

Evolving challenges in eschar removal in the treatment of severe burns: a roundtable discussion

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In the treatment of severe thermal burns, surgeons must work quickly to assess the severity of the wound to plan for the optimal treatment strategy while considering the timing for the removal of the eschar. These steps play a central role in the ability to advance a patient to wound closure and healing. In planning for eschar removal, surgeons must consider many factors, including depth, the severity and location of the burn, the physical and emotional health of the patient, and multiple potential risks, including inflammation, blood loss, pain, infection and scarring.

For centuries, the standard in burn treatment has been the use of surgical excision to clear the wound bed of eschar using a sharp instrument. In fascial excision, surgeons work to excise full-thickness skin and subcutaneous tissue rapidly to create a reliable bed for skin grafting or other forms of wound closure. Tangential excision is a procedure where eschar is removed gradually in thin slices of tissue until a viable bed of dermis or subcutaneous fat is reached. Research has also led to the potential applications of enzymatic options in eschar removal, which involve the topical application of a chemical agent to break down and support removal of dead/non-viable tissue (Rosenberg, 2012).

While there has been limited innovation in the tools and strategies in eschar removal over the past 50 years, several studies indicate that mortality rates among patients with severe burns are declining. Recent research also indicates that strategies that lead to earlier excision and grafting are among the contributing factors in this decline. However, many leading burn treatment specialists note that factors including surgeon experience and training, burn centre resources and the wide variability in patient profiles in the treatment of burns significantly inhibit the ability to establish clear guidelines and best practices in eschar removal.

In March 2021, Vericel Corporation sponsored a roundtable discussion focused

on the challenges in eschar removal and the impact that different approaches in patient management can have on outcomes. Participants included Dr. Jeremy Goverman, Plastic Surgeon at the Sumner M. Redstone Burn Center at Massachusetts General Hospital, US, Dr. Steven Kahn, Chief of Burn Surgery at the Medical University of South Carolina and Dr. William Hickerson, former Medical Director and Plastic Surgeon at Firefighters' Regional Burn Center and former President of the American Burn Association.

During the discussion, participants shared perspectives on a range of issues in eschar removal, including challenges associated with wound assessments, current standards of care in both fascial and tangential excision, establishment of a viable wound bed, evolving strategies in eschar removal, and concerns related to a range of outcomes assessments including pain management, blood loss and infection risk. Following are excerpts from the discussion.

Q In the treatment of thermal burns, what are the most significant challenges in eschar removal?

Dr. Goverman: I think the only major change that I've noticed in the past 10–20 years has been that we do less fascial excision and more tangential than we used to because we are more focused on preserving function and reducing morbidity. Back when I first started, many more

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patients were treated with deeper fascial excisions. Other than that, there have been no real improvements in the past 50 years on eschar removal.

A fascially excised wound bed is much easier to manage and graft, at least in the acute phase, than trying to preserve adipose tissue in a big burn. You quickly excise down to adipose or even some deep dermis and you cover it. You are a lot less likely to need to re-excise and have the problems that go along with that, such as blood loss. Today, we do a lot more re-excision because we are trying to preserve the adipose.

Dr. Hickerson: Topline, if you're looking at how you get to a viable wound bed, that's been a great conversation all the way back to the 1970s. Fascial excision has never been one of my go-tos. I went to fascial when I had problems with fungus. Otherwise we would excise into viable tissue. This led to more bleeding and the need for transfusion, but studies have shown that this did not lead to an increase in mortality. In cases where you need to excise into fascia, the cosmetic appearance is horrific and there are problems with the lymphatics, because you're taking away superficial veins that can be a good size and you'd like to see these still be able to work.

Dr. Kahn: Years ago, the burn community was heavy into fascial excision. Even 15 years ago, there were fewer surgeons who were attempting to graft on fat. I found early in my career, that there were a lot of surgeons who believed it was a black and white paradigm, where you either grafted on dermis or you grafted on fascia. Dr. Hickerson was a pioneer in the 70s regarding grafting on fat, which now most of us do and think is the right method. Not only is fascial excision cosmetically worse, but it is also functionally worse. I have never seen a graft over fascia that performed better than a graft over healthy fat. I think that most practice patterns have sort of evolved away from fascial excision.

