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Cerebrovascular Neurosurgery: The Highly Specialized Care for All Aspects of Cerebrovascular Disease

Welcome to Medical Breakthroughs from Penn Medicine, advancing medicine through precision diagnostics and novel therapy. Your host is Dr. Lee Freedman.

Lee Freedman:
Cerebral vascular neurosurgery is the highly specialized care of all aspects of cerebral vascular disease. What are the most common diseases treated by a cerebral vascular neurosurgeon, and what are the latest treatment options and advances in this field? I'm your host, Dr. Lee Freedman and with me today is Dr. Michelle Smith, Assistant Professor of Neurosurgery at the Hospital of the University of Pennsylvania. Dr. Smith, welcome to the program.

Dr. Michelle Smith:
Thanks for having me.

Dr. Lee Freedman:
I'm not that familiar with the field of cerebral vascular neurosurgery. Could you give us a thumbnail of what your field entails?

Dr. Michelle Smith:
Sure. So, in general, cerebral vascular neurosurgery is when interventions are performed for diseases, like you said, that affect the blood vessels of the brain, of the neck and of the spinal cord, so anything neuronal. It's kind of a very broad topic so it includes things like stroke, but also includes brain aneurysms, brain AVMs, carotid stenosis and for example, spinal cord AVMs.

Dr. Lee Freedman:
And are there general ways that you think about the interventions that you provide?

Dr. Michelle Smith:
For modern cerebral vascular neurosurgery, there's really two main forms of intervention. So, one is open microvascular neurosurgery and then the other one is endovascular neurosurgery.

Dr. Lee Freedman:
And it sounds like endovascular is through the blood vessels where as open is through the skin, is that right?

Dr. Michelle Smith:
That's correct. So with open microvascular neurosurgery, you know, in a nutshell, it's where I have to make a cut in the skin, and for example, for brain surgery or aneurysm surgery, I have to do a craniotomy or make an opening in the skull, and then using a really highly specialized microscope, you know, dissect down to the blood vessels, do microdissections and for example, clip an aneurysm. Where as on the flip side of that, for endovascular neurosurgery, like you said, we're able to put a sheath in the femoral artery and because all the blood vessels in the body are interconnected, using X-ray guidance, we can thread catheters through there, get them all the way up to the blood vessels in the brain and for example, coil an aneurysm. So when I'm doing that, to treat an aneurysm per se, I usually have to remind my patients they just had brain surgery from the inside out.

Dr. Lee Freedman:
Very well put. And it would sound like when possible, endovascular might involve less morbidity and faster recovery?

Dr. Michelle Smith:
Yeah. When a patient and a specific pathology is most appropriate for that type of treatment, yes, then recovery is often faster.

Sometimes we still need to use open neurosurgery and that's why it's nice that I do both because I have very frank conversations about both types of treatments with my patients.

Dr. Lee Freedman:
And I know with cardiac angiography, occasionally they're going through the brachial artery or radial artery. Is it always femoral when you do an endovascular neurosurgical procedure?

Dr. Michelle Smith:
I would say at least 95 percent of the time it's femoral, but occasionally we do have to do brachial. You know, for example, if someone's bilateral femoral artery or _____ (3:05) aortic arch is impaired.

Dr. Lee Freedman:
Well, