover a patient in harm’s way or can be used as a mobile source of cover when providing care or extracting a downed victim. These blankets, although effective, are extremely heavy and bulky.

The weight and bulk of all nonmedical tactical equipment hinders the ability to carry large amounts of additional material. The medic needs to decide how much can be carried and whether to wear a backpack or a load-bearing vest, or neither. In general, the tactical medical provider must be able to effectively carry equipment and operate in a tactical situation without hindering the rest of the team. Of the two general sets of medical equipment, one is carried for immediate care, typically worn in a small backpack or load-bearing vest, and the second is carried in a larger backpack or duffel bag in the support vehicle. The latter is used for more extensive treatment, multiple casualties, and prolonged transports.59

### Communication
Communication between team members and members outside the area of the operation is often essential. Radios with throat microphones and headsets are fairly standard on most tactical units. Radios tend to be on secure channels to ensure the security of a mission. Some communications may even be encrypted. Simple communication between members may involve standard or specialized sign language.

### Entry and Breaching Tools
Specialized entry tools are used to gain access to barricaded subjects or closed doors. Typical items, familiar to firefighters and EMS personnel, include pry bars, battering rams, sledge hammers, hooks on chains or rope, stop blocks, and halligan tools (Fig. 23-17). Ladders may be needed to gain access to an elevated or depressed point. In extreme cases, a variety of explo-

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**TABLE 23-3. U.S. Department of Justice Rating of Body Armor**

<table>
<thead>
<tr>
<th>ARMOR TYPE</th>
<th>TEST ROUND</th>
<th>TEST AMMUNITION</th>
<th>NOMINAL BULLET MASS</th>
<th>MINIMUM REQUIRED BULLET VELOCITY</th>
<th>REQUIRED FAIR HITS PER ARMOR PART AT 0° ANGLE OF INCIDENCE</th>
<th>MAXIMUM DEPTH OF DEFORMATION</th>
<th>REQUIRED FAIR HITS PER ARMOR PART AT 30° ANGLE OF INCIDENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>38 Special RN Lead</td>
<td>10.2 g</td>
<td>259 m/sec</td>
<td>4</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>22 LRHV Lead</td>
<td>158 gr</td>
<td>(850 ft/sec)</td>
<td>2</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td>II-A</td>
<td>1</td>
<td>357 Magnum JSP</td>
<td>10.2 g</td>
<td>381 m/sec</td>
<td>4</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>9 mm FMJ</td>
<td>158 gr</td>
<td>(1250 ft/sec)</td>
<td>4</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>1</td>
<td>357 Magnum JSP</td>
<td>10.2 g</td>
<td>425 m/sec</td>
<td>4</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>9 mm FMJ</td>
<td>158 gr</td>
<td>(1395 ft/sec)</td>
<td>4</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td>III-A</td>
<td>1</td>
<td>44 Magnum Lead SWC Gas Checked</td>
<td>15.55 g</td>
<td>426 m/sec</td>
<td>4</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>2</td>
<td>9 mm FMJ</td>
<td>8.0 g</td>
<td>(1400 ft/sec)</td>
<td>4</td>
<td>44 mm (1.73 in)</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>30-06 AP</td>
<td>10.8 g</td>
<td>868 m/sec</td>
<td>(2850 ft/sec)</td>
<td>1</td>
<td>44 mm (1.73 in)</td>
<td>0</td>
</tr>
<tr>
<td>Special requirement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*See section 2.2.7 of reference.
g, grams; gr, grains.
sive devices are available to trained explosive experts in the tactical unit to gain entry to an area.

**Weapons Systems**

Whether a team medic should be a sworn law enforcement officer or an armed civilian has been a subject of much debate. Regardless, a provider must be familiar with the unit’s weapons systems.

For offensive or defensive purposes, weapons systems are constantly encountered in the tactical arena. A provider who is a sworn officer has a primary role as an operator on the unit and a secondary role as a medical provider. However, a provider who is first a medical officer would still have to protect himself in a hostile situation and therefore would be armed defensively. In another scenario, the provider may be unarmed but may have to take charge of an officer’s weapon in a medical or tactical situation. An armed officer who is disoriented may become a danger to the team, so the provider would need to take charge of all of the officer’s weapons and render them safe. In the worst case, the provider may have to defend a downed officer using the officer’s weapon.

Weapons system familiarity is paramount for the tactical medicine provider. A provider should be familiar with every handgun, shotgun, rifle, submachine gun, assault rifle, and smoke or chemical agent gun used by the team. All tactical team members, whether providers or not, should be able to use any weapon a team member carries and render it safe. The provider should not be exempt from this requirement.

Different weapons systems use different ammunitions (see Chapter 22). Typically, there is a duty handgun, which shoots low-velocity handgun ammunition. This same ammunition may be used by a submachine gun, such as the Heckler and Koch (HK) MP5 UMP 40, or UMP 45. Calibers of the handgun and submachine gun should be matched to avoid the wrong caliber ammunition going into the wrong weapon, causing malfunction in a crisis situation.

Assault rifles, such as the Colt AR 15 or Colt M16, shoot .223-caliber high-velocity rifle that is bolt action for precision shots. The flight characteristics and ballistics of shotguns, rifle, and handgun ammunition vary depending on the weight, shape, and velocity of the ammunition. The provider should be familiar with the effects in order to treat field wounds appropriately.

In addition to traditional ammunition, the provider may be faced with the use of distraction devices, chemical munitions, and less lethal munitions. Chemical munitions deliver a chemical agent to an intended target to disorient or incapacitate and facilitate capture or surrender without loss of life. Typical chemical agents used in tactical operations are tear gas or a derivative of pepper spray. Less lethal munitions are also fired to incapacitate and facilitate capture. Unfortunately, with this use of force, injury is common, so the provider should be familiar with the injuries and their treatments. These munitions are low-velocity projectiles of wood, hard rubber, foam rubber, plastic, or bean bags. They have enough force to cause pain and usually make an assailant stop aggressive action on contact. They usually cause minor blunt trauma, but they may achieve enough force and velocity to penetrate into body cavities, causing penetrating injuries (Figs. 23-19 through 23-21).

Explosive breaching techniques and distraction devices, such as “flash-bangs,” are often deployed during tactical operations. The small explosives used to gain entry into an area can create injuries that the medic must be prepared to recognize and to treat effectively. For example, the flash-bang is a device that is hand thrown into an area to deliberately disorient a suspect and divert attention toward the device and away from the entry team. These devices usually have a nonexploding canister and a small explosive charge. The device is activated and thrown much like a military hand grenade, but it causes a brilliant flash of light (6 to 8 million candlepower) and a thunderous noise (175 decibels). This is accomplished by venting explosive gases through multiple holes in the canister (Fig. 23-22). Medical problems caused by flash-bangs and explosive entries include the following:
• Burns, both minor and major
• Smoke causing bronchospasm
• Vestibular dysfunction
• Transient visual disorientation
• Emotional upset and anxiety

Of note, in general use, the flash-bang has not been reported to cause ear drum rupture.

Explosive breaching is the role of the team’s explosives expert, with whom the medic should consult, as part of the medical threat assessment, about the types of explosives planned and the blast forces that may be encountered.

**Vision**

Covert operations and low-light situations dictate the use of visual adjuncts. Binoculars, tactical mirrors, spotlights, periscopes, strobe lights, chemical lights, and headlamps are often deployed in a low-light tactical environment (Fig. 23-23). Proper training and discipline are required for use of these devices in the tactical environment, as they may give away one’s position and alert a hostile opponent to the team’s position. Similarly, electronic night vision equipment, which operates outside of the range of visible light, is also extensively used.

**Medical Personal Protective Equipment**

Universal precautions against infectious diseases must be deployed; tactical medicine is no different from any other venue in this respect. Medical personal protective equipment (PPE) includes masks, eye protection, gloves, and perhaps gowns. In remote locations, surgical treatment may be provided prior to transport to a tertiary care center. The basics for protection should be carried on the provider’s person in a readily accessible location. Some don surgical gloves underneath their shooting gloves prior to an operation so they will be ready if the need arises. Although not sterile, they provide protection from blood and body fluid–borne pathogens.

