

TPWKY - Ep 213 - Burns Part 2

[00:00:00]

EW: This episode features descriptions that some listeners might find upsetting. Please listen with discretion.

Emma: Hi, I'm Emma. In May of 2020 I was working at my job as a bookbinder when a machine error caused my dominant hand to be crushed and burned inside a machine used for stamping foil designs onto book covers. That day I went to the ER for treatment where I also got to have my first COVID test. About a week later, I had my first surgery.

The first procedure was extensive wound debridement that couldn't have been achieved while I was awake, and the application of homografts, which is essentially a very fancy bandaid, that's cadaver skin. A couple of days later, after allowing the wound site to calm down a little bit, the homograft was removed and something called BTM or Biodegradable Temporizing Matrix was placed on the burn sites.

BTM is an incredible innovation. It's basically a sort of foam that acts as a structure for the body to rebuild tissue into over time. Over a period of several months, the BTM then dissolves, leaving just the newly grown tissues. After the BTM was placed, I went home for about a month to allow the sites to mature.

During this time, I had to rinse the wound and the BTM every four hours with Dakin's solution, which is a diluted bleach concoction that's been in use since the Civil War for wound care. After a month, I went in for my third and final surgery. My surgeon took a skin graft from the right thigh and applied it to the matured BTM.

Watching the grafts heal and adhere to the healthy tissue around the wound site was really incredible and honestly felt miraculous. I eventually was made custom compression gloves and got to attend hand therapy. And about three months after my injury, I was able to return to work. But never fear, I don't work on that machine anymore. We keep a distance from each other. I'm very happy to say that I've had a really good outcome. I'm very fortunate to have a incredible range of motion and good strength in my hand to the point that I don't have to think about my injury most days.

Dealing with the immediate aftermath of a burn is really difficult. I dealt with nausea, fatigue, lack of appetite, pain, discomfort, fear, and a lot of isolation, especially during my long hospital stays during COVID. I had a lot of support and care from my family, especially my parents, who allowed me to stay with them and took care of a lot of really extensive wound care, my coworkers who visited and checked in on me frequently, and a really fantastic medical team that went above and beyond in caring for me. It took at least a year after my final surgery to begin to feel like I was returning to normalcy, but I also had a very small burned area, about 1% TBSA or total body surface area.

I have so much respect and empathy for those that are recovering from larger burns and the strength it takes to endure that every day. I also want to take a moment to recognize and emphasize the importance of workers' compensation. Without workers' compensation, the cost for burn treatment and wound care supplies would've been astronomical. It's so important that workers have access to medical care and financial support to help them recover from injuries sustained at work and receive long-term care for any lingering complications.

EW: Emma, thank you. Thank you so much for sharing your story with us.

EAU: Yeah,

EW: meaningful, like, and, and you hit on such a number, a number of incredibly important points, and we, we just really appreciate you being willing to relive that and,

EAU: Go through it all and share it with us and share it with all of our listeners. Thank you.

EW: yeah. Thank you.

Hi I'm Erin Welsh

EAU: And I'm Erin Allmann Updyke.

EW: And this is, This Podcast Will Kill You.

EAU: Welcome back to burns

EW: back, burns

EAU: part two.

EW: We're here. We're here. Uh, this is the episode where if you didn't listen to the first episode, go check it out, because it

EAU: Yeah.

EW: lay some important

groundwork for what burns are, how we measure the severity, what's going on, and I mean, really the treatment of burns throughout most of human history,

EAU: Most of it,

EW: Yeah.

EAU: which is grim.

EW: grim.

It really is. But this episode is where things turned around,

EAU: Mm-hmm.

EW: so

EAU: Yeah. Today we're talking how we have figured out how to treat burns in modern times and how we treat them today.

EW: And how we treat them today.

EAU: Yeah.

EW: It's pretty, it just, it, it's one of those topics that makes me go, can you believe how far, like, medicine is so cool. Science is so cool.

EAU: I [00:05:00] feel like it's one of the topics. Wow. This is gonna get too niche. I just thought of this, but it's one of the topics that makes, that would make Dr. Who be like humans, you know how Dr. Who is always like humans

EW: that's adorable. Yes.

EAU: it

EW: yes. Anyways.

EAU: we can do any of that, it's quarantine time.

EW: is we're drinking the same thing that we

drank last week, which is a non-alcoholic bees knees that we are calling,

EAU: By degrees.

EW: And Listen, we're not, we're not equipped to, to create a new cocktail recipe every week. We're in the hundreds of episodes now. And

EAU: just drink it.

EW: we're, we're making, we're borrowing from established knowledge, is bees, knees.

It's

EAU: you can find the full recipe on our website. This podcast will kill you.com and on all of our social media channels.

EW: You can, uh, we didn't mention this, but it is honey and lemon and non-alcoholic gin and it's great. And on our website, which is also great, you can find lots of things like transcripts, you can find, uh, links to merch. Links to our bookshop.org affiliate page are good reads List, uh, music by blood mobile firsthand. Account form, contact us form, and. about us, Paige, that hasn't seen an update in a number of years and doesn't have that much information anyway. So to see what information is provided, check it out.

EAU: You really sold that about us Paige there, Erin?

EW: Do we even have like the start date of the podcast, which still blows my mind that we are in our ninth year of doing this?

EAU: I know. No, we don't have that on there.

EW: Okay.

EAU: it might say that we're still in grad school, which is quite out of date. I think we've updated it.

EW: Yeah.

EAU: Yeah. Listen. Anyways,

EW: let's get to the episode itself.

EAU: let us right after this break.

EW: Last week, I took us through the history of burns from before humans were humans until the late 18 hundreds, early 19 hundreds, which

is quite, quite a lot of time to

EAU: Just a few millennia.

EW: I think I, I think the earliest thing I mentioned was like 400 million years ago fire was possible on this planet. So, but for that entire time that we covered burns remained pretty much beyond the reach of medicine.

