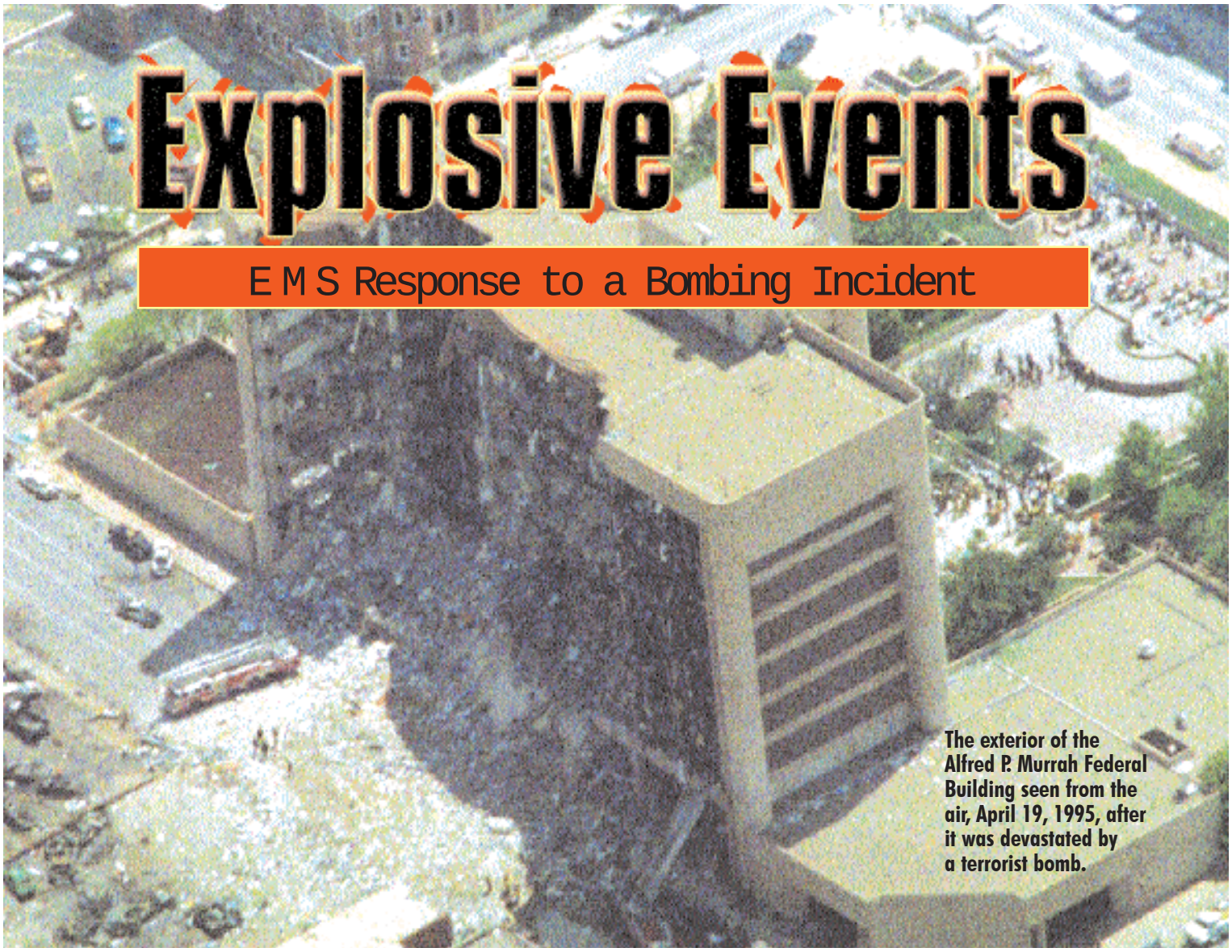
Explosive Events

EMS Response to a Bombing Incident



The exterior of the Alfred P. Murrah Federal Building seen from the air, April 19, 1995, after it was devastated by a terrorist bomb.

Photo: Reuters

By S. Christopher Suprun, Jr., NREMT-P

We were sitting in the station house when the place was rocked by what sounded like a thunderous sonic boom. No way, *I thought.* That was too powerful.

I ran outside and saw a big cloud of smoke coming from downtown. "Something bad's happened," I announced, not even bothering to be officially dispatched. "Let's go!"