**Personal Supply Module**

To reduce the amount of equipment carried by the medic and to help team members help themselves, each member of the tactical unit should carry a personal supply module (PSM), or “self-help kit,” with medical supplies. A team member can thus provide self-help or aid another member, and the medic may not have to be summoned until the scene is more secure. A typical PSM should be vacuum sealed and contain supplies for basic trauma care and for IV access (Table 23-4 and Fig. 23-24). Vacuum sealing these contents provides protection from the elements and makes them last longer. It also cuts down greatly on bulk, but it adds some weight.

**Basic Medical Module**

In addition to a PSM, a basic medical module (BMM) should be carried by team medics. Because every team member in a tactical unit should have at least basic EMT certification, a BMM could be used by any team member to provide initial care to a victim. The BMM should have basic splinting material and dressing material (Table 23-5).

Basic airway tools, such as nasal airways and pocket mask, should be included. A bag-valve-mask or a more compact alternative is advisable in the tactical environment. A simple bag-valve-mask alternative device (BVMAD) can be constructed out...
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Figure 23-21. Target areas for direct-fire or skip-fire less-lethal projectiles. The orange areas are nontargets, the green areas are preferred targets, and the yellow areas should be targeted with caution only. (Courtesy Armor Holdings, Inc.)

Figure 23-22. The Def Tec 25 flash-bang device. (Courtesy Lawrence E. Heiskell, MD.)

Figure 23-23. A Surefire headlamp setup can use white light or LED light in low-light tactical situations. (Courtesy Lawrence E. Heiskell, MD.)
of respiratory supplies from a one-way valve, flexible tubing, and a mouthpiece (Fig. 23-25). This is the preferred ventilatory device in the tactical environment, as it allows a rescuer to provide ventilation without unnecessary bulk.

Oxygen is rarely useful in the immediate tactical environment, so O₂ cylinders are left in the support vehicle with a regular bag-valve-mask and retrieved when necessary. An automated external defibrillator (AED) should be carried in the support vehicle. A small collapsible litter for extrication of a downed person should be a part of every BMM.

**Intermediate Medical Module**

An intermediate medical module (IMM) is intended to be used by paramedics and registered nurses. Unlike the BMM, it contains equipment and supplies suitable for advanced life support (ALS). Under standing orders from a team physician, ALS providers may provide advanced cardiac life support to a victim. An IMM is much more extensive than a BMM. It contains medications, IV tubing, IV fluids, an endotracheal tube, a Combitube, a laryngoscope, a light wand, and, if protocol allows, a cricothyrotomy kit (Table 23-6 and Figs. 23-26 and 23-27). These facilitate placement of a definitive airway prior to transport, which, when used with a BVMAD, permits hands-free ventilation of a patient, allowing extrication by one or two team members. Proficiency with the airway toolkit is of high priority, as conditions in the tactical environment are difficult at best.

**Advanced Medical Module**

The most complex module is the advanced medical module (AMM), intended for independent practitioners, such as nurse practitioners, physician assistants, and physicians. These practitioners can perform advanced surgical procedures and medical interventions that can make the difference between life and death on a long transport. Transport to definitive care should not be delayed unless medically necessary. However, if advanced care in the field is indicated, it can be provided by an independent practitioner with an AMM.

**Major Trauma Module**

Lengthy surgical interventions in the field are not advised and have extremely poor prognoses. Although rapid transport to a trauma center should not be delayed, some surgical procedures may be of benefit when performed in the field: laceration repair to stop bleeding or facilitate evacuation, cricothyrotomy, and,
in critical situations, chest tube insertion. These types of procedures can usually be performed using only the essential equipment found in a vacuum-sealed minor-surgery tray (Fig. 23-28), which can be one component of the major trauma module (MTM) for advanced providers (Table 23-7).