EAU: Right.

EW: In 1900, those who were under 61 years of age, who had burns covering more than 25% of the body surface, of those 100% died

EAU: Wow.

EW: 100% in 1900, 25% total body surface area.

EAU: Wow.

EW: adults under 50. Under 61. Mm-hmm.

EAU: But it's actually interesting that it's not also in adults over age 61, but I wonder if there just weren't that many of them.

EW: Uh, I mean,

EAU: I

EW: sure that there were, I don't know

EAU: dunno why?

EW: I think because mortality even increases further at that point,

EAU: Oh, okay. Okay.

EW: how can it increase beyond a hundred percent?

EAU: No, why that it might be a lower body surface area even or something like that. 'cause Yeah, 'cause age is a big part of it. Oh my God, though. That's horrific.

EW: Yep.

EAU: very different than today. Just so everyone's aware.

EW: Well, and that's sort of what I wanted to, to kind of establish where, where things stood

EAU: Yeah. Yeah.

EW: years later, 1950, nearly 70% survived,

EAU: Wow.

EW: the mortality had gone down to 30%. From 100% to 30%. That's huge. Huge.

EAU: it. It it's unfathomable.

EW: Yeah. Yeah.

EAU: Wow.

EW: In those 50 years, burn care had undergone a profound revolution, and we've continued to make tremendous strides up through the present day. I'm gonna leave those present day strides to you, Erin, and

EAU: Okay.

EW: I wanna focus on instead is those 50 or so years. What changed in medicine to drive such a transformation? There was no single moment or breakthrough, but there were many. There was skin grafting, antiseptic technique, fluid balance and nutritional support, antibiotics, and airway management. It was through integrating all of these medical advancements through the formation of burn care as a specialized approach, that the scales finally tipped survival rates that this integrated management could now achieve were beyond the imagination of any physician in past centuries. Like I, I imagine someone. Trying to treat someone with a burn in like 1500 and then coming today to a burn center and just, like chills that

EAU: Right.

EW: to think about

EAU: Like the opposite of Outlander. Yeah.

EW: Yeah. Here's some moldy bread. We'll try

that out. Yeah.

EAU: Yeah. Yeah.

EW: [00:10:00] But so what I wanna do today is take us through how that happened, piece by piece, skin grafts and burn excision.

EAU: Okay.

EW: So these approaches date back to ancient times. For

instance, in the fifth century, CE Sushruta, the famous surgeon from ancient India described how he treated amputated noses by taking a flap of skin from the forehead, and then later the butt, and then grafting it over the nose wound.

EAU: Fascinating.

EW: Yeah, so skin grafting in that way has very, very deep roots.

EAU: Wow.

EW: And from this point, until the 18 hundreds, a few physicians had tried their hand at grafting over the centuries with varying rates of success. Allegedly, the first rhinoplasty, I think, was performed in the six, 16 hundreds or 16th century, I can't remember,

EAU: Okay.

EW: like a while ago. Yeah, a while ago.

EAU: Yeah.

EW: But still, it was very much touch and go. Not very, it was definitely more of an art than a meta than a science,

EAU: Mm-hmm.

EW: things turned around in the 18 hundreds. The early part of the century saw a few surgeons experimenting with skin grafting in animals, which showed some promise, but more importantly, those experiments help to clarify some crucial concepts about. You know, tissue death, circulation, and immune rejection. What's actually going on in the wound healing process and what's necessary for the skin graft to actually take,

EAU: Right. What is it? What is it that determines whether or not this one is going to work versus that one?

EW: Yep. Yeah. In 1869, inspired by these animal experiments, Swiss surgeon Jacques Louis Reverdin, who was still a medical intern at the time,

EAU: Wow.

EW: a tiny slice of skin into the middle of a wound. Free skin grafting, no skin flaps required. So finding success with this, he varied his approach to see what was possible. Your own skin. Skin from another human related to you. Skin from a human, not related to you, skin from another species. Just let's run the full gamut here.

EAU: Mm-hmm. Mm-hmm.

EW: This free skin grafting technique was first applied to burns in 1870

EAU: Okay.

EW: a surgeon named GD Pollock treated his 8-year-old patient's thigh burn by transplanting skin from her abdomen to the wound.

EAU: Okay.

EW: And after six weeks, the grafts looked pretty excellent. Which

EAU: Wow.

EW: incredible.

EAU: Yeah.

EW: Skin grafting became really popular and other surgeons refined various techniques like the split thickness skin graft where you take bits of the dermis along with the epidermis. And this technique promoted faster healing and less scar formation, which reduced, uh, scar contractures, which also you'll talk about, I know. And skin grafting proved to be a major advancement in burn care. And physicians also noticed that wounds healed much more quickly and completely when that burn tissue was removed beforehand.

EAU: Mm-hmm.

EW: So that was where sort of the excision comes in, which people had experimented with in the past, but it kind of became more of like a, no, this needs to be a routine part of

things

EAU: This is actually helping to take this off. Yeah.

EW: it was debated. Yeah.

EAU: Okay.

EW: So by the early 19 hundreds, grafting and burn excision was, or wound excision was. They were pretty well established techniques, but no matter how skillfully you grafted or debrided, if your instruments weren't clean, if the wound wasn't clean, infection often led to death

EAU: Mm-hmm.

EW: Antiseptic technique. This is like a mini history of many

EAU: Of all of medicine. Yeah. Like the things that revolutionized all of medicine also revolutionized burn care. Surprise. Surprise.

EW: Surprise.

EAU: Yeah.

EW: Okay. So antiseptic technique for centuries, surgery of any kind remained a last resort, an act of desperation. Before science and medicine had connected the dots between dirty instruments and deadly infections, anyone bold enough to go into surgery believed that the best surgeons wore the bloodiest filthiest coats.

EAU: Yeah, it's so gross to think about.

