

WOUNDS OF WAR

Balm for the Fires of War: Caring for Severe Combat Burns

BY DENNY SMITH, SENIOR EDITOR

A tremendous explosion and fireball lifted the Humvee completely off the ground and soldiers in the convoy behind it saw Staff Sergeant Robert Henline fall to earth, enveloped in flames. “One of the guys ran up and doused me with an extinguisher, but then I was choking on some of my teeth, so he cleared my mouth. He saved my life twice in a matter of seconds.”

Staff Sgt. Henline had been in the front seat of the first vehicle of his convoy in Iraq when it ran over an improvised explosive device (IED) in 2007, killing all four other men inside and leaving him with severe burns and fractures that he wrangles with daily more than three years later. “It was my fourth tour of duty. And that day was like the movie ‘The Hurt Locker,’ with one IED planted in the center of the road and connected to three or four more buried along the roadside. The fuel in the Humvee combined with the antitank material in the bomb and it burned all together in a huge fire. I was conscious at first. But now I don’t remember anything between the blast and waking up in BAMC.”

Bamsee. Like the many physicians who care for him, Staff Sgt. Henline pronounces the acronym for Brooke Army Medical Center reverently, even affectionately. The patients and physicians at BAMC, which is a component of Fort Sam Houston in San Antonio, clearly hold each other in high regard. BAMC is the only level 1 trauma cen-

ter in the Department of Defense and houses its only unit dedicated to caring for profound burn trauma.

From Baghdad to Brooke. Staff Sgt. Henline arrived at BAMC with full-thickness burns over nearly 40 percent of his body. “My left arm was burned from the shoulder down, my head was burned down to the skull, the backs of my legs and calves were burned. My face has been grafted many times,” he said, referring to some of the 42 surgeries he’s endured since his hospitalization, including one to amputate his left hand, which was finally determined to be unsalvageable.

“My left eyelid was completely destroyed in the fire. I’ve had twelve surgeries just to try and get my eyelids closed and working. The right eyelid works now, but the left eye graft doesn’t open or close—it doesn’t have muscles.” Staff Sgt. Henline is especially grateful to Lieutenant Colonel Sheri L. DeMartelaere, MD, who was attending when he arrived at BAMC. “They wanted to throw away my left eye when I first got there—they thought it was ruined. But Dr. DeMartelaere said, ‘Let’s wait until he comes out of the coma to see if the eye works.’ If it did, she thought she could save it, which is what happened. So she’s done a lot for me.”

Eye Surgeons: On Duty

Dr. DeMartelaere herself served in Iraq in 2003, where she treated wounded troops minutes from combat. For nine years, ophthalmologists have stood

A Soldier and Survivor



An IED blast burned Staff Sgt. Robert Henline over nearly 40 percent of his body, including his face and eyelids. The left lid was destroyed completely.

alongside other U.S. military surgeons treating soldiers and Marines emerging from battle with wounds that range from the cursory to the catastrophic. The wars in Afghanistan and Iraq have left almost 40,000 Americans with life-altering injuries. Seriously wounded Iraqis and Afghans may number many times that, and neither of their societies currently has a medical infrastructure that can address the enormous need for rehabilitative care.

The fires of war are more than a metaphor for many veterans of Iraq and Afghanistan. Seven percent of all combat injuries include burns, said Lieutenant Colonel Evan M. Renz, MD. Not included in that number are those who perished from their wounds. Dr. Renz is a trauma surgeon who served in Iraq from 2005 through



Staff Sgt. Henline two weeks after Dr. DeMartelaere performed full-thickness grafts on all four eyelids (1). One

month after more grafts to the left upper and lower lids (2). Two months after grafts to right upper and lower lids (3).

2009, and he is now chief of the burn center at BAMC. He said the center has admitted more than 850 burn casualties since March of 2003, and at least half of those sustained other serious injuries—including oculofacial trauma, fractures of all kinds, soft-tissue injuries, tympanic membrane perforations and closed-head wounds.

The vulnerable face and eyes. Eye trauma is still all too common in Iraq and Afghanistan, Dr. DeMartelaere said, especially when protective eyewear is missing. “In IED blasts, the eyelid does not always have time to reflexively close, so we see ocular surface burns.”

And “protective” is a relative concept, anyway, Dr. Renz said. “The face is often the least protected in combat—so facial burns are common and often involve the nose, the ears, the mouth. Eyes, thankfully, are the most commonly protected area of the face but that only goes so far. Eyewear protects against penetration but not as much against temperature or flame.”

The first three days. The initial care of combat trauma may determine the final outcome months or years later, said Dr. DeMartelaere. “During fluid resuscitation for the first 72 hours, patients are at risk for orbital compartment syndrome from the increased IOP and can develop optic neuropathy and go completely blind. We relieve that with a lateral canthotomy and cantholysis. Sometimes that’s a decision that needs to be made in theater, before that patient gets on the flight to be transferred home. It doesn’t require

an ophthalmologist—military ER physicians attend a course reviewing orbital compartment syndrome and are trained to do lateral canthotomy and cantholysis prior to deployment.”

Burns = Whole Body Trauma

The severity of burns presenting at BAMC routinely distresses internal organs as well. “A burn that involves more than 20 percent of total body surface area affects almost every other body system,” Dr. Renz said. “Most affected are pulmonary, cardiac and kidney function. The chemical factors released in burns alter fluid balance, for example, which affects the kidneys, and severe pain affects the heart.”

We’re on your team. Upon admission to the burn center, Dr. Renz said, severely injured patients are admitted to intensive care and managed by a multidisciplinary team that includes an attending burn surgeon and specialists like ophthalmologists, as well as nurses, respiratory therapists, physical and occupational therapists, social workers and nutritionists. Everyone on this team must collaborate. “The complex surgical repairs warranted for most patients mean there are lots of simultaneous surgeries. Orthopedics might need to share anesthesia time with ophthalmology; a head and neck surgeon may need to operate alongside a surgeon working on the torso.” The surgeons work in tandem so much, Dr. Renz said, that they often know intuitively the plan and sequence of repairs for each patient. “And we take the eyes into account with everything we do.

When we go to the OR, we are very careful not to irritate the conjunctiva with a prep solution, and we use a lot of ocular protectors to make sure we’re not exacerbating an injury.”

A plan for every patient. Given the complexity of most patients’ wounds, it is not useful to adhere to one common treatment protocol for everyone, Dr. DeMartelaere said. For example, therapeutics like silver sulfadiazine that might be appropriate for burns on the torso or extremities are not indicated for the eye. “As you approach the ocular surface these other modalities are restricted to prevent chemical injury to the eye,” she said. “Every case depends on the associated injuries. Last week, we had a case of bilateral ruptured globes in addition to burns. And there are different levels of burn. The superficial burn typically just blisters, and the patient does fine. But, of course, we mostly see deeper ones, in which there aren’t enough residual epidermal cells to regrow. Some of these patients have intact skin to graft from elsewhere and some don’t—we have patients with burns over 95 percent of their bodies.”

Replacing lost dermis. When autologous grafts are not feasible, burn specialists must settle for skin substitutes. But before either skin grafts or substitutes can be applied, eschar and devitalized tissue, including on the ocular surface and eyelids, are removed by gentle surgical debridement with scissors or scalpel, Dr. DeMartelaere said. She added that excision and grafting are best done in the same surgery.

For grafting, Dr. Renz often operates with the ophthalmologists. “If we do a complex eye reconstruction case, I find Dr. DeMartelaere tissue that will work to reconstruct lids while she’s working to release lid contractures and we save the patient anesthesia time. If we can’t find healthy skin on the patient, we can use a dermal matrix such as Integra, a bovine collagen that allows autologous epithelium to grow in.”

In addition to Integra, Dr. DeMartelaere has used several other decellularized skin substitutes, including Alloderm, a donor collagen graft, Enduragen, a porcine-derived collagen, and, for a tarsus substitute, another porcine collagen, TarSys.

“And for the ocular surface,” she said, “I have used ProKera amniotic membrane, buccal mucosal grafts, and conjunctival and corneal autografts. If needed, I refer a patient for corneal transplant by Dr. Anthony Johnson, our cornea specialist.”

Battling Complications

Beyond replacing lost skin, at least four post-trauma battles are constantly being waged on behalf of burn patients like Staff Sgt. Henline:

- **Fighting infection.** Dr. DeMartelaere noted that risk of infection in her patients is ever present. “It’s a constant worry, and yet we don’t want to encourage drug-resistant bacteria by putting patients on Vigamox (moxifloxacin) for every epithelial breakdown that occurs.”