Many users include hemostatic dressings in trauma kits, but their use is not yet well studied. The efficacy versus the potential harm of hemostatic dressings is a subject of debate.

Direct pressure with a sterile dressing is the initial approach to hemorrhage control. The traditional and time-tested approaches of pressure-point compression and tourniquets are useful adjuncts to any bleeding problem, so these materials should be included in the MTM. A set of combine dressings, gauze, petrolatum gauze, and Israeli dressings should also be carried.

Support Vehicle Module

Additional supplies and equipment are kept in the support vehicle module (SVM). Consumable items should be kept in the SVM, so that other modules can be restocked from it (Table 23-8). The SVM contains equipment such as O2 cylinders, an AED, airway adjunct devices, fiberoptic scopes, nebulizers, surgical trays, chest tubes, cervical collars, backboards, peroxide, povidone-iodine, liter bags of crystalloid IV fluid, replacement filters for gas masks, and fiberglass splinting material.
TABLE 23-8. Sample Contents of Support Vehicle Module (SVM)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biohazard container</td>
<td>Disposal container for used sharps and medical waste</td>
</tr>
<tr>
<td>Saline eye flush</td>
<td>Foreign bodies in the eyes are common on entries</td>
</tr>
<tr>
<td>Elastic (ACE) wraps</td>
<td>Strains, sprains, and fractures are common</td>
</tr>
<tr>
<td>Splinting material</td>
<td>Fairly bulky and difficult to carry in the medical pack, C-collars are frequently kept here and may be retrieved when needed</td>
</tr>
<tr>
<td>IV fluids</td>
<td>For prolonged transport or massive hemorrhage, more IV fluid should be kept in the SVM and not carried on entries. Multiple IV start packs for use when necessary</td>
</tr>
<tr>
<td>Ice packs</td>
<td>Ice packs are commonly used, as ice is not always available in the field. If the location has a freezer, bags should be kept to use existing ice</td>
</tr>
<tr>
<td>Wound dressings</td>
<td>Additional adhesive bandages, Israeli dressings, combine dressings, ABG pads, and burn dressings</td>
</tr>
<tr>
<td>Advanced airway tools</td>
<td>Difficult-airway tools may be needed in the cold zone prior to transport, to secure a definitive airway</td>
</tr>
<tr>
<td>Spare uniforms</td>
<td>If decontamination is needed, the victim will need to be reconditioned in a clean, dry uniform, particularly in cold or wet environments</td>
</tr>
<tr>
<td>Oxygen cylinders</td>
<td>Best left in the support vehicle because of their weight</td>
</tr>
<tr>
<td>Bag-valve-mask (BVM)</td>
<td>Replaces the BVM alternative device when hooked up to oxygen in the cold zone</td>
</tr>
<tr>
<td>Automated external defibrillator (AED)</td>
<td>The AED is proven to save lives but is too bulky to carry on entry</td>
</tr>
</tbody>
</table>

Field care is limited only by the equipment that can be transported and the training of the providers. Items carried by advanced providers include the following:
- Central line
- Tracheotomy set
- Retrograde intubation set
- Laryngeal mask airway
- Chest tube set
- Fiberoptic intubation set
- Blood products or blood substitutes

CBRN Specialty Modules

Depending on the role of the tactical unit, chemical, biologic, radiologic, or nuclear (CBRN) threats may be encountered. These incidents require tactical emergency medical care because they involve large crime scenes with casualties. Individuals trained in tactical emergency medicine are much more familiar with evidence collection and preservation, and they usually already have necessary security clearance to enter such an area. Until the scene is cleared, the tactical physician may be the only one who can provide medical care to victims inside.

The chemical and biologic environments are specialized depending on the agent released. Various civilian and military protective gear and respirators or supplied air sources may need to be worn. Operating in CBRN protective gear requires extensive training in addition to regular tactical training. Antibiotic prophylaxis with ciprofloxacin, as well as agents detection equipment, may be carried by the medic in this case. Several biologic and chemical diagnostic kits and meters are available but costly.