EW: was like, wow, you've got some experience. How many people have you operated on today? 15. And you haven't rinsed your hands once? That's what I want. In a, in a surgeon. No, it's not.

EAU: thank you. Please.

EW: no, no. Uh, thankfully Joseph Lister or sepsis episode

EAU: Mm-hmm.

EW: surgery in the 1850s with his recognition that if you operated with cleaning surgical tools and you cleaned the wound, your patients were less likely to die. His solution of choice, his antiseptic solution of choice was carbolic acid, often mixed with Vaseline for use in burn patients to reduce

the pain of having acid rubbed into your wound.

EAU: Yeah. Okay.

EW: Uh, later during World War I, other antiseptic solutions were developed like boric acid, acetic acid, and a 25% solution of sodium hypochlorite, also called dakin solution.

EAU: Still use that today.

EW: still use that today. [00:15:00] Antiseptic technique was a major step forward in reducing infections and deaths following surgery, such as removing burn tissue or performing skin grafts. And the same principles were used for wound management in burn patients, even if they didn't have surgery,

EAU: Hmm.

EW: because your skin, as you, as you've talked about, is a, a barrier.

EAU: Mm-hmm.

EW: infection. When that barrier is disrupted, it leaves it super vulnerable to infection. And so if you can find a way to decrease that vulnerability through antiseptic ointments, antimicrobial ointments, bandages that are infused with antiseptic. Components

stuff. These things are integral in improving outcomes for those who have burns,

EAU: Yes.

EW: minor and

EAU: major. Mm-hmm.

EW: By reducing infection through antiseptic technique, these and these specialized ointments physicians could chip away at one major, major source of mortality for burns, but other threats remained fluid balance and nutritional support.

EAU: Yeah.

EW: Yeah, this is a big one. More than I realized. I think despite having re-watched all of er, I don't think it really hit home to me how important this part of it was. Um, as though ER is a super.

EAU: accurate.

EW: It's like I saying, despite med school, despite er, um, same, same the centuries, a handful of physicians had noticed that providing a burn patient with, with lots of replenishing fluids and food seemed to help. But this was very much against the beliefs of the day. Things like bloodletting and purging were still the standard for centuries.

EAU: yeah.

EW: it wasn't really until the late 18 hundreds, the late 18 hundreds, that doctors began to crack the code on fluid balance and nutritional support.

EAU: Wow.

EW: And it started when a few doctors observed that the renal failure in burn patients looked very similar to that, that they observed in cholera patients

EAU: Oh

EW: Or their bodies were extremely dehydrated and they just, their fluid balance was

EAU: yeah.

EW: it was in super imbalance, I

EAU: Right. They're losing tons of fluid and they're losing tons of electrolytes because they're pooping pure water liters at a time in cholera. Uh, and that totally makes sense. 'cause the same thing is happening. It's just going out through this surface area that you have lost from your skin.

EW: Yep.

EAU: Fascinating.

EW: Yeah, that was sort of like the first little light bulb moment. And then one doctor went further and discovered in 1893 that blisters and burn tissues were filled with plasma. Meaning that fluid, that fluid was not where it should be. And so it was like, oh, this is the same thing. It's This belongs in our blood vessels. Somewhere else, not we're in the blister. And some people then tinkered around with fluid replacement, with saline administered orally, rectally,

or intravenously. But it wasn't really until World War that the technique was refined and not until 1921 that it was applied systematically to burn patients.

EAU: Okay.

EW: So that year. A fire broke out at the Rialto Theater in New Haven, Connecticut, and a professor at Yale. Frank Underhill saw the, that the composition of fluid and blisters was the same as plasma and loss of those compounds he suspected is what led to shock in burn patients. And so he was like, I think that this is actually causing that fluid loss is causing mortality in burn patients, it's not toxins. So previously

EAU: it was believed that toxins

EW: were the thing that killed people, which it can still be

EAU: interesting

EW: if you think of toxins as like a, um, bacterial infection

EAU: Right, right, right, fungal But that would be more usually later rather than like immediately following.

EW: Yeah, so he's like this is an emergency. Like this is what's happening right now. Fluid loss. Can we, can we treat fluid loss? I mean, this was a huge step forward

EAU: Wow. Because fluid

EW: loss could be reversed by providing saline solution with protein intravenously

EAU: Mm-hmm.

EW: And later work in this area led to formulas to quantify how much fluid was needed, depending on the age and the size of the person and the surface area and the depth of their burn.

EAU: Yeah.

EW: About a decade after the Rialto Theater Fire in which happened in 1921, physicians began to notice that burn patients also needed an increased caloric intake and that extreme loss of lean body mass put them at high risk for poor outcomes. So death, decreased wound healing, impaired immunity, and so on. the nitty gritty of how to best provide adequate nutrition and calories that took decades to

EAU: Oh, yeah, yeah,

EW: get consensus on. But the recognition of this issue was absolutely critical.

EAU: yeah.

EW: Next up is antibiotics.

EAU: Mm-hmm.

EW: Antisepsis and antimicrobial dressings were a huge step [00:20:00] forward, they didn't always entirely prevent infection. The development of penicillin in the early 1940s, I mean, it was discovered in 1928, but it wasn't widely available until the war ended in 1945 and then later. Broad spectrum antibiotics. This really helped to control infection. When it did arise in burn patients.

EAU: Mm-hmm. One

EW: of the very first uses of penicillin in the general public was, in fact, after the Coconut Grove Nightclub fire in Boston on November 28th, 1942.

EAU: Huh.

EW: Yeah.

EAU: I didn't know that.

EW: yeah, I think, I feel like I remember talking about it. In our antibiotics episode in

EAU: You probably did, right? That was season three, so I don't remember it.

EW: no. But,

EAU: Coconut Grove sounds vaguely familiar though, doesn't it?

