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Bridging the Gap conference
November 11, 2023

The Scope of Surgery for CSF Leaks: Concepts, Techniques, and Expectations

Thank you. Pleasure to be here today. It's hard to figure out what to say when we're talking about all of surgery, maybe, for these problems in 15 minutes. So I'm going to start with just some generalizations and then really want to present and show you some cases that I think show the unique things that we as surgeons get to see, the pictures you don't see on the radiographs or the scans.

And as we go through those, we can talk a little bit more about some specifics. So when I'm not treating leak concerns, there's, most of my practice ends up being treating pain problems, often related to the spine. And that's and as a result, doing minimally invasive surgery is something I've been doing for 20 some years.

And I do find that smaller incisions, less invasive surgery is likely to be associated with less post operative pain. And so that's what I brought to this experience. Most of the incisions then, the way I do these surgeries, and this is again, not to say that this is the best way, but this has been my experience, uh, are one to two inches in length at the most, typically do that with what we call a hemi laminectomy.

So rather than taking the whole lamina, just working through half of the lamina. Although this approach can lend itself to doing a complete laminectomy, I just haven't found it necessary. Usually using the operative microscope, and you can see up there, this is an operative microscope that we use in surgery, and this is how we have to set it up to keep it sterile during surgery. And it's nice that while I'm seeing what I can see through the microscope, the other people in the room can watch it on a monitor. The tubes, which are the most common way I do these are these types of tubes.

They're, they come in different diameters and and so some of these cases are done, you'll see with some examples. For instance, a 20 millimeter tube may be all that's required, and so that's really about a 21 millimeter incision. So less, less than an inch. Average length of surgery varies greatly, of course, depending on what we're looking for and what we find. So while I say two to three hours, I've done some that are certainly much less and some definitely take longer.

Because the incisions are small, I do think that the pain is more easily managed. Not to say that there's not pain. But, typically, fairly easy to manage compared with some other approaches. Length of stay in the hospital varies as well. Most of the time, I would say 1 to 2 days is probably all that's required.

ICU care is often not needed, but again, every case is different and we might observe for a period in the ICU. Often what can increase length of stay for instance, is this concept of rebound intracranial hypertension, which we need to learn a lot more about, but that can certainly prolong stay.

A lot of people with patches have had that experience temporarily And I find from my colleagues that some people preempt this and prior to surgery will have a patient take medications for management of this. Some started after surgery empirically without waiting to see if rebound is going to happen.

And I haven't found that to be necessary in most cases, but there are occasional times when we say, your reactions were severe with your patches. Let's consider just starting you now in case you have that same reaction after surgery. Lumbar drain is another tool you've heard some negative things about, but it is the way that we can drain spinal fluid continuously after a surgery if somebody were to have severe rebound.

It's also used, of course, in other settings to help seal leaks, in some instances, uh, so we'll look at that. Risks of surgery, you heard Dr. Schievink showed some nice slides. I'm not gonna spend too much time on that, but it is a surgery done under general anesthesia, so that has a certain amount of risk.

Again, wound care concerns aren't too great, especially in small incisions, but can be an issue. And then neurological risks. Again, I think you saw some numbers with Dr Schievink. They're quite small, but they're not zero. And neurological deficits associated with surgeries, obviously very concerning. And that really depends on which type of leak we're treating and what's required to accomplish the surgical goal.

We've been over this quite a bit already and I'm not going to spend a lot of time on it. I would add one category maybe that hasn't been touched on a lot and that's just these traumatic leaks. And I'll show you a quick example of that. But I think of these as traumatic related to a specific event or a fracture.

The iatrogenic ones we heard about, these can be after a labor epidural, like we've seen, after just standard epidurals that are done for pain management. And then I have an example I'll show you of a leak around an indwelling intrathecal catheter that's used for management of, for instance, pain or spasticity.

And let's not forget spine surgery in general, which is obviously very common, and different numbers can be found in the literature, but, uh, one study, which was a pretty big multi-center study confirmed that maybe 9 percent incidence of leaks after just standard spine surgery. So this is surgery for things like herniated discs and spinal stenosis and things, and they can have leaks associated with them.

Then there's the spontaneous leaks that we've been hearing a lot about and are more intriguing than these other ones because we just don't understand why they occur. This looks like maybe a familiar slide. This is a slide from Dr. Callen, my colleague. I've just added a little change to it because, and this was just a surgery I just did I think last week, I just wanted to point out this the ventral collections that we've looked at on a lot of the studies so far; I had a beautiful example in surgery last week, and that is a loculated ventral collection that we see at the time of surgery.