Radiologic incidents involve the dispersal of a radiologic agent with conventional explosives, the combination often referred to as a dirty bomb. Nuclear detonations refer to the splitting of a radioisotope and the resultant massive energy release from a nuclear bomb. Geiger counters are available for radiologic and nuclear situations. These situations require a great deal of additional training, but they are not beyond the realm of tactical emergency medicine.

Hazardous material (hazmat) situations are frequently seen in civilian law enforcement raids on clandestine drug laboratories. Level A, B, or C protective suits with gas masks or supplied air may be required in these situations as well. Hazmat and CBRN situations are highly specialized in their nature and require extensive training, beyond the scope of this text.

Medical Threat Assessment

Any mission planning must include a medical threat assessment (MTA). The SWAT commander uses information from many sources to create a tactical plan prior to execution of a mission, including the manpower available, building layouts, street layouts, support equipment needed, nature of the mission, available weaponry, and various sources of intelligence. An MTA is an important component of the intelligence the commander needs to properly execute the mission. It is the responsibility of the tactical medic to provide a concise and accurate medical briefing to the commander. MTA forms should be used on every mission to ensure systematic planning, as scenarios and problems may be unique. Only a systematic approach ensures complete assessment of the situation.

The tactical medical team and its MTA are key factors in dealing with apocalyptic terrorist events, such as the Columbine school shootings and the school hostage crisis in Beslan, Russia. Other venues, such as protection details and the war on drugs, rely heavily on a team’s internal capacity for medical care, as evidenced by the U.S. Marshals Service Judicial Protection Training Program. A complete threat assessment should include these elements:

1. Location of the operation, with a brief description of the goals of the mission and the other teams involved, with their needs and resources (Table 23-9).
2. Locations of all surrounding hospitals and medical care facilities, such as designated burn and trauma centers, with phone numbers to facilitate communication. Local EMS numbers should be listed.
3. Helicopter flight plan. Before the mission, it should be ascertained that a helicopter is available and that there is an acceptable landing zone (LZ) for day or night conditions. This should include the exact location, its strength, and its global positioning system (GPS) coordinates of the LZ. Obstructions and debris should be cleared prior to the mission (Table 23-10 and Fig. 23-29).
4. Weather. Factors to be evaluated include temperature, rain, wind, humidity, wet-bulb temperature (Tw), and wind chill. Sunrise and sunset times should be recorded and logged. The Tw is the lowest temperature to which air can be cooled by the evaporation of water into the air at a constant pressure, so it reflects the limit to which a person can shed heat.
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through sweating in a hot environment. The TW is used to
determine fluid requirements and the need for work–rest
cycles. The weather-related components of the MTA are used
to determine the appropriate uniform to wear and the shelter
required to prevent overheating or hypothermia (Table
23-11). Water sources should be recorded prior to the
mission as part of the MTA.
5. Plant and animal threats. Plant exposures, especially to
poison ivy and poison oak, are common to snipers.
Snakebites are common to team members working with
police dogs. Anticipated animal threats should be recorded,
along with telephone numbers for the police veterinarian,
animal control, and poison control, including sources of
antivenom (Table 23-12).

Forms and Documentation
Medical records should be kept for the team and for anyone
treated or evaluated as a TEMS patient. Records should be
stored for a minimum of 10 years and have proved to be indis-
pendable as defense documents in several antipolice liability
lawsuits. Without a medical record, there is no proof that
appropriate medical care was given.

<table>
<thead>
<tr>
<th>TABLE 23-9. Sample Form to Provide Operational Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Other teams</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 23-10. Sample Form for Helicopter Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helicopter</td>
</tr>
<tr>
<td>Landing zone (LZ)</td>
</tr>
</tbody>
</table>

Figure 23-29. Air ambulance helicopter preparing for tactical casualty evacuation. (Courtesy Lawrence E. Heiskell, MD.)