EW: Yeah. But yeah, so that was the first time that penicillin was used, uh, to see if it improved. And I don't think. I think the, the data were not strong enough to see, did this actually help

EAU: right.

EW: there was a lot of, still a lot of other things that needed to be figured out, but, this tragedy also led to the refinement of fluid replacement calculations

EAU: Hmm

EW: the recognition of airway injuries after a fire.

EAU: Hmm. Yeah.

EW: and so, but since, since then, since this nightclub fire. Antibiotics have often been employed in treating systemic infections that arise after a burn or used prophylactically to prevent infection in the first place. But their use in burn patients can be tricky. So first, antibiotic resistance is a major problem, especially for certain types of bacteria found after burns like pseudomonas.

EAU: Yeah.

EW: And antibiotic use can also lead to other opportunistic pathogens taking over. So, for example, certain fungal species such as candida albicans,

EAU: Mm-hmm.

EW: um, so it's, it's not, it's not, it's, it's a little bit of a mixed bag or it's like, it's not, it's not the way that antiseptic technique or fluid replacement is

EAU: Right.

EW: role that it plays in the

EAU: Especially 'cause you're talking about like systemic antibiotics, right? Like IV antibiotics or oral antibiotics, like the kind that you would use to treat an infection

EW: Mm-hmm.

EAU: and Yes. And that, and that makes sense. 'cause we don't really use them that much in burns today.

EW: yeah.

EAU: Um, unless we need to.

EW: Unless we Exactly. So

like

EAU: So like having it there when needed. Exactly.

EW: Exactly. But yeah, uh, like you said, I mean the, the systemic part of it. And so having this knowledge of, of antimicrobial properties to then infuse bandages,

EAU: Mm-hmm

EW: I kind of lump that in with the antiseptic technique, but like that was a huge part of it too.

EAU: Yes,

EW: like

EAU: totally.

EW: How do we topically treat this and prevent infection. Right. Yeah.

EAU: Right.

EW: And then last on the list is airway management.

EAU: Hmm.

EW: So This includes both the recognition of airway injury as well as ways to treat it. Now, if we're still considering just that 50 year window between 1900-

1950 airway management was mostly restricted to recognizing the damage that smoke inhalation could do to lungs that could lead to poor outcomes.

EAU: Okay.

EW: So doctors treating victims of the Coconut Grove Nightclub, uh, fire in Boston in 1942 made a made note of this quote.

EAU: Okay.

EW: "It was obvious almost at once, that we were dealing with something more than the problem of burned skin. A severe impairment of respiration also existed." End quote. And this was

EAU: Wow.

EW: yeah,

EAU: Inhalation. That's so interesting that that's so late.

EW: I think that people recognized it, but it like,

EAU: It wasn't

EW: do about

EAU: right.

EW: I mean, I think that, I don't know.

EAU: Yeah.

EW: I

EAU: Yeah. I know. It's a lot. There's a lot of components there.

EW: a lot of component. This is like the one where I was like, I don't even know where to begin

EAU: Yeah.

EW: the history of this, because respiratory issues following burns that could be due to direct burns, carbon

EAU: Mm-hmm.

EW: CO poisoning, can happen inhalation of the toxic substances that are being burned, later on it could be bacterial pneumonia due to impaired immune response

EAU: Mm-hmm. Or ventilation assistance like we see today if someone is intubated because of swelling. Yep. Uhhuh.

EW: Yep. Right. So there's, there's a lot of, there's a lot of factors to

EAU: Yeah. Yeah.

EW: um, and doctors though, I think that the recognition that those who had smoke inhalation injury and pneumonia tended to experience worse outcomes and that led to increased focus on how to better manage lung injury alongside wound management, fluid balance, nutritional support, and so on. And then later, of course, supplemental oxygen. And the invention of mechanical ventilators led to some relief.

EAU: Mm-hmm.

EW: But really What you can kind of see is the pieces of all of this, like,

EAU: Yeah.

EW: we're, we're relieving the threat due to, uh, fluid imbalance. We're

EAU: Yep.

EW: relieving the threat due to infection in the wound [00:25:00] directly. We're relieving the threat of all of these different things and kind of saying, okay, what's left that we can improve upon? And

EAU: Yeah.

EW: how the history of burn treatment kind of goes

EAU: Yeah,

EW: It's a lot,

EAU: it's

EW: I,

EAU: a lot.

EW: Even though I haven't been talking for all that long compared to how somehow sometimes how I go on and on. There's, I, I'm sure that you've already forgotten the details of how fluid replacement was discovered or the earliest skin graft performed. And if, if you have forgotten, don't sweat it. Like that's, you don't need to remember the details. The important thing that I want everyone to take away from all of this is kind of what I already said at the top. It's not one thing that changed the landscape of burn care. It's many things not working in isolation, but coordinated care. At the end of the 1940s, researchers had made all of these incredible advancements that made survival after a severe burn more possible. But one last step remained before possible, turned into probable. And that was the formation of burn units or burn centers. Coordinated round the clock care that integrates expertise across many different disciplines working as a team.

EAU: Yeah.

EW: The first burn units in the United States were founded in the mid 20th century, and they have transformed burn care and offered tremendous hope. They also act as a research unit, constantly striving to improve not only survival, but quality of life.

EAU: Mm-hmm.

EW: Pain management, psychological trauma, stigma, physical therapy. At these centers, people with burns are treated not in pieces, but as a whole.

EAU: Yeah.

EW: And as we've gotten better at managing the immediate injury at managing the physiological impact of burns, it has also left us more able to address and improve the injury to the parts that you can't see. Right, like the huge trauma that happens, the stigma, all of these different aspects,

EAU: Yeah.

EW: I just like, especially after doing these episodes, really want to acknowledge the incredible work of the healthcare professionals at these centers. Because it is, is crucial

EAU: Mm-hmm.

