



By JOHN HOWSER

GSW

Sometimes the echoes of a **gunshot** never stop

*The toll of gunshot wounds
on bodies, families, society,
and the medical professionals
who care for the victims*



D

R. RICHARD MILLER KEEPS A PHOTO IN HIS OFFICE.

In it the trauma surgeon stands beside a tall, athletic woman; the two of them have just completed a triathlon, and are wearing running shorts and t-shirts and racing numbers. They are smiling the smile of tired accomplishment that most runners wear after such a grueling event.

The woman, Stephanie Styles, is a friend of Miller's, and on one level that's why he has the photo in his office—a picture of a friend at a happy time together.

But there's another level of meaning to this picture. It is there as a reminder—a reminder of what a bullet can do to the human body, and, just as important to a trauma surgeon, a reminder of how, if everything goes perfectly, things can turn out OK.

It never hurts to be reminded that things can turn out OK because of all the hundreds, if not thousands, of gunshot victims Miller has cared for, Styles' injuries were among the worst he has ever seen.

Miller, who is now associate professor of surgery in the division of Trauma and Surgical Critical Care at Vanderbilt University Medical Center, treated her while practicing in Greenville, S.C. Styles, a schoolteacher who lived alone, owned a .38 caliber revolver for protection. One night after thinking she heard a prowler, she retrieved the handgun from a nightstand. While walking across her house in the dark, she tripped and shot herself in the abdomen. The bullet passed through her body with devastating results.

Even years later with many gunshot injuries in between, Miller still remembers every detail.

year's time, she is now recovered and back to doing two things she loves: teaching school and competing in triathlons.

Miller talks with her from time to time by phone, and keeps this photo over his desk. As a reminder.

Level One

It would be nice to think the story of Stephanie Styles' injuries is an isolated one, but unfortunately it's not. Not in the U.S., not in Tennessee, and not in Nashville. At Vanderbilt University Medical Center, the number of firearm injuries is significant, both in terms

of suicide attempts are not successful."

Miller says another group of gunshot victims is related to law enforcement—either someone shot by officers while in the commission of a crime, or officers themselves injured in the line of duty. Since finishing his trauma surgery fellowship here at VUMC, Miller has cared for four police officers who suffered gunshot wounds in the line of duty.

Hunting-related injuries round out the list of activities common to firearm-related injuries treated at VUMC.

"About 15 percent of our trauma patients each year are the result of penetrating trauma,

"Some bullets are engineered to tumble upon entrance into the body, or to implode upon impact. Some of these bullets are absolutely designed to maim. And they have an amazing ability to ricochet off things inside the body. I've had patients shot in the chest whose bullet winds up in the leg."

"The bullet went through her stomach, through the major branch of her abdominal aorta, through her pancreas, and out her back. This was a beautiful, blonde 6-foot-tall woman who was dying in our emergency department. She was in severe hemorrhagic shock. The bullet had blown a huge hole in her stomach, which happened to be full at the time, so food was everywhere inside her abdominal cavity," he says.

"We rushed her to the OR and had to go to heroic efforts to stop the bleeding. On the first resuscitation we used more than 50 units of blood and blood products. After surgery she was so swollen we had to leave her abdomen open and cover it with a sheet of plastic."

The story then takes an even more bizarre twist.

"After we took the woman to the intensive care unit and were trying to stabilize her again, someone in the unit asked who the woman was. Finally, someone else called out the patient's name, and a nurse on the unit upon hearing this exclaimed, 'What! That's my sister!'"

"The entire unit went completely silent for a few seconds, then everyone stepped it up a notch and we went right back to work."

Styles survived her injuries. After 12 operations and multiple complications over a

of the number of victims and the consumption of health-care resources.

Patients arrive day and night by ground ambulance and by LifeFlight. On occasion a gunshot victim will be driven here by a "business associate" to be deposited unannounced outside the Emergency Department as the driver speeds away.