THE TACTICAL MISSION

Each mission has a number of phases:
1. Warning order (issued when the tactical team is first
   requested, and establishes the situation and chain of
   command)
2. Gathering of intelligence
   a. Building intelligence (targets location and surrounding
      areas and includes avenues of approach, escape routes, and
      rally points, as well as natural and man-made obstacles,
      fields of fire, opportunities for cover and concealment)
   b. Suspect or hostage intelligence (as detailed as possible)
   c. Medical threat assessment (complete)
3. Operation order
4. Briefing phase
   a. Detailed planning
   b. Detailed briefing
   c. Equipment selection
   d. Move to staging
5. Execution phase
   a. Entry
   b. Secondary search
   c. Transfer to arrest team and investigation team
   d. End of mission
6. Debriefing phase
   a. All persons, weapons, equipment, injuries, shots fired,
      and ammunition must be accounted for.
   b. Any problems must be discussed.
In general, a tactical mission follows this order, although it
may differ somewhat between agencies and missions. Proper
handling of each point is required in order for a mission to
flow seamlessly. Without proper intelligence, a mission becomes
hazardous.

RESERVE PROGRAMS

The ways a tactical medical team is utilized by a law enforce-
ment agency can differ widely, especially between the East Coast
and the West Coast. For example, in the western United States,
especially California, Arizona, Nevada, Washington, Utah, and
Oregon, there are many reserve programs in the police and
sheriff’s departments. In these programs, the tactical medical
provider has additional, formal law enforcement training, such
as found in the Peace Officer Standards of Training (POST)
program in California. This program allows the provider to be
a sworn peace officer, bringing about an enhanced comfort level
for the department and potentially mitigating some issues of
civil liability. On the East Coast, reserve opportunities are less
common, and medical providers typically serve as auxiliary
units borrowed from traditional fire and EMS agencies. The lia-
bility issues and expenses in this type of relationship are often
resolved via a written “memorandum of understanding”
between the participating agencies.
Selecting appropriate providers must be accomplished through interviews, psychological testing, background investigations, and physical fitness testing. The tactical team leaders should use a careful approach in the selection process for each candidate, just as they do for other members of the team.58

**MILITARY COMBAT FIELD UNITS**

Field units vary significantly with the mission, service, and threat (Fig. 23-30). Most often, medical care is provided in the open, or in as secure a location as possible. It is done on the ground, on a table, in the back of a Humvee, or on an aircraft or a watercraft. Specific types of shelter and equipment are available, most often in the far-forward care under fire and the tactical field care phases, but generally the equipment is as noted earlier.

When CBRN threats or high explosives are added to the scenario, the forward elements are the same, with the exception of the appropriately protective clothing. Once evacuation occurs, the injured team member is taken to a standard unit with the capability for decontamination and treatment, much as is done in the civilian setting. Most larger military transport planes have the capability to accept a critical care air transport team (CCATT), which has a physician trained in critical care (emergency medicine, anesthesiology, internal medicine), a critical care nurse, and a respiratory technician. Most larger Navy ships are equipped with fully functioning operating rooms and intensive care units, or they can expand to provide this service quickly. All the services have basic medical units, from the self-aid or buddy-aide, to an aid station (with a physician), to forward resuscitative systems (surgical and nonsurgical), to surgical companies, combat surgical hospitals, and their equivalents. All services also have teams that are available to move far forward to provide surgical capabilities quickly should the need arise. These units can operate on any semi-flat surface, do resuscitative surgery, and package the patient for expeditious transport for further care.13

**TABLE 23-11. Sample Form for Weather-Related Information**

| Temp high | Wet-bulb temp | <60 | 60–78 | 78–82 | 82–85 | 85–88 | 88–90 | >90 | Sunrise: AM | Sunset: PM |
| Temp low | H₂O q/hr | 0.5 | 0.5 | 0.5 | 1.0 | 1.5 | 30 | 40 | Work cycles: Yes/No |
| Rain % | Rest Min/Hz | 0 | 0 | 0 | 10 | 15 | 30 | 40 | Heat casualties: Y/N |
| Wind: MPH | Cold casualties | Y/N | Y/N | Y/N | Y/N | Y/N | Y/N | Y/N | Uniform adjustments: Y/N |