EW: what they do,

EAU: I think too, Erin, it shows how much

EW: like

EAU: the, all of the changes that you had mentioned, just kind of show how much people have started to recognize or pay attention to the fact that a burn is not just skin damage. It's not the same thing as a cut or a scrape. It is. It is a system wide, it is a whole body system wide like event that we have to treat as such.

EW: Right.

EAU: yeah.

EW: Yeah. It is such a, to me it is such an interesting way of approaching medicine because it's, you have to have expertise in all of these different areas all at once and apply them differently. And each case is a different, and at the same time as amazing. As incredible as these centers are, they can only help someone if someone has access to them, which is a pervasive issue across the globe that I know you'll talk about.

EAU: Mm-hmm.

EW: And as transformative as burn treatment has been over the past century, continued improvement can only be achieved through funding for research. And I know you've, everyone has listening has heard this all before, but. I just, it bears repeating, like it bears repeating until we all internalize

EAU: something changes.

EW: something changes. But with that, Erin, I'll turn it over to you now to fill us in on some of the incredible treatments out there for burn injuries that happened after those 50 years were

EAU: Oh. I can't wait to do that. Erin,

The basic principles of burn care today. Erin, kind of fall along a lot of the same lines that you just walked us through and how we figured out to do a better job at treating burns. so what I wanna walk through is less of the like acute phase of fluid resuscitation and nutrition management and airway control, which is integral and so important in those first, especially those first like 24, 48, 72 hours. All of that is imperative. So I'm not, you know, knocking the importance of that. But what I wanna really focus on is the long term on how we treat these burn wounds to heal them over time

EW: Right.

EAU: because the technology that we have now to improve upon these outcomes is really, truly phenomenal and it builds on everything that you talked about already, Erin. So the first part is the surgery. And this idea of surgical excision is a mainstay of burn care for anything that is a deep partial thickness. So a two B, a second degree, like a deep second degree burn, or worse a third degree, or down into the muscle or bone [00:30:00] tissue surgical excision. Early is a mainstay exactly when and exactly how early. Depends on the burn center, depends on the situation, but usually within the first day or two or three to remove all of the dead or necrotic tissue. What this does is it helps to ensure that the surrounding tissue has less damage because remember we talked in last episode about how there's kind of a, a zone around the worst part of the burn that is really at risk. Of further damage. So by removing the necrotic tissue, we can help to kind of keep that tissue viable.

EW: mm-hm,

EAU: and this can go in a lot of different ways, so sometimes it means like actual surgery with like sharp instruments where things are kind of scraped away down to healthy, bleeding, viable tissue. Sometimes it might mean newer technology, like water, like high pressured water we now have, which is fascinating, and that's to basically like go through the planes of tissue, um, but in a way that causes hopefully less damage to healthy tissue. 'Cause it can sometimes be really hard to tell apart healthy tissue from dead tissue.

EW: how does it help

EAU: Sorry.

EW: No, it, yeah. Yeah.

EAU: Yeah.

EW: It feel, yeah. How does it help preserve healthy tissue? Like how is Yeah.

EAU: Essentially because it's not going to cause as much damage, so it's not something that's sharp where you're gonna accidentally cut, where you didn't mean to, but it's just really high pressured water that can kind of, um, go through the layers and it will like, take off the dead tissue because that is dead. So it kind of just falls away

EW: Okay. So it does

EAU: with less pressure.

EW: so it does a better job with distinguishing healthy and not healthy

EAU: potentially in some scenarios. Sometimes we might also use enzymatic debridement, which you mentioned, Erin. Um, some of the solutions that they used way back when, might still be solutions that we used today, um, to kind of in a much more gentle manner, debrided away all of that dead tissue. In some cases we might even use maggot larva therapy.

EW: I was wondering about that. Okay.

EAU: Yes, and so that might not be, you know, not in those first 24, 48 hours, but especially if areas become necrotic later, or places that you didn't get to in surgery. There's a lot of reasons why you might end up using those kinds of therapies later.

EW: Okay.

EAU: But removing the dead tissue is the first incredibly important step. Next is preventing infection. And this is both next and at the same time. So that means washing wounds, right? To remove any dirt, remove any debris, and then covering wounds, whether they needed surgical excision or not with antibiotic infused dressings or ointments or what have you. And we've had huge improvements like there are. Way too many to count in terms of the types of

dressings and antimicrobial dressings. A lot of the ones that we use in burns tend to be silver, um, infused dressings, and that's because silver is a good antimicrobial, um, that is really only topical, so it's not penetrating deep, it's not going systemic, et cetera. But honey based dressings, aloe vera based dressings with all of these, the goal is to inhibit the growth of bacteria to reduce the chance of infection. IV antibiotics, like I mentioned, we don't tend to use unless there is an infection that leads to something like sepsis because not only is it overboard to use IV antibiotics that might increase the risk of antibiotic resistance and other things, but also these wounds don't really have any blood flow, so IV antibiotics don't really work that effectively.

EW: that was

EAU: Exactly.

EW: the, the conclusion of the, the Coconut Grove. They were like, we don't know if this did anything or not.

EAU: Exactly. Yeah. And it might not have,

EW: not have.

EAU: but for some people it might have. Yeah. But for any burn that needed a surgical excision, any burn that extended. Into the deep part of the dermis, into that subcutaneous tissue is not going to be able to heal completely on its own, and it is going to need some kind of help from something like a skin graft or a skin substitute. So the gold standard for treatment of any burn that had to have a surgical excision is still a skin graft, even though they're apparently as old as. Dirt, as old as

EW: old. So

EAU: I had no idea.

EW: Yeah.

EAU: The way that we do skin grafting today, um, is mostly by what's called a split thickness skin graft. So that means a skin graft that has both epidermis and a small amount, the very top of the dermis. For more sensitive areas or more cosmetically important areas like say the face or maybe even the hands, you might use a full thickness skin graft. So that would be epidermis and the whole

entirety of the [00:35:00] dermis. and skin grafts are really fascinating. You could probably talk in way more detail about them, but

EW: Yeah,

EAU: will just give us all the basics of how these work. essentially you take a healthy, non burned piece of skin and use that to cover the burned wound. You adhere it with staples or sutures or something. Ideally, the skin comes from you.