During the last five years, VUMC has added a dedicated Trauma Unit offering highly specialized care for victims of firearm injuries, and two additional LifeFlight air ambulances to transport patients from as far away as 150 miles.

Thanks to specialized Level One trauma care available for these patients, greater numbers than ever are surviving such devastating injuries.

Gunshot wound (GSW is the abbreviation used in the trade) victims fall into several categories, Miller says.

"While there are many stories of an innocent person at the wrong place at the wrong time, the vast majority are not. [Most shootings] are drug and gang related," Miller says.

"Another group we see in significant numbers is firearm-related suicide attempts. Gunshot wounds are very common in suicide attempts, especially to the face and mouth." And, he adds ominously, "At least half, or more,

usually gunshot wounds. As far as being labor-intensive to manage, these patients take up a lot of resources," he says.

By the Numbers

Over a five-year period ending with fiscal year 2001, VUMC treated 1,302 victims of gunshot wounds. If this violence could be considered an epidemic, it is an epidemic that feeds on testosterone; 89 percent of gunshot patients were male. Unfortunately, no age group is excluded. Typically, about 9 percent of VUMC's gunshot victims each year are under age 18. Young adults, ages 18 to 35, make up the bulk of victims—about 56 percent. About 33 percent are over 35.

The average VUMC hospital charge per gunshot victim over the five-year period from 1997 through 2001 was \$30,000. Average physician charges per gunshot victim at VUMC are typically in the neighborhood of \$15,000.

Based on average charges, from 1997 through 2001, the cost of care for gunshot victims at VUMC totaled approximately \$58.5 million. It is not unusual for combined hospital and physician charges to accumulate into the hundreds of thousands of dollars for the care of a single patient. These charges do not include rehabilitative or long-term care,

which is almost always necessary for patients suffering injuries of this severity.

Caring for the vast majority of Middle Tennessee's gunshot victims requires a substantial financial commitment from VUMC. Typically, about 21 percent of these patients have commercial insurance, 35 percent are insured by TennCare (the state's managed health-care program for low-income individuals), and another 8 percent are insured by workers' comp or Medicare. The remaining 36 percent of gunshot victims are "private pay," which means they have no form of insurance.

Patients treated at VUMC for gunshot wounds have an average survival rate of about 80 percent. About 60 percent of these patients, the lucky ones, are treated and discharged directly to home. Two percent of VUMC's gunshot victims are discharged directly to jail.

Of Ricochets and the Blast Effect

Miller says doctors and nurses often don't want to know details about how a patient was shot. The information usually isn't necessary for patient care. "Sometimes it's just better not to know," he says. "We want to treat every patient the same, and it serves no purpose to have your judgment skewed by a story that may not even be true."

However, Miller says knowing how many times a patient was shot, or where on the body, is vital. Though one may believe the need for this information would be obvious, it's often not the case.

"Knowing how many entrance and exit wounds there are, and what type of weapon was used, is very important to the management of a patient," he says.

Damage done to the body by a firearm depends on a number of factors. Of course, where a bullet enters the body has a significant impact on the outcome. Engineering specifications of a particular weapon contribute to its overall impact on the human body—a phenomenon known to health-care providers as the "blast effect."

The blast effect refers to the zone of damaged tissue around a gunshot wound caused by the bullet itself, and by shock to surrounding tissue caused by the sheer speed with which the projectile enters and travels through the body.

"Blast effect is determined by the size and velocity of the bullet. Some bullets are engi-

Dollars and Death

The United Nations study *The International Study on Firearm Regulation, Crime Prevention and Criminal Justice*, published in 1997, noted that the United States and the Czech Republic are the only countries among industrialized nations that do not have a firearm licensing system. The U.S. is among only 22 percent of responding nations, according to the U.N., that do not have regulations regarding the storage of firearms.

A 1996 study by the National Institute of Justice, the research and development agency of the U.S. Department of Justice, found about one-third of all U.S. firearm sales are currently excluded from federal law on background checks: sales at gun shows, through classified ads, or among friends and family.