**TABLE 23-12. Animal and Plant Threats**

| Animal Threats | Yes/No | Animals present? | Yes/No | Types of animals | Number | Poisonous snake exposure | Animal Control: | Poison Control: | What type? | Veterinarian address: |
| | Yes/No | Police dog? | Yes/No | Do you anticipate wild animals? | Yes/No | Vet phone: | 973-470-2242 | 800-222-1222 | | |
| Yes/No | Animal Control: | Poison Control: |
| Plant Threats | Yes/No | Exposure to poisonous plants likely? | Yes/No | Type | Tecnu or Ivy Block available? | Yes/No | Recommendations: |
| Yes/No | Exposure to poisonous plants likely? |
| Yes/No | Tecnu or Ivy Block available? | Yes/No | Recommendations: |

Figure 23-30. Law enforcement tactical medical team during a training exercise. (Courtesy Lawrence E. Heiskell, MD.)
missions, gear is heavier. Clearly, the operator needs to be in excellent physical condition, and the mission commander must proactively manage nutrition, hydration, and exertion levels.

From anecdotal reports, the military has seen a significant decrease in truncal injuries because body armor has improved. The medical personnel have noted that the insurgent combatants in Operation Iraqi Freedom have changed their IEDs to target the head, neck, and extremities more than the whole body. Continued development is underway to produce body armor that will protect against higher-energy weapons, protect extremities, and be lightweight and flexible enough to allow fieldwork.

As protective clothing is not removed in the field, the medic must work under and around it. Vigilance is required to check all body areas for hidden wounds. This is clearly more difficult in the field, in the dark, with sound and light restrictions, and with clothing in place than when the patient is undressed on the trauma table.

Because the medic carries all the usual combat equipment, medical equipment is additional. Stethoscopes are usually kept behind, as the medic cannot use the earpieces under the helmet, the environment is not conducive to being able to hear anything, and the victim is usually wearing body armor. Advanced medical gear is usually found on the MedEvac vehicle, or further to the rear where it is safe enough to remove protective equipment and further evaluate and treat the patient.

► EDUCATION AND TRAINING PROGRAMS

Tremendous advancement in tactical medicine education over the last decade has resulted in numerous training programs, many providing formal continuing medical education (CME) credits. These courses focus on the core issues of tactical medicine. A unique aspect of tactical medicine is application of ALS in an austere environment. The traditional approach to providing EMS is often not feasible in a tactical situation. 59

Cost-effective training is available and should be afforded to all involved, medical personnel, including prehospital care providers and physicians, who should be trained to the highest level possible. Such training provides emergency medical personnel with an understanding of tactical procedures and an appreciation for why some routine prehospital care techniques may not be appropriate in the tactical environment. 59,60

Tactical medicine training needs to be as realistic as possible with live teaching scenarios in full tactical gear. This allows the medical providers to more fully understand the unique aspects of law enforcement tactical operations and the roles and responsibilities of each team member, along with the integration and application of EMS. With an established body of knowledge and skills, graduates of such training programs are better prepared to effectively perform as safe tactical medical providers. 60

The International School of Tactical Medicine, a law enforcement agency program, is based at the Palm Springs Police Department Training Center in Palm Springs, California. This school has conducted high-quality realistic tactical medical training courses since 1996 and offers a 2-week, 80-hour program. The training and educational courses are designed for the U.S. military and federal and local law enforcement agencies to enhance their provision of medical care in the tactical environment. The standard curriculum for each course can be seen in Tables 23-13 and 23-14. Both the basic and advanced courses offer category 1 CME credit through the American College of Emergency Physicians. The school is approved by the State of California Commission on Peace Officer Standards and Training (POST) (see www.tacticalmedicine.com). 67

The Tactical EMS School of Columbia, Missouri, offers two TEMS educational programs. The Essentials of Tactical EMS is the basic entry-level course. The Tactical EMS Field Operations course is designed to augment the training offered in the essentials course and is scenario-based teaching with a focus on casualty care in the tactical environment (see www.tactical-specialties.com).