EW: Yeah.

EAU: Because then your body recognizes it and there's no, there's much less risk of rejection or anything like that. There's two ways that we can do this, depending on how important the cosmetic outcome is and how large the burn wound is. In some areas you might take a piece of skin and just use it as is to cover sort of just like a flap graft essentially.

EW: Okay.

EAU: In other cases, you might do what's called meshing.

EW: Mmm.

EAU: Which means you take the skin that you're going to use as the graft and you run it through a machine that basically turns it into a mesh so that you can stretch it over a much larger area. Your face doesn't look like it appreciates that

EW: Um, the technology. Just

EAU: it is. It is so fascinating. My dad had one of these skin grafts, not for a burn. He had a fasciotomy for compartment syndrome, but he, so he has two scars, one that's barely visible. It's just like a little bit of discoloration on his upper thigh. That's a perfect rectangle from where they took a section of his skin. And then on his lower leg, he has a wound that is, it's a little bit deformed because his. It wound was all the way down to the muscle, basically.

EW: Okay.

EAU: Um, but it also is a bit stippled looking like it's, you can tell that it wasn't like completely covered and that's because that was meshed. And so he had this mesh covering of his own skin that covered that wound while it was healing.

EW: Okay. So this is the meshing. I mean, it's very cool. It just,

EAU: It's fascinating.

EW: not my favorite thing to think about, the

EAU: Okay, fair. Fair enough. Uhhuh.

EW: but this meshing, so this is for larger areas

EAU: Mm-hmm.

EW: then reduce sort of the how much other, how much skin you're taking from other parts of your body.

EAU: Exactly. Exactly. Yeah. Yeah, yeah. Because if a person is stable, their burn wound is clean and they have enough donatable, other skin, then this is the way that ideally skin grafting would be done. But.

EW: okay.

EAU: In many cases, someone might not have enough skin. Maybe their burn area was really, really high, um, or maybe they're just not very stable, they're super sick at the time. And so we don't wanna risk a prolonged surgery where we also have to take skin from other areas to try and make it into, uh, a graft to cover. And so in those cases, we might use what's called an allograft, which means skin from someone else. Usually it's a cadaveric skin graft. Or sometimes even xenograft, which is with another animal's skin, so something like porcine skin or something. These are usually temporary because usually our body is going to reject them in one way or another, and so they act as a covering, but often have to be removed after a couple of weeks or so, or if there's any signs of infection.

EW: So they act as a covering and they are a better covering than. Surgical dressings, ointments, et cetera.

EAU: Well, that's a great question, Erin. It all is going to depend, and this is really where we can get into some of the life-changing technologies that exist in the world of burn healing

EW: Mm-hmm.

EAU: because there are now a huge variety of things that are there to act as essentially skin substitutes.

EW: Mm-hmm.

EAU: Okay. whether a skin graft isn't possible or whether, you know, maybe something wasn't quite deep enough to warrant a skin graft, but you're worried that the healing process is still going to take a really long time. And dressing changes are incredibly painful, and can be really distressing. And

EW: so.

EAU: A lot of these other skin substitutes, even if they're not taking the place of a graft, maybe they're used while we're awaiting for a graft. Maybe they're used in a place to reduce the need for frequent dressing changes, even in a, even if we don't need a skin graft later on. There's some really incredible things. Some of them are still in the realm, not of science fiction, but of more research. And some of them are already accessed, like commercially available. And if you have access to a great burn center that actually can get them, then you can get them. So let's talk about what some of these might look like. Some of these dressings might be made from natural polymers like chitin. Which is fascinating, like from an insect exoskeleton and things like that. Right. Okay. Some of them might be made from cellulose, from plants or even like fibrin or [00:40:00] hyaluronic acid, collagen, gelatin. Any kind of polymer that you can think of that might come from nature and others are from synthetic polymers. Something like silica or maybe synthetic carbon-based compounds. And these dressings can come in a really wide variety of textures. Some of them are what are called hydrogels, which still take me. I still can only barely understand them 'cause they basically are these things that help to soak up fluid. In the wound. So they reduce how wet that wound is going to be, and then they, by hydrating themselves, they also like their properties become more available to your skin or to, to your healing wound. They're really weird.

EW: blot and moisturize.

EAU: Yes, yes, yes, yes. They blot and moisturize. There's also films, patches, sponges, nano fibers.

There's a lot of interest in like nano medicines,

EW: Yes. Yeah.

EAU: But the goal of all of these things is to promote wound healing and reduce the amount of time that it takes for our body to actually grow new skin in and of itself. They also serve to reduce the risk of infection. And the goal is to maintain a kind of optimal wound healing environment. And wounds heal best when they are moist, but not too wet because too much fluid can actually impair wound healing. You need to be able to have oxygen flow in and out. So you need something that's semi-permeable like our skin is and prevents infection. Right? So something that's going to block other. Either have antibiotics in it or can just block other microbes from getting in. And ideally, these dressings can also help to reduce pain, either because they have something in them that's analgesic or just because they're reducing the number of dressing changes and, and the friction or anything that you might have from other dressings.

EW: Mm-hmm. Mm-hmm.

EAU: Um, so like I said, there's too, there's literally too many of these kinds that can go into these. One that I think is quite interesting is an acellular fish skin,

EW: Excuse me.

EAU: right? So, you know how we said sometimes we can use like xenografts from like porcine skin, so pigs or something like that. Um, there is a acellular fish skin that can be used now for wound healing, including burns. But it can kind of act again as like a temporary skin. So you put it on, leave it on until your skin starts to re epithelialize itself. It's.