Thanks to this bountiful supply of firepower, 28,633 deaths in the U.S. were associated with firearms in 2000. On the good side—if such a level of carnage can have a good side—that number actually represents a significant decrease in the number of firearm deaths from the previous decade.

Closer to home, data from the Centers for Disease Control and Prevention (CDC) indicate Tennessee ranks well above the national average in the annual number of firearm-related deaths.

In 2002 Nashville had 65 homicides. Again, if your nature tends toward the sunny and optimistic, you may take heart that this number represents a 30-year low, and was down significantly from 1997's all-time high of 112. Over the last 39 years, the homicide rate in Nashville has varied widely from year to year, with a low of 45 in 1963 to '97's record year.

According to Metro Nashville Police Department spokesman Don Aaron, of Nashville's 65 homicides in 2002, 46 of those were committed through the use of firearms. In Nashville, Fridays, Saturdays, Sundays and Mondays are when most homicides occur. Sunday is currently the most popular day for killing somebody else, with approximately 30 percent more homicides than any other day of the week.

"It appears that a majority of Nashville's gunshot victims come from the inner city," Aaron says. "The obvious question is, Where are all the guns coming from? Illegal drug activity has been, and continues to be, an ongoing theme with Nashville's gunshot victims."

Aaron says most weapons used in drug crimes are cheaply made and inexpensive to purchase on the streets. "In all likelihood the majority of weapons used in these homicides are purchased with proceeds from drug activity."

CDC data indicate that 73.8 percent of U.S. homicides in 2000 were by firearms. In terms of years of potential life lost before age 65, the 28,633 deaths associated with firearms in 2000 equals 738,486 lost years of living for the people killed.

—JOHN HOWSER

neered to tumble upon entrance into the body, or to implode upon impact. Bullets are designed to do maximum damage, which creates a lot of havoc for us," Miller says. "Some of these bullets are absolutely designed to maim. And they have an amazing ability to ricochet off things inside the body. I've had patients shot in the chest whose bullet winds up in the leg.

"The hardest thing for us as trauma surgeons is to determine the bullet's trajectory and locate all the bullet holes, which is not an easy thing at times. Usually, there is an even number of holes in a gunshot victim. If there is an uneven number of bullet holes, then we really have to search around."

There is an entire science on the pathophysiology and management of gunshot victims, complete with in-depth textbooks on the topic.

Human Toll

The human cost of firearm injuries is recognized every day not only by the loved ones who must live without a son or daughter, father or mother, husband or wife, but by the health-care workers who must care for the victims.

When health-care professionals who care for victims of firearm injuries are asked if they remember particular patients, there is

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almost always an immediate response. Maybe it's a memorable case of physical carnage left in the bullet's wake; maybe it's the pure senselessness of how a particular victim was shot. Whatever the reason, caring for gunshot victims is not work that is easy to leave behind. Images linger.

Miller, as a trauma surgeon, treats firearm-injury victims almost daily. He's seen lifetimes of the effects of bullets and the damage done. He has vivid memories of many of the gunshot victims he's cared for. One patient in particular stands out, both because of the uniqueness of the injury and the tragic outcome.

"One of the gunshot victims here at VUMC who I remember well was a young woman who happened to be about eight months pregnant. Unfortunately, she was shot when two of her relatives were in an argument and she was trying to break it up. In the midst of all this, a gun went off and shot her in the belly," Miller says.

"She came in, in significant shock. We had to do an emergency C-section to deliver the baby. The bullet had passed right through the baby's head; it was dead on delivery. The mother lived, and actually had suffered very little injury to anything other than her uterus."

Innocent Victims

After working in VUMC's Emergency Department for 14 years, Brenda Smith, R.N., has cared for hundreds and hundreds of Middle Tennessee's gunshot victims. She's literally seen it all. When asked what upsets her most about gunshot cases, she doesn't even have to think: "The children," she says.

Even after 10 years, Smith must choke back tears when recalling the gunshot victim she considers most tragic, a 3-year-old who found his father's gun under a bed and shot himself in the heart.