Okay, so let's just go through some quick examples. I have just these x-ray pictures, but just because this is very common. And again, this is just these are all just recent cases that I've encountered here at the University of Colorado. So this is just a young gentleman who was in a car accident, as you might expect from a trauma like this.

And the fact that you— there's a fracture here, there's a fracture dislocation here, and there's fracture in front of the spine. So we call this a three column spine injury. And that dura we've been hearing all about is right in the middle. So if you have a significant trauma that creates injury in front of the dura and behind the dura, it's a good chance you're going to have injured the dura. And in fact, at the time of this surgery, I did find a dural tear here and one there as well.

And the other point I'll just say about this as an intraoperative picture just showing that fracture reduction and realignment is that I had people that were involved in my training, for instance, that would say at the time of an injury like this, well, if you don't see an obvious leak during the surgery, don't look for it.

That is, they get hemorrhage, they get other things that it's a, a blood patch that occurs at the time. And so sometimes we do the initial surgery and we don't see active leak. It has been my practice to actually look for it because we know blood patches don't last forever in some cases.

And so, but there are people that will have had a surgery like this. No leak was identified. No leak was fixed. They certainly did have a leak though, and it may become a problem later. So,

All right, now just a couple cases of iatrogenic leak. Again, these are just recent cases. We, this was a case that I worked on with Dr. Callen. So, many of this typical symptoms of SIH that you hear about, won't go into that a lot. But all these symptoms that you see there, the tinnitus, the blurry vision, the light sensitivity, the postural headaches, all began after his placement of his intrathecal pump.

And it was a challenging evaluation because we didn't associate, obviously, you can see, I guess, right over here, the catheter coming in, and these second two pictures, there's just a little abnormality right there and right there as well. But hard

to really define. And this patient did, though, get, because of symptoms, got empiric patching and then with temporary relief decided exploration might be worth it.

This is the axial picture. I think you can see a little bit better the leak, the arrows pointing to there. It's just adjacent to that catheter. And then of course that surgery, and that's a high magnification picture. You see the catheter coming out and I was able to just put a stitch right around it there and stop the leak that way.

So, very rewarding there. Again, a quick example of an iatrogenic leak from spinal surgery itself. This unfortunate gal had numerous surgeries. They knew they had a leak. They were unable to fix it. And you can see on my scan there on the left the large leak, and then on the right, you had that large leak.

You can actually see it. We don't often see it so clearly. That's why I liked this picture, but it tracks all the way down to the dura. And was related to the surgical procedure. And then this is an intraoperative picture showing, and you see the the large overall defect I've said there is dural defect, and the arachnoid was healed over except in that one central spot and it was just spinal fluid just pouring out of that spot.

So this wasn't one I could primarily fix. You also see the nerve traversing there along the top of that hole, and she actually had nerve pain related to this, so, sciatica kind of pain. You see this repair technique here, that's a collagen type patch filling the defect, followed by a fat graft of the patient's own fat, and then a little fibrin glue.

Icing on the cake there. Another example of an iatrogenic leak. This was one we've heard about a little bit. So this is after an epidural for childbirth. Someone who had a short-lived post-dural headache after that, but then years of really doing quite well. Sudden onset of SIH years later.

And a workup showing this nice picture. There were other workup in pictures as well, but this shows an MRI, a picture of that little bleb. And then, as Dr. Carroll alluded to, here's a close-up picture. So this is a surgery done in that minimally invasive way through a 20 millimeter tube in the microscope.

And I'll show you in a minute the blood when it's more visible. But this shows you this, all that red, it's a neovascular membrane that forms over these. And and I agree, many other patients I've operated on developed these membranes as well. But this was compressing that blood, if you will, I think maybe as partly as a reaction to absorbing any CSF as well, and it developed this very vascular network. But when I dissected that free, then you see a very distinct bleb and some CSF pooling just at its base there. So that was fixed with literally a single stitch, pushing, involuting it back in and then and then stitching it.

Some other quick examples here, then, this is a spontaneous ventral leak, again, typical SIH symptoms, for time's sake, I won't go through all that did have the brain findings associated with SIH, including, unfortunately, hemosiderosis. Had the ventral collection on MRI and then diagnosed a ventral leak.