Q How has standard of care in eschar removal changed over the past 20 years?

Dr. Goverman: We are more focused on preserving viable tissue. There have been no major advances in the products we use.

Dr. Kahn: We are attempting to be more precise with our excision.

Dr. Hickerson: There has not been a paradigm shift.

Q What is driving changes in approaches to eschar removal?

Dr. Goverman: I think there has been a natural progression of how medicine has improved, in general, and the fact that mortality for burns has decreased to a level where it's not just about survival anymore. It's also about quality of life. Our critical care is better, we ventilate patients better, we feed them better, and mortality rates are low. Only 40 years ago, we just wanted people to survive and now survival is the expectation. According to the American Burn Association (ABA) guidelines (ABA, 2018), guidance for eschar removal is in the first 72 to 96 hours. The data on the benefit of early excision is still evolving, but I think we all believe that early excision is better.

Dr. Kahn: I think that the community, in general, is simply more accepting of the early excision paradigm because of all those things Dr. Goverman mentioned. In general, things move forward with good data or when people start doing some of these things in isolated practices and people see the good results, thought leaders start talking about it, it catches on, we do more and more of it in our own practices and everyone starts to see the results. It creates this positive feedback loop and a self-fulfilling prophecy of buy-in. I think Dr. Goverman made a good point that eschar removal is only one part that must go hand-in-hand with the general management of the critically ill patient. It is more than just the operation. It is all the supportive care and getting their wounds closed in a timelier fashion.

Dr. Hickerson: Obviously, we are all trying to leave as much viable tissue as we can now. But unfortunately, we don't have any good interoperative tools to look at a wound bed and see what it looks like. You have techniques where you inject something to look at a wound bed, but basically it goes back to looking and seeing. When you were using other things, such as chemical debriders, you had to learn what to look for. If you had a dermal bed, you could still see that you had a bleeding dermis. Now, we are looking for a tool that is more precise that will do that for us. We are trying to find better ways to determine what is going to be viable or not.

Q How challenging is the wound assessment, for burns with varying degrees of thickness?

Dr. Kahn: This is really an interesting topic because people have studied this, and burn surgeons get these types of assessments in indeterminate burns right only about two-thirds

of the time. Some of the best experts get it right maybe 75% of the time. And non-burn-trained folks get it right less than half the time. But everybody thinks they can get it right, right away.

Q And when you say “get it right,” what do you mean?

Dr. Kahn: Decision making is very straightforward when it comes to third-degree burns and more superficial burns. However, some burns are indeterminate and the issue is whether we think we are going to need a graft. That depends on a lot of factors: the patient’s physiology, how thick the tissue is, the depth of the actual wound and factors related to conversion over or under resuscitation. All these things can result in burn wound conversion where partial-thickness wounds convert into deeper wounds that require surgical intervention. Over the years, most of us develop patterns of recognition. We know what the mechanism of the burn was — for example, grease is generally going to be worse than a hot water scald. Young, healthy people are generally going to heal better than older people. We do our best to determine whether this is something that’s going to heal, something that is definitely going to need a graft, or that we have to give it time to allow the depth and healing potential present. Sometimes you are talking about a long hospital stay with wound care as you are watching it. Right now, there is no way to put a device on a burn to confirm whether it will heal well. There are imaging technologies, but they are not completely validated and there is no perfect modality on the market yet. We rely on our own experience.

Dr. Goverman: The modalities we are talking about are just an imaging study that tells you whether there’s regenerative potential. They have been around for 15 plus years and they have not taken off. It only gives you a snapshot in time. If that wound with regenerative potential according to a Doppler then gets infected, it is probably going to progress and will have no regenerative potential.

Q Can you talk about the relationship between pain management and eschar removal?

Dr. Hickerson: Pain issues vary from individual to individual. Some patients that look like the toughest guys in the world have a very low pain tolerance. Meanwhile, some frail seniors have seemed oblivious to pain. It is a very difficult situation to summarise quickly. It is a

big bell curve, but you often can’t tell where an individual patient is going to fall on the curve.