- **Fighting decubiti.** Another nonstop project is protecting bony prominences, especially for patients who are not ambulatory. “Decubitus care is a special problem in guys with exposed bone,” Dr. Renz said. “No buffer for the bone means that the elbows, the coccyx and sacrum, the occiput—all these are very concerning for pressure insults. To avoid this we have to use prone positioning, rotating beds, elevation of extremities, and various nets and slings.”

- **Fighting pain.** Contrary to what many people assume, pain control has really evolved in the acute management of burn injury, Dr. Renz said.

There is no need for patients to suffer severe pain. Analgesia has become more sophisticated through the use of new agents and various combinations of agents, he said. In the longer run, though, Dr. DeMartelaere noted that some patients can have pain that eludes management. “Ocular pain typically resolves once we obtain full eyelid closure; however, there is frequently chronic pain from other facial burns and graft donor sites.”

- **Fighting scarring.** Burns are famous for cicatricial contractures. “We use compression masks to minimize facial scarring. But that doesn’t work on the eyes, obviously,” Dr. Renz said. Dr. DeMartelaere agreed, “As the wounds heal, the skin contracts and the eyelids are pulled open, leaving the corneas exposed. Our goal is to maintain good coverage of the ocular surface and avoid exposure keratopathy. Sometimes we excise and graft their burn and sometimes we put in a suture tarsorrhaphy to keep their eyelids closed. We can also apply a ProKera amniotic membrane or a Boston ocular surface prosthesis.”

In Staff Sgt. Henline’s case, the Boston prosthesis accomplished several things, Dr. DeMartelaere said. “It enabled Bobby to be free of hourly eye-drops, which his wife had to administer and which significantly blurred his vision. It also relieved him from wearing moisture-chamber goggles—the strap for those was preventing his scalp from healing. This was all a big step forward in his independence, his ability to interact with family and friends, and his being able to actively participate in his rehab.”

- **After everything, he sees great.** Toward the end of wound healing, after infection, decubiti and cicatricial contractures have been controlled, what is salvaged from severe burns in terms of nerve endings, sweat glands and muscle function? That is quite variable and depends on the depth of the burn, Dr. DeMartelaere said. And if the eyes were burned, that same variability is true for visual function.

Interestingly, considering that some troops can sustain significant visual

loss with no obvious external trauma, others can survive terrible oculo-facial wounds with intact visual acuity. For example, in spite of his adnexal trauma, Staff Sgt. Henline’s vision was largely preserved—20/25 in his left eye and 20/20 in the right. But his rehabilitation in other respects resembles a crazy quilt of medical measures:

- To keep his left cornea from ulcerating from constant exposure, he still wears a Boston ocular prosthesis and applies lubricating drops at night. “Bell’s phenomenon makes my eyes roll back so I can sleep at night,” he said, sounding not unlike an ophthalmology resident.

- The explosion decimated his teeth and lower jaw, which have been largely repaired with bone grafting. But he faces more tooth implant procedures.

- His skull burns were perhaps the biggest challenge of all. “They had to scrape a layer of burned bone off my skull. I was an inpatient for six months, but for 16 months I didn’t have skin on the top of my head. They finally got some tissue from my stomach to grow on my head and they used a wound vac to encourage blood circulation there. It’s kind of funny—now I have belly hair on my head!”

Life Beyond BAMC

Her patients routinely surpass expectations, Dr. DeMartelaere said. “Because they are young and in such great physical shape, they are incredibly resilient patients. So many are surviving after tremendous trauma. What it does to their body systems—cardiac effects, for example, is like running a marathon for two years straight.”

BAMC and military medicine earned high marks from Staff Sgt. Henline. “The military has done everything they could for me. Even as

Radio Rehab

For two years, National Public Radio has followed Staff Sgt. Henline’s progress with a series of stories. To listen to them go to www.npr.org and enter “henline” in the search field.