Two minutes later, we were dodging chunks of debris, wire and broken glass in the street. Parked cars were burning and exploding all around us, their tires bursting like bombs. This is just too weird, *I thought. It was like we had entered some futuristic, post-nuclear holocaust scene.*

This account is from Jana Knox, a paramedic in Oklahoma City, OK. She was talking about her response to the 1995 bombing of the Alfred P. Murrah Federal Building. Her account, detailed in the book *The Heart Behind the Hero,* by Curt and Karen Yoder, talks about the immediacy of the response to the Murrah Building attack. Two years earlier, the World Trade Center's north tower was rocked by an underground explosion that missed its mark in crippling the skyline sculpture. These bombings, while not as devastating as the attacks of September 11, 2001, were some of the first indications that Americans weren't safe anymore.

Explosives

Annually, bombings and explosives incidents account for the majority of terrorist activities both domestically and abroad. The Federal Bureau of Investigation's 1999 *Report on Terrorism* lists 321 separate bombing events in the United States as part of 457 total terrorism events from 1980–99. The availability of explosive components and bomb-making information that can be found in high schools, on the Internet and probably at your local library makes these weapons of mass destruction a favorite of those persons or groups intent on causing fear and intimidation and injuring both civilians and rescuers.

While many reading this will think *I've never had to respond to a bombing and probably won't,* it is important to remember that bombings are increasingly being used not only for terrorism purposes, but also for criminal activity. Every community in America has faced bomb threats at some point. While they may only occur here and there, this low-frequency event carries with it a high risk, and risk managers will tell you that high-risk/low-frequency events cause most trouble. To take any reported bomb or bombing event lightly is dangerous for you, your crew and the citizens you protect.

Explosions are caused by a chemical reaction that happens nearly instantly, changing solids, liquids or gases into superheated gases that expand into a greater volume. This greater volume of gas travels outward away from the explosion, following a "path of least resistance."

Explosives are categorized as high or low explosives based on their speed of combustion. Whereas low explosives are designed to burn, or deflagrate, producing a gas output (such as gunpowder propelling a bullet out of a barrel), high explosives are designed for a much quicker energy release. Typically, low explosives will combust in milliseconds, whereas high explosives detonate thousands of times faster, in microseconds, producing the characteristic supersonic boom we associate with explosions. This movement of gas is known as the *shock front* or *shock wave*.

Blast waves can reach speeds ranging from 3,600 feet per second to more than 27,000 feet per second.[1] For comparison purposes, a hollow-point bullet shot from a 110-grain Winchester .357 Magnum jacket will achieve a velocity of approximately 1,300 feet per second.[2] This explosion speed, also known as *detonation velocity,* will help determine if the explosive has a shattering or pushing effect. The former is known as *brisance,* the latter as *heave.* An explosive with a higher detonation velocity will have a higher likelihood of causing a shattering blast—a blast that cuts through an object.

High explosives are further categorized by the level of sensitivity the explosive has for various "insults," such as heat, friction, impact, electrostatic discharge and shock. In this case, shock is not inadequate cellular perfusion, but rather any type of impact that produces the needed charge to fire the primary explosive. These "insults" will ultimately start a high-explosive train—a series of smaller explosions leading to bigger ones—until the device has been fired.

It is important to consider these insults because simply using your portable radio, thereby sending electrostatic energy through the air, may trip an explosive. While electrostatic energy from a portable radio may not set off a grenade by itself, it could fire another trigger on a more complex device. Additionally, safe distances for radio use will be governed by the type of radio and explosive, so the best guideline is to not use them until additional information is obtained. Opening a canister of an unknown substance at a bomb threat may, depending on the compounds used for the device, produce the friction needed to explode the chemical. This is why only explosives ordnance demolition teams should be used to render bombs safe.

The Bombing Scene

Many bombing-related calls are hoaxes. Some bombings are a pretext to use additional bombs, or secondary devices, against civilians and rescuers. Incidents involving secondary devices can be deadly and should cause us to reconsider our approach to the pre-bombing incident.

Eric Rudolph is alleged to have bombed Centennial Olympic Park and a gay bar in Atlanta, as well as abortion clinics in Atlanta and Birmingham, AL. He is also alleged to have planted secondary devices with the intent of harming first responders.[3,4] These devices included shards of metal and nails intended to injure those in the vicinity of the device when it detonated. Secondary devices have been used not only to injure civilians and rescuers, but also to herd them toward larger attacks or create diversions from a primary attack, such as in the 1999 Columbine school attack in Littleton, CO.[5] While the conventional thinking has always been to move people away from a reported bomb threat, that is no longer the preferred course of action. Moving people in this way may actually bring them closer to harm than leaving them where they were.[6]

In any case where a device is actually found, people should be moved away from the device, not the device away from people. Again, these devices may be designed to fire in a number of ways, from motion or light sensors to changes in temperature. By moving people

away from the device, you are making them safe while isolating the device. Personnel should also realize that *under no circumstance* should they attempt to make the device safe themselves unless they have specific training as a bomb technician.