EW: Mind is blown by that

EAU: I know,

EW: fish,

EAU: really fish skin. That was, that was I think one of the newest ones for me. But then there's also a lot of interest in things that are even more, they honestly sound like science fiction. So there are things that are available commercially that are kind of like scaffolds

EW: Yes,

EAU: can take some of our own cells. Send them off to these companies who engineer them and then spray them

EW: yes.

EAU: or otherwise infuse them into these like films, these scaffolds that we then can use as a dressing.

EW: I feel like I read about this in Replaceable You by mary Roach it's possible.

EAU: Yes,

EW: that totally blew my mind.

EAU: I know.

EW: Kind of 3D printing your own cells in

EAU: yes, so, and that's even, I would say a separate thing because 3D printed cells is a huge area of research and it's been done on animal models. I think there is actually some like clinical in human data from it, but it's all in the realm of research as far as I can tell right now. But that's even like a step beyond what already does exist, which are these, like these dressings that you can impregnate even with your own cells.

EW: So cool.

EAU: I am sorry. It's just like what I,

EW: I,

EAU: I don't know.

EW: like, and it's, to me it's, it's a really interesting. Trajectory of burn care because

EAU: Yes,

EW: for millennia, it was, the focus was on the, the wound itself. Very topical

EAU: right.

EW: very isolated, the local treatments. And then once more awareness was gained about the systemic effects that Burns can have, then it was like, well, we need to provide supportive care for fluids, for food, for anti, you know,

EAU: Mm-hmm.

EW: Antiseptic technique, all of these different things. uh, airway management. then now we have a lot of those things more under control. We can go back to the burn and say, I mean I know it's all been done simultaneously, but like we're now kind of some of the most exciting research is in this area of how do we promote healing? Again,

EAU: Exactly.

EW: fixated on that burn itself on the topical

EAU: Exactly.

EW: local area.

EAU: Right. And I think what's so interesting too [00:45:00] is it's kind of like, like what you were saying, it's for a long time it was just how can we, how can people survive this?

EW: yes,

EAU: Right. Like early on it was probably just treating the people who did survive. So that's why it was just treating the, the burns of people who did survive. And then it was, can we help people to survive even if they had a big burn? And now we absolutely can. How can we make sure that they thrive going forward? Right.

EW: Yes. Quality of life.

EAU: Quality of life. And so for that reason, a lot of the research that is going on right now in burns and wound healing is into improving these, especially bio-engineered types of skin grafts. And this idea of 3D printing and using our own cells or other cells, like just things that will help to promote healing. And the reason why this is so important is to reduce the risk of scarring. Because, especially in cases when we cannot do an autologous skin graft. So if you cannot take skin from yourself to be able to do a skin graft, then one of the most common complications of burn wounds is what's called hypertrophic scarring.

And hypertrophic scarring is as high as 70% in people with burn injuries. And basically what happens is that as the scar forms, it is laying down collagen in this like linear way that ends up lacking the flexibility of uninjured skin.

EW: and is that because it's like just trying to get this done as quickly as possible

EAU: Kind of, that's kind of the way that I think of it. I don't know if that's like a perfect, but that's kind of the way that I think of it. When you have a large area, your body's just like, get it down, get something down. We need to cover this up.

EW: Okay. And

EAU: And when that happens, there ends up being too much of this collagen deposited and like not the right types of collagen basically. Um, and it results in a very thick, inflexible scar that's really painful and really itchy.

EW: Mm-hmm. This is

EAU: this is different, by the way, than a keloid scar, which can also be a complication of burn injury. But keloid scars grow beyond the edge of the initial wound. And that's because of them being stuck in that proliferative phase of wound healing and not moving on to this remodeling phase of, of typical scar formation. Um, so certain types of skin might be more prone to keloids than others. But overall, all burned skin is very prone to hypertrophic scarring. Um, and both keloid scars and hypertrophic scars can be painful. They can be hugely impactful on quality of life. And they're really hard to treat after the fact. Additionally, what happens as this, like dysregulated collagen is being laid down is that you also have what are called myofibroblasts that are being laid down, and these are cells that our body uses specifically to close up the wound bed itself. So like you said, are they just trying to get it done? Yes. And so our body uses these cells that try and decrease the area of the wound by contracting it. And that can result in what are called contractures. And you've mentioned these a few times, Erin, but these are basically scars that can form that are very tight and painful and especially in an area. Where you need to have movement like your hand or your face, I mean almost anywhere on your body. Your skin needs to be able to move. Um, that can really impact quality of life and like the ability to do the things that you need to be able to do.

In general, the deeper the wound, so the deeper the burn, the worse likelihood there is for scar formation, or like the more likely you are to have bad scars.

That's a weird way to say that. Apologies. Um, but what we know and what I think is really interesting is that this is more related to the time that it takes to heal. So any dressings or any treatments that we have that can. Reduce healing time to less than 21 days or so

EW: Oh,

EAU: significantly reduces the risk of especially hypertrophic scarring.

EW: Maybe this is like a question for another episode. Maybe we should do an

EAU: Okay.

EW: like just wound healing scars in

EAU: Yeah. Mm-hmm. Mm-hmm.

EW: But I, I feel like what is, the skin is different, whether

EAU: Yes.

EW: There's a graft, whether there's not a graft like hair. Does the hair grow? Does it not grow? Do is different and what makes it different? And if that's beyond the scope, then we can just say, we'll get to that another time.

EAU: I do think it would be interesting to do a whole episode on that, Erin. 'cause there is a lot to it. It's all gonna depend on the depth of the wound of if there was a skin graft, where did that skin come from, whether melanocytes were completely lost. Those are our pigment producing cells. And so that's why a lot of times we see changes in pigment. and then yes, like our body is healing by scar formation. Especially if you have lost the. like stem, the skin [00:50:00] stem cells to where you're not fully regenerating the skin that was there before, but you are instead filling it with scar. It's like it is a different tissue than the skin was initially, if that makes sense.