The Counter Narcotics Tactical Operations Medical Support program (CONTOMS) at the Casualty Care Research Center (CRC) is a multidisciplinary injury-control research and training facility in Bethesda, Maryland. It is based in the Department of Homeland Security, Federal Protective Service, Special Operations Division, forming the Protective Medicine Branch (see www.casualtycareresearchcenter.org).

► THE FUTURE OF TACTICAL MEDICINE

Tactical medicine will continue to grow as a medical discipline, and emergency medicine is the ideal specialty to lead its development. Since the fall of 2002, under leadership of the International Tactical EMS Association (ITEMS), a multidisciplinary group of subject matter experts has been working to achieve consensus on development of a standardized national curriculum for tactical medicine training. 67 Emergency medicine residents and surgeons with no special interest in participating in tactical medicine should have an understanding of this discipline, as they may well have the opportunity to treat an injured
Musculoskeletal and soft tissue injuries account for 70% to 80% of injuries that occur in a wilderness setting. Being able to identify and provide initial, acute treatment of the most common types of injury is particularly important. In the initial management of a musculoskeletal injury, the following must be considered: the etiology and time of the injury, the direction of the causative force in relation to the individual or limb, and the environment where the accident occurred. These factors may indicate the severity of the injury and help determine examination and treatment priorities that can affect outcome. Special considerations for injuries to the skeletal system that occur in the wilderness include the effect of weather (exposure to wind, cold, or heat), lack of usual devices for stabilization of bone or joint injuries, and increased time to initiation of a victim’s definitive care.

Stabilization of a victim’s cardiovascular and pulmonary status is critical. Once this has been accomplished, examination of the musculoskeletal system should be undertaken in a sys-

TABLE 22-14. Sample Curriculum for Advanced Tactical Medicine (ATM) Training

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Administration and Introduction</th>
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<tbody>
<tr>
<td></td>
<td>Pediatric Trauma Management</td>
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<td>Trauma Anesthesia</td>
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<td>Building Clearing Techniques Review</td>
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<td></td>
<td>Tactical Medical Scenarios</td>
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<tr>
<td>Day 2</td>
<td>Range Advanced Pistol–MP5</td>
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<td></td>
<td>Advanced Airway Management</td>
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<td>Advanced Airway Management Skills Stations</td>
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<td>Day 3</td>
<td>WMD Biological Weapons Part 1</td>
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<td></td>
<td>WMD Biological Weapons Part 2</td>
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<td></td>
<td>Medical Issues of Less-Lethal Weapons</td>
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<td></td>
<td>Low Light Tactics and Team Movement</td>
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<tr>
<td></td>
<td>Tactical Medical Scenarios</td>
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<tr>
<td>Day 4</td>
<td>Pistol–MP5 Field Courses</td>
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<td></td>
<td>Explosive Entry Demonstrations</td>
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<tr>
<td></td>
<td>Medical Management of Blast Injuries</td>
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<td></td>
<td>WMD Chemical Weapons</td>
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<td></td>
<td>WMD Nuclear and Radiation Injuries</td>
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<tr>
<td>Day 5</td>
<td>Written Exam</td>
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<td></td>
<td>Safety Briefing</td>
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<tr>
<td></td>
<td>Tactical Medical Scenarios</td>
</tr>
</tbody>
</table>

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Wilderness Orthopaedics
Julie A. Switzer, Thomas J. Ellis, and Marc F. Swiontkowski

Tactical medicine is wilderness medicine taking place in both the urban environment and some of the most remote places on earth.

In these times, when the threat of violence to civilians in our society is at its greatest, we rely on our law enforcement professionals and the military to do all they can to keep us safe and protected. It is the role of tactical medics, providing medical care under any and all operative conditions (Fig. 23-31), to give back to these professionals by ensuring that someone is there to care for them if they are injured in the course of doing their duty.

The references for this chapter can be found on the accompanying DVD-ROM.