Dr. Kahn: You can often get a sense of how they are going to do when you see what happens with their initial debridement. There are a lot of people who think that because third-degree burns are insensate the patients have no pain. The burn is sometimes mixed depth and not always insensate, and many times those patients have a lot of pain. Patients with third-degree burns often have a deeper pain underneath the burns.

Dr. Hickerson: I would say third-degree burns are insensate except on the edges where there may be some second-degree or first-degree burns.

Another important point is prevention of post-traumatic stress disorder, which comes from two places. They have the experience itself, the perceived threat to their own life and the life of people around them, and the trauma of what happens to them after the injury. Patients can develop post-traumatic stress disorder (PTSD) from uncontrolled pain during wound care. That is a major reason why removing the eschar and healing more quickly is an important tool in that multimodal pain control toolbox. It will help shorten the course and thus decrease the risk of PTSD and other psychological impairments.

Dr. Goverman: My overall mindset is still to try to do painful stuff in the operating room (OR) and then minimise dressing changes and use options like paracetamol. But you know ... it is painful.

Dr. Hickerson: Regarding pain, yes, it is real. Everything we do to them is real pain that we are inducing. They also often have a lot of anxiety that goes with it and for those who have had any anxiety already this just kicks it up and makes it worse.

Dr. Kahn: When it comes to pain, not only is it discomfort, but the physical and emotional consequences of it are real. We all try to address it the best way we can, but there is no one-stop-shop. There is so much we do not know about it.

Dr. Goverman: I would say that my choice on pain management is somewhat affected when a patient has a low tolerance of pain, whether it is a patient with a substance abuse history or someone who is just not tolerating things very well. For them, I am a lot less likely to see how long they can deal with dressings and try to get a burn to heal. Even though this might not be the best option for cosmetic outcome, I might be more likely to remove the dressing earlier and apply autograft to get them closed. Even for patients who just lack the facilities or resources

to managing their dressings, we often have to weigh these considerations to make the best decision about when we close them.

Dr. Kahn: I agree, 100%. I found that we can make grafting a little less painful now using long-acting liposomal bupivacaine on donor sites coupled with nerve blocks. Some surgeons do these themselves, and some use anaesthesiologists. I have used local-block pain management techniques on patients and when I walk into their room immediately post-op, I've noticed their laptop is resting right on top of their thigh donor site and they are typing away on it. This would not have been possible without the newer, long-acting local anaesthetics. So, there are ways we can make grafting less painful than just altering dressing strategies.

Q Is there sort of a trade-off then between timing in eschar removal and risk of pain for patients?

Dr. Hickerson: There is nothing we do in burns that is pain-free. You need to have pain control. It is an individualised sort of patient-centred decision depending on how painful the wounds are, how disrupted the patient's physiology is, their critical illness and how well you are able to sedate them. We also consider factors like daily wound care and the ability to induce amnesia that can contribute to PTSD. You also have to consider the resources at a burn centre and how well you can manage an extended course of treatment.

Dr. Kahn: It is also important to understand what is making these patients sick. It is the body's response to the burn injury and having the eschar on them. While the eschar is on, it continues to make them sick. If you can remove it early on, the physiology is going to recover somewhat. It is a little more complex than that in real life. But that conceptualises the basic premise.

Dr. Hickerson: In general, with eschar removal, the sooner you can do it, the better it is for the patient's wellbeing. But the reality is that some mornings you'll come in and you'll look at a patient you thought would be ready to go the night before and you won't like what you see. You want to get him a little better. We have to give him something to take care of the primary fibrinolysis before we can get to the OR and there are a lot of other things that go into that consideration. What is the cardiac index doing? How is the patient overall? If you are talking about elective surgery, you have plenty of time. But as long as the eschar is on, the sicker they get with all the inflammatory mediators that are

flying out of those flames into the circulation. That makes it much more difficult. If you could do something to quickly see the depth of the wound and then know what you had to do from there, you are much better off. If there is an excisional solution that can help me declare the depth of a wound, then I would know if I've got dermis left. I'd feel much more comfortable in doing some type of skin substitute or getting coverage even sooner.