To control the frenetic pace of a bombing response, preplanning is vital. The most important aspect is to coordinate strategies and incident responsibilities with other agencies and work out issues ahead of time. A unified command structure is the national standard for coordinating actions at major incidents, and should be used.

Unlike other situations in which multiple agencies come together for large accidents or fires and "it just works," bombing responses require discussion, collaboration and training of multiple agencies prior to an occurrence in order to minimize casualties and maximize prosecution opportunities.

Scene Management

Before directly treating a patient, take proactive steps to maintain the scene, establish order and protect yourself. A quick reference in planning your actions is the Five Ss.[7] They stand for:

- Self
- Size-up
- Send info
- Set up the medical group
- Stabilize.

Self refers to your own self-protection. Is the scene safe? If you become a victim of a secondary device or another pitfall, you are compounding the problem, not addressing it. The safety of you and your crew must be paramount as you work a bombing incident. Personal protective equipment is important to remember. At the Murrah Building bombing, the single rescuer fatality was a volunteer nurse who rushed to assist with medical operations and was killed when falling debris struck her head.[8] While she was offering her support to the rescue efforts, it was help outside of the official emergency response, and her sacrifice only further burdened responding agencies. PPE is designed to protect responders in hostile environments—not using it is dangerous.

Scene *size-up* is the first thing to do upon arrival at a call. Upon staging your unit in a safe place, what do you see? Don't let the situation overwhelm you. Ask the questions you would normally ask. How many obvious victims are there? Is there a need for an active firefighting operation? Are patients exhibiting atypical symptoms such as seizures? (Remember that explosive devices can be used as dispersal agents. The first World Trade Center attack may have had cyanide gas as part of the attack.[9]) Is the mechanism of injury obvious and consistent with a bomb blast? Do you need specialized rescue resources to handle collapsed structures? Are you at the address to which you were dispatched, or are there multiple events occurring? Are you in a target area for a secondary device?

Bombing-related injuries are not that different from other traumatic injuries. Shrapnel is still penetrating trauma. Crush injuries are still crush and blunt trauma injuries. Panicked victims with difficulty breathing will still be cared for in much the same way as at other large events.

Send info refers to getting your size-up information to the other responders coming. As discussed earlier, bombing responses will

Glossary[19]

Brisance: The shattering power of an explosive. High explosives tend to have greater brisance and will produce a "cut" as opposed to rubble. Brisance is proportional to detonation velocity and density.
Deflagration: Rapid burning.
Detonation: An energy release that supports a shock wave. High explosives are designed to detonate.
Detonation Velocity (DV): The speed at which a shock wave travels from an explosive. Ideal explosives, as a group, tend to have greater detonation velocities.
Explosion: The rapid expansion of matter into a greater volume.
Explosives: Materials designed to produce a nearly instantaneous release of energy. Classified as high or low explosives based on speed of release.
Heave: Explosives whose energy is not added to the shock front create a push after the shock wave travels into the surrounding area.
Pyrotechnics: Used to produce light, heat, smoke and sound. Examples include fireworks and road flares.
Propellants: Designed to produce the controlled release of gases to propel objects.
Shock Wave: The wave created by explosives undergoing rapid chemical reaction. This wave is pushed out at the speed of the detonation velocity.

likely include fire, EMS and police. The FBI has statutory authority regarding terrorist events, and special agents and technicians from both the FBI and the Bureau of Alcohol, Tobacco, Firearms and Explosives will likely be involved.

Bombing incidents create their own communications issues. Transmissions from portable radios, cell phones, pagers and other personal communicators can trigger firing systems, setting off unexploded bombs and secondary devices. How will you communicate with other fire, EMS and law enforcement responders? How will you determine at what distance you can safely operate a radio?

Set up refers to setting up the EMS sector or medical group. Perhaps the most difficult of the incident command system sectors, the EMS sector is responsible for triaging, treating, transporting and tracking potentially hundreds of patients. Knowing who has responsibility for what will improve the overall success and efficiency of the operation.

The fifth S, *stabilize,* refers to scene control. Entry and exit must be quickly controlled to limit bystanders trying to enter and potentially contaminate the crime scene. It must also be controlled to keep bystanders safe and prevent unorganized rescue attempts.