People Who Just Want to Live

The cruelties of war have shadowed civilians as well as soldiers in the long-standing conflicts in Iraq and Afghanistan. Colonel Kevin Winkle, MD, is a pediatric ophthalmologist who served in Balad in 2006 and 2007 and treated this young girl and many other children who were severely injured during hostilities. Dr. Winkle said the trauma he saw in civilians was usually the result of suicide bombings and improvised



explosive devices detonated in public places. “About 20 to 25 percent of surgical cases were our active duty men and women, and the rest were local Iraqis. We saw faces and eyes that had just been blown apart . . . For the kids, unfortunately, there were usually no parents or relatives around. So after we did what we could, they were shipped to local Iraqi hospitals. We never saw them again.”

Bashar Khalid, MD, is an Iraqi ophthalmologist who has treated terrible ocular trauma at Ibn Al Haitham Teaching Eye Hospital in Baghdad. Dr. Khalid himself was recently injured in an explosion, and his experience at Ibn Al Haitham has practically made him a default trauma expert. (He is now seeking a pediatric or anterior segment fellowship in the United States.)

One day at the hospital remains particularly haunting for him. “I have seen many patients who were burned in explosions, but that day, especially, remains in my mind. A suicide bomber had struck in an area south of Baghdad when I was in residency in 2006. It was horrible how the people came to the hospital with all their clothes burned off. They were naked and shouting, and we tried



so hard to treat them. I can never forget that image. One father came to me with photos of his three children. God help him—their bodies couldn’t be found. It really broke my heart. I want to say to people who are willing to explode themselves: Why kill innocent people, people who just want to live?”

far as cosmetic worries—if I say ‘I don’t really like how this looks,’ they try to fix it. They have a lot of great programs. And because I had severe burns, even when I’m in VA care, I can always come back to BAMC.”

Soldier, survivor, buddy, goofball.

Most people facing appalling, life-threatening injuries like those coming through the doors of BAMC might forgivably turn inward to heal their bodies and souls. Staff Sgt. Henline faced the other direction. “I’ve made friends with a lot of burn survivors because we’re here for so long—you really get to know each other. My experience maybe helps the next guy. And I do some stand-up comedy in San Antonio

clubs. My routine is called ‘Comedy, Well Done.’ Dr. DeMartelaere is in some of my jokes. ‘Oh my God, I didn’t know that’s where you got that graft!’ Actually, there are three of us burn survivors who live a block from each other here in San Antonio. We kid around that it’s the scariest block on Halloween.”

Resilience: off the chart. Given the dedication of the staff at BAMC and the motivation of the veterans under their care, Dr. Renz said learning to build a new life with the resources at hand is a truly reachable goal. He echoed Dr. DeMartelaere’s thoughts on resilience. “Before their injuries, these were clearly young, healthy, athletic

guys who could survive more than most. In trauma scoring systems, these men go off the chart. In the Vietnam era, the chance of surviving these wounds would have been so poor that the scoring systems didn’t even bother to account for them. Imagine a 22-year-old guy, thrown 50 feet out of a burning vehicle, on fire, surviving an explosion that takes off part of his skull and brain, one eye, maybe both hands, and fractures ribs. And the young man is still alive. The word ‘resilience’ doesn’t come close. It borders on the miraculous, I think, that they can deal with all that—and they do. The energy that comes from just being around these guys is amazing. They’re kind of like their own little nuclear reactors.”

Same dad and husband, just different. Staff Sgt. Henline is steadily regrowing his life. “Rehabilitation was really hard, especially for my kids—they wanted their old dad back. Now they are dealing with my PTSD and learning how to be with me out in public. Sometimes I get paranoid or have a panic attack and want to suddenly leave wherever we are. But I’m getting a little better about it. It took a while to learn to deal with people staring all the time. In the beginning my kids would want to stare back or say something. But people don’t mean to stare. Sometimes people will ask, ‘Were you in a war or a motorcycle accident or what?’ Little kids are especially curious. I’ll just say ‘I got blown up.’”

As with most soldiers coming home with injuries, Bobby Henline found that his family tended to—and saw past—his wounds. “My wife had a hard job. I was like another kid to take care of, with all the wound care we faced every day. In the beginning it would take four hours to get me up, bathe me, clean my wounds, get my splints on, wrap my legs and get me to my appointments for the day. During that time we really lost a lot of the romantic thing because going out or even cuddling hurt a lot. But very slowly, we’re getting back to our old, regular life,” he said. Then he paused.

“In fact, we’re going out to dinner tonight.”