And so again, we'll go through the radiographic stuff real quickly. This one did have an associated bone spur, you see there on the right. And then Dr Callen, thankfully for me, places often these fiducial markers, and those are in cases that we think surgery may be necessary because localizing levels in the thoracic spine in the operating room can be challenging and that helps me and saves time in surgery.

That's what that looks like. So, this is again that dorsal dural opening on the left that you heard Dr Schievink describe being held apart. And then there's the ventral leak. Remarkably, they often look just like this. And I'm going to skip ahead here and just show you a few videos. Because again, you don't get to see these things.

So this part of this is with an endoscope, which isn't something that I routinely use, but it provides a really nice live picture for you to see. So that's the dural opening significant membranes. That's the spinal cord there. And you're going to see in a minute here, as I just mobilize that just a little bit, you'll see that ventral leak.

Okay. And there's the hole. Again, you can see that spinal cord pulsating in and out. You can imagine how that might be challenging to otherwise fix. I'm scraping that little osteophyte off there with my instrument. And Dr. Schievink described this, that sometimes that dura is easily pulled over and I can safely suture. This is sped up a little bit. It generally isn't that quick. But I can generally in those cases, I can move the dura over safely. I can suture that directly. And that is, as a surgeon, very gratifying when you can fully close an opening.

Although I would say, and I'll show you a quick example, most of the time we rely on patching in that setting. So that was one stitch. And then I placed three others to end up closing that. Just, again, a quick showing you what it that dorsal dural opening that we make has to be closed as well. That's a potential leak site if we don't do a good job of that. And this again just shows that quick closure. And then at the end of that closure, generally after closing that, we try to close that in what we call a watertight closure, and then usually put a patch over it as well, just for extra security.

And this is just another example of how we might treat that same problem. The ventral hole on the left upper left. And then that is a, a patch that I placed extradurally and pulled into the, into that hole. And then put a patch intradurally over top of that. This has been really well described and illustrated by Dr. Beck in one of our neurosurgery journals just earlier this year, I encourage you to look at that. So, this is an example quick of a spontaneous CSF-venous fistula. Again, we'll save time by not going through the history. But this person had a beginning of a small subdural there you can see on the bottom.

And and that subdural progressed despite patching. And so we and you can see the fistula here on the right side, uh, provided by Dr. Callen there. And then this was a case that I was able to, again, do in a minimally evasive way and identify that fistula. And you can see I've got two clips directly over that fistula, which I then divided and the subdural, as you can see there result.

So just skip that history again, just a dramatic example, which impressed me, of one of these cases that looks like such severe brain sag on the left that some people might confuse with the Chiari, uh, and then post treatment of a fistula. Within a month, I think that was scan ned. Quite an improvement and almost normalizing the brain findings.

And again, this was a single vessel, that little arrow points to a fistula that I put a clip on, and this was after a case of failed endovascular embolization with onyx. And that was just the remaining untreated portion.

This is another case of a fistula, and just to show you some additional technology that I now have available. Again, this is a, how we open a small incision like that. Dilators on the top right, uh, placing this tube. And this particular tube actually has endoscopic camera built into it.

So I can actually see this sort of picture at the bottom of my tube that shows you, a little bit bloody there, but it is the thecal sac there on the left and the fistula well, a diverticulum layer that's dilated and then two clips. This patient had a very complex fistula and felt it would be better to just take that nerve entirely rather than try to isolate a fistula. Again, because of my treating pain so much, we worry sometimes about clipping a nerve, that somebody might have post clipping pain when we do this procedure like cutting a nerve for pain. We tend to cut out what's called the dorsal ganglion. And so that's how I do these. I wouldn't want to trade one problem for another. So I clipped that nerve and remove the dorsal ganglion.

And and then I, fortunately have not any occurrences of significant pain after surgery. This is that case. You see the incision up top and that is a lumbar drain that in this case we placed because of a severe history of rebound hypertension with their patching. This, again a lateral leak from a diverticulum. And nice picture to show you just because this patient had some fibrin glue injected not too long before the surgery. You saw this picture earlier. So. Just showing you the fibrin glue in this case was perfectly placed. It just wasn't enough to stop that leak. And this one was a leak I was able to just simply sew closed and then put a patch over the top. So, I know I went long here, but I just want to say a couple other things.

This really is a team approach. I can't do any of what I do without the rest of the team. And that team really includes my local colleagues, but also others throughout, including colleagues like Dr. Schievink, who has been so helpful. And then again, as others have pointed out, really, we need our patients here to collaborate with to help us solve this problem.

Thanks.