Dr. Kahn: When we are talking about eschar removal for big burns in the OR, you might ask why we don't just go to surgery and get the eschar off right away? The answer is that these procedures are disruptive from a physiologic standpoint and many patients can't handle an operation. When you do a big surgery on someone, you induce more inflammation and you cause more physiologic disruption. If someone is walking on that tightrope, you can push them over the edge towards a critical illness or even death. That is why we often don't want to do it right away or when a patient is too sick.

Q Are there any issues that are related to the patient profiles or burn locations that you think are important to highlight?

Dr. Goverman: I don't want anyone to come after my hands with a Goulian blade! Our instruments are from the Civil War era. They have not been changed in so long. In terms of sensitive locations, it would be the hands and the genitalia. But burns in these locations do not represent established exclusion criterion.

Dr. Kahn: The face is also one area that no one wants to graft. It simply won't have the same appearance that it had before. With imprecise instruments such as blades, we run the risk of removing healthy tissue and being deeper than we needed to be, making us more likely to need to do a graft.

Q What about different patient profiles: children, seniors, obese, diabetics?

Dr. Goverman: You could make a special case for every one of those populations. In terms of preservation of function, with kids the structures are a lot smaller. With a Goulian blade, you're not going to be able to go cell by cell. In younger patients, the deeper you go, the closer you could come to important structures. With elderly patients, I think it is just less physically demanding. It is less traumatic and there is less blood loss. But you always want to preserve function and maximise the

tissue that is alive. And that is for everybody.

Dr. Kahn: With fascial excision, there is nothing that takes you further than the ‘cell by cell’ premise. You need to leave healthy dermis behind to have a chance to heal without a graft. That is more problematic in paediatric and geriatric age groups who have thinner skin than healthy, young adults. And in individuals who are on medications or have disease processes that have thinned their dermis or that affect their healing.

We have to recognise that for many patients that are at higher risk, including those with thinner dermis, the precision that we were talking about in eschar removal is even more critical. I think that these patients are more likely to require an ultra-precise excision as opposed to an imprecise excision with a blade.

Q Can you talk about how the risk of infection and sepsis plays a factor in decisions related to eschar removal?

Dr. Kahn: Eschar is essentially devitalised protein, so it is a culture medium. And that is part of the reason why we want to get rid of it — to prevent infection. Even with perfect wound care, some patients will still get infected along the way. Patients who don’t have access to the healthcare resources they need, that are in remote areas, who have to manage daily wound care, who can’t stay in the hospital — these patients can face considerable challenges. Sometimes there are noncompliance issues that directly result in an infection. We often have to keep some folks in the hospital for protracted periods of time just to work on pain control or address social issues or complexity of the wound care. For them especially, eliminating eschar early can help make their course a little smoother and shorten their hospital stay.

Q Can you talk a little bit more about the issue of inflammation and how it drives treatment decisions and timing?

Dr. Kahn: If there’s excessive inflammation, it will prohibit the ability to do a graft early on. When we talk about early excision, that is just removing the eschar. Almost no one is going to receive grafts on over 20% of their body less than 72 hours after a burn injury because of that excessive inflammation. It will affect how a graft takes, and tissue can convert underneath. Inflammation can make patients critically ill; sometimes so sick they are unable to tolerate an operation. It can put them into multi-system organ dysfunction. You must break that cycle by

getting rid of the eschar. However, you want to break it in a fashion that does make them even sicker. Although surgery removes the eschar, it temporarily compounds their inflammation and illness via bleeding and tissue trauma.

Q What do you look for in terms of having a stable patient who is ready for treatment?

Dr. Goverman: This is a day-to-day assessment that needs to be constantly reassessed as things change. With a deep-partial thickness burn, we might have to watch them for up to 3 to 4 days. We use topical solutions to try to cool the extremity of the burn. That could help it progress by causing vasoconstriction, but there is not a lot of data available. We watch the wound, and once it becomes clear that it is not going to heal in 2 to 3 weeks we decide to excise it. In that case, we are usually going to graft it because we have to excise it deeply.

Q Can you talk now about approaches to treatment and concerns about scarring?