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It cannot be overestimated how important it is to have an organized approach to dealing with a scene of this nature. The first responding ambulance to the original World Trade Center bombing later reported a "feeling of impending doom"[10] as scores of victims started to surround them. Before you are faced with this feeling, you and your agency should start planning, coordinating with your local and state law enforcement, and conducting joint training so that if an explosives event takes place in your community, your preparation will make you feel more in control of the scene.

Patient Care

Injuries from bomb blasts are generally caused by shock waves and shrapnel. Injuries can also occur from patients *becoming* projectiles. These injuries are defined by the American College of Emergency Physicians and are categorized as primary, secondary and tertiary.[11]

- *Primary* injuries are caused by the shock wave. These injuries affect hollow organs such as the lungs, eardrums and gastrointestinal tract.
- *Secondary* injuries are caused by shrapnel and other flying debris.
- *Tertiary* injuries are caused by the patient becoming a projectile and eventually falling back to the ground.
- *Miscellaneous* or *quaternary* injuries also occur in conjunction with an explosive blast. Such injuries include burns, crush injuries, closed-head trauma and aggravation of existing illnesses such as asthma, high blood pressure and other acute coronary syndromes.[12]

It is important to keep in mind, as you deal with primary injuries to patients, that because you're dealing with overpressurization of an area, the victim will be more significantly injured if they are in an enclosed building and the explosion occurs inside it.

Blast waves are reflected off solid objects. This means standing behind a wall will provide some protection, but the blast wave—and subsequent negative pressure wave—will still find its way around the object, causing some injury to whomever is behind it. The intensity of a pressure wave will also decline at the rate of the cubed root of the distance from the explosion. This means a person standing three feet from the blast will receive nine times the pressure of someone six feet away.[13] This is important, and it demonstrates the need to put space between you (and bystanders) and the explosive device.

As opposed to typical hazmat situations in which time-distance shielding is used as a method of protection, distance is the No. 1 factor in dealing with explosives. If distance is not possible, then thought should be given to what you are standing behind. Concrete is better than wood, and reinforced concrete will afford better protection than unreinforced concrete.

The ears, lungs and gastrointestinal tract are all potential primary-injury problem points after an explosion. The ears may be ruptured, and patients may be thrown to the ground with anywhere from a 1.0–3.0 pounds per square inch (PSI) change in atmospheric pressure.[14] Lungs and other vital organs may be injured at 6.0–7.0 PSI.[15] Lung injuries will have a far greater mortality, and possible injuries could include pulmonary embolism, tension pneumothorax and "blast lung." Oxygenation of these patients will be needed to increase perfusion, but care must be taken not to worsen any barotrauma.

Blast lung is a specific injury characterized by three clinical conditions: apnea, bradycardia and hypotension.[16] Blast lung occurs from overpressurization and differences in air pressure. These pressure changes rip the alveolar spaces, disrupting oxygen exchange and allowing blood into the lungs. These patients may present with hemoptysis and dyspnea.[17]

Secondary injuries—those caused by shrapnel and fragmented device parts flying through the air—will be like other penetrating trauma, and may involve a single piece of shrapnel or hundreds of small bits. Objects partially penetrated into the body should be stabilized in place with gauze or other rigid devices that can keep them from moving.

Finally, tertiary injuries will involve blunt force trauma. Overpressurization will lead to patients being knocked down or blown a distance from the force of the blast pressure. The subsequent impact with the ground should be considered a significant mechanism of injury. C-spine precautions should

be taken when possible, but may not be feasible if the scene is large and there are many victims with immediately life-threatening injuries.

Other injuries can include burn injuries from fires occurring secondary to the explosion, or blunt trauma from falling debris. These are referred to as *miscellaneous* injuries.

In addition to standard treatments for victims of explosions, remember that another way to help these patients is to assist the law enforcement agencies that will investigate the crime. As with any other crime scene, clothing and other material on the patient may contain evidence of the explosive or materials used in it. Holes ripped by shrapnel into clothing should be cut around when possible, and can be used as evidence if the chain of custody is not broken. Additionally, when possible, paper bags should be used to store clothing and other items, as plastic may render such specimens unusable.[18]

"Much like a fire scene, it is amazing that any evidence is found among the rubble and ruins," says Dan Limmer, a former police officer and paramedic from Colonie, NY. "In spite of all the confusion, the basic principles hold true: We are all on the same team and can work together. Saving lives and collecting evidence don't have to be mutually exclusive."

Conclusion

While most EMS providers may not experience bombings firsthand, it is important to train and prepare for such events. Providers need to know what actions to take in order to ensure orderly responses to bombing scenes, preserve potential evidence, treat patients and keep responders safe. ■

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