"Everyone here worked on the child as hard as they could. We had to repair the hole in his heart right here in the ER, but we couldn't get it to restart. He died down here," says Smith. "If you get where things like this don't bother you, then you need to quit. I will never forget that for as long as I live."

Miller says VUMC sees its share of children who suffer gunshot wounds.

"Most of these injuries are accidental

because parents do not have appropriate safety measures in place to keep children from getting their hands on the guns," he says. "Some kids we see have shot themselves because they thought the gun was a toy."

Pediatric trauma-prevention specialist Mary Fran Hazinski, M.S.N., assistant in surgery and assistant in pediatrics, has worked for years to educate Middle Tennessee parents about the importance of handgun safety when it comes to their children.

"When you look at the data, younger gunshot victims tend to have higher injury severity scores, along with very high charges associated with their care," says Hazinski. "When you look at the outcomes, about 20 percent go to rehabilitation and 20 percent require home health care—which means 40 percent require ongoing medical care."

About 9 percent of all VUMC's gunshot victims are under the age of 18. From 1997 through 2001, Vanderbilt Children's Hospital treated five children under the age of 4 who suffered gunshot wounds. These patients spent an average of nine days in Children's Hospital with an average hospital charge topping \$25,000, not including physician charges. No deaths due to firearm injuries at Vanderbilt Children's Hospital were recorded in this age group between 1997 and 2001, which, Hazinski is quick to say, does not mean every child had a good outcome.

"Studies have shown that 25 percent of children who are injured by firearms are left with chronic health problems," she says. And the reason firearm injuries in children are more devastating than in adults is simple physiology.

"Children are smaller, so the chances of a bullet hitting a vital organ are much higher, and many times the bullet ends up crossing the midline of the body and injuring vital vascular structures."

Hazinski cites Centers for Disease Control and Prevention data stating firearm injuries are the leading cause of death in adolescents. CDC data suggests that more than 66 percent of U.S. households have handguns—which are often stored loaded and unlocked.

From 1997 through 2001, Vanderbilt Children's Hospital treated 48 gunshot victims ages 4 through 15.9. This group didn't fare well. Twenty-one percent died, another 16 percent required long-term care, and a lucky

58 percent were discharged to home. Already at this age, 2 percent of patients were discharged to jail.

"In this age group there are more suicides, so there are a significant number of people with self-inflicted firearm injuries who don't survive. Firearms are a very effective way to commit suicide," she says. "Literally, there isn't time for a second thought."

What's shocking among the under-16 age group is the number of homicides. CDC data from 2000 indicates that 68 percent of fatal firearm injuries in children under age 4 were homicides. In the 5 to 9 age group, 71 percent of fatal firearm injuries were homicides. In children 10 to 14, suicide accounts for 36 percent of firearm deaths, while homicides account for 45 percent of deaths.

Hazinski has studied this issue for years, talked to anyone who will listen, and is passionate about the need for adults to protect children from the damage guns can do.

"If parents want to prevent firearm injuries in children, they need to use trigger locks or store guns in lockboxes. To be skeptical and say these methods won't work isn't true. If the guns are locked up, then the kids can't get to them," she says.

The toll gets to the doctors and nurses, and it gets to the cops, too.

Metro Nashville Police Department spokesman Don Aaron says that any time children are shot, or are in a home where they witness a shooting, it's particularly troubling to law-enforcement officers. "You can't help but feel a great deal of emotion. You can see it in the faces of the officers at the crime scene, particularly if they are parents," he says.

Children, adults, rich, poor, male, female, black, white. A bullet doesn't care, and the cumulative toll is staggering.

Brenda Smith, the trauma nurse who is a 14-year veteran of VUMC's Emergency Department, sums up the state of affairs best. "It breaks my heart that we have to waste so many resources on senseless violence," she says. "We have patients, some as young as 17 years old, who have been here for repeat visits due to gunshot wounds. It's really sad." ▼

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