Dr. Hickerson: Any time you put a blade on someone, you are going to have scarring. The problem you get into is when you have a multi-depth burn and it is not smooth. You can have some scars that are smooth and do not stand out. But we get scars that show all the imperfections. You try to make it as smooth as you can. You want to leave as much dermis as you can. This highlights some of the issues we now have with the terminology of burns and dermis. A second-degree burn used to be called a second-degree burn. Now most people stratify more. It could be a ‘superficial second’ or a ‘deep second’. I might even take it into thirds and say that a burn is so superficial we don’t have to do anything to it. Then you have the deep dermal wound that you are probably going to have to cover if you want it to heal. And all that goes to the fact that we’re going to re-epithelize that wound from basically three structures: the edges of the wound coming in, some contracture that may occur to the wound, or the epidermal appendages that we have in the dermis. Those epidermal appendages do not run in a straight line; they are at varying levels. You also have to consider issues including hair follicles and sweat glands.

Dr. Goverman: Every cut is going to make a scar, the depth of the cut matters, and the deeper the cut, the worse the scarring. The more you preserve dermis, the better the outcome is going to look. Anything we can do to preserve

dermis is going to preserve function and form and improve the ultimate appearance.

Dr. Kahn: The other thing is the amount of time to wound closure. The longer you leave a burn untreated with eschar in place, the worse the cosmetic and functional outcome is going to be. This is also related to inflammation, specifically unbalanced inflammation.

Q What about issues related to helping the patient maintain quality of life as it relates to scarring and outcomes?

Dr. Goverman: We consider it. The dead skin has to come off, so we try to do the best job we can at the time.

Dr. Kahn: I think every decision we make is sort of weighing the different options about what is going to happen with a scar. When we decide to do a skin graft, it is our thought that the graft is going to give a better cosmetic and functional outcome than what the body can do on its own. With every patient, we decide on whether we can let the body heal on its own or if we have to help it along by transferring some tissue or placing a skin substitute. Some of this stuff is black or white. We know what we need to do with a real third-degree burn versus a superficial partial-thickness burn. But with deep partials, we need to assess when a graft may be better than what the body does on its own. Every one of these patients is a judgment call. Another key consideration is a patient's genetics. We can look at previous scars on the body. Sometimes we can observe scarring on the parents for pediatric patients. Age, ethnicity and skin type can play a role as well, so all those factors have to be taken into account.

Dr. Kahn: When it comes to scarring, ethnicity is complex and it is not always a dichotomy. In general, darker skin forms worse scars, but you can have folks with really dark skin types who don't form bad scars at all, and you can have lighter skin types that we would think are not as prone to scars who can scar terribly. I do not think anyone really understands it.

Dr. Hickerson: But we think about it every day. We are trying to figure out ways to fix the problem the best we can with the least amount of scarring and the best function that we can get.

Q Is there a desire for more standards and consistency in treatment decisions related to eschar removal?

Dr. Goverman: While I think it is more common for plastic surgeons to feel comfortable using 10 different approaches to treatment, I think general surgeons prefer to have standardised approaches. But the problem is that burns and wound care are so hard to standardise. There are not a lot of good quality studies and there is often no one best way to proceed. Some of it depends on the resources and staffing at a treatment centre. There are some established standards like preserving the maximal amount of viable tissue. That is a best practice that we should all strive to do. But even there you need to consider different factors. A patient that just wants to get back to work as soon as possible might do better with an excision and a graft.

Dr. Hickerson: There are still many surgeons who go directly to fascial excision because they feel that it is the best option when you are unable to distinguish areas between a full-thickness skin burn and fascia. But many of us make it a practice to see how we can get better and what we can do with our practices, the available tools, our critical care and approaches to pain control, psychological issues, all of the things that we need to look at. We are always looking for ways that make things better. When we find new approaches that work, we then may have to change the strategies and resources at our practice. In some cases, that can be tough. I anticipate that someday you will be able to excise burn wounds with an appropriate agent without having a lot of blood loss. You may even be able to regenerate skin and have a better long-term result without having to use skin grafts or other coverage options.

One saying that I think is an important guide in burn care is: "If you only focus on the problem, you might miss the solution." That is why it is so important to look at the entire patient. **WINT**

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