EW: Why?

EAU: Yeah. We could do a whole episode on it someday, Erin, but what I think is really, I mean, there is so much work that has been done and it's such important work. But the biggest issue, there's a lot of biggest issues, but one of them is how are these new technologies going to be made available? Because

right now, most of the people who really could benefit from access to these new technologies do not have access to them.

EW: yeah.

EAU: So the World Health Organization reports that globally there's at least 11 million people who have burns bad enough that they are being reported, which likely means that they are severe. So more than 10 or 20% of your body surface area that we don't have great numbers on that because we do not have like global repositories of burn data. No one's reporting all of this. On a country by country scale.

EW: yeah.

EAU: And this results in at least 180,000 deaths from Burns Worldwide every single year.

EW: Mm-hmm.

EAU: And it's estimated that 90% of burns, and I think 95% of deaths from burns occur in low and middle income areas of the world.

EW: Yeah.

EAU: And this is severe burns, not just burn burns. Um, mortality rates from burns have dropped substantially in high income countries, but that's to a much greater degree than the decreases in mortality in low and middle income countries. We also see a bimodal age distribution in who is most likely to have burns. Young children under age five and working age adults are the two highest groups that suffer from burns. And like I said in last week's episode, flame burns and scald burns are the most common types of burns with chemical and electrical burns being relatively rare, and kids under age five are more likely to get scald burns than flame burns. So from hot water and things like that. In the US where we have a little bit more like hard data, it's estimated that more than half a million people seek medical treatment for their burns each year.

EW: Wow. Yeah.

EAU: That results in anywhere from 25 to 40,000 hospitalizations, depending on the year that you've looked at, and at least 4,000 deaths in the US from Burns every single year. Despite all of our advancements in treatment,

EW: yeah.

EAU: and like we've mentioned, burn injuries can result in really severe scarring, which is painful and can be disfiguring, which can result in social stigma, isolation, and has a really profound effect on people's mental health. And I don't wanna discount the effect on the health of caregivers

EW: Yeah.

EAU: The care of people who have had burn trauma is very prolonged. It can be very intensive, and that can be really hard on caregivers, especially if you don't have access to something like a specialized burn center, which, even in high income countries, over 20% of the population in this country does not live within two hours by ground or air of a burn center,

EW: Wow.

EAU: that they don't have access, and that's in a high income country. In low and middle income countries, they have even less access.

EW: Yes.

EAU: So there's been a lot of research too on. People who have suffered burns, people who have been caregivers of people with burns, and people who care like you know, medical professionals and things on what do we need to do, what are the priorities in burn management? And the biggest ones that have been identified so far are improving the actual wound management. And so that's where I think most of the research that I have seen has really been in, which is like wound dressings and skin substitutes and all of these things. But the second most common response was improving psychosocial outcomes,

EW: Yes.

EAU: think that we have done. Maybe less of a great job of focusing on

EW: Mm-hmm.

EAU: so, and then other things like rehab and helping to treat scarring after the fact were other things that were identified as kind of high priorities. And I think it shows that when we have access to dedicated facilities to teams who are really experts in burn care and to these incredible technological developments and advancements that we've seen.

EW: Mm-hmm.

EAU: There is the potential for the treatment of burns to be phenomenal. Like really, really incredible.

EW: We have so many things in our toolkit,

EAU: Yes.

EW: but yeah. Again,

EAU: Yeah.

EW: Who has access to the toolkit?

EAU: Yeah.

EW: Yeah.

EAU: And that Erin is Burns [00:55:00] today.

EW: Yeah, I, I have no words.

EAU: Yeah. It's a lot.

EW: I'll say sources. How

EAU: Tell you where you can learn more.

EW: There we go. There we go. Again, I have a bunch of papers for this and I'm gonna shout out just a few. There's by Moore 1999 then and now treatment volume, wound coverage, lung injury, and antibiotics. It was sort of like personal reflections on treatment of burns has changed. And then by Jackson 1991, the Evolution of burn treatment in the last 50 years. So from, that's pretty interesting paper. Uh, then by Barrow and Herndon, uh, I think it's a book chapter called History of Treatments of Burns

EAU: Love it. I.

EW: Plus More.

EAU: Actually just, I will still shout out again the paper I shouted out last week, which was from Nature Reviews Disease, primers. It has a lot in there about how we treat burns today, and it was from 2020, so relatively recent, but I have some other ones as well. There was one from 2023 from the International Journal of Molecular Sciences that was called an overview of recent developments in the management of burn injuries. I found that one helpful. There was a couple from the Lancet, one that was from the Lancet Global Health that I mentioned that was. Called the top 10 research priorities in global Burns Care. Um, so that one was kind of how we need to focus on burn care going forward. Um, another one just specifically on hypertrophic scarring and how much we need to focus on that. A whole nother paper on nano technologies. Oh my gosh, there's so much more. You can find them all on our website. This podcast will kill you.com under the episodes tab.

EW: you can. Uh, thank you again so much to Emma for sharing your story with us. It means the world and I, we just, we really can't say enough how much we appreciate your willingness to share.

EAU: It's true. Thank you. Thank you.

EW: Yeah. Thank you also to blood mobile for providing the music for this episode and all of our episodes.

EAU: Thank you to Lianna and Tom and Pete and Mark and everyone over at exactly right who there's, there's too long of a list.

EW: too long of a list.

EAU: Thank you everyone.

EW: and thank you to anyone who watches, listens, subscribes to this podcast. It really does. It helps us. It means everything. We do this for you, so thank you for letting us.

EAU: Thank you,

EW: Yeah.

EAU: as always, a special shout out to our patrons for your support over on Patreon. It really does mean so much to us. Keeps us going.

EW: It

EAU: Thank you,

EW: Until next time, wash your hands.

EAU: you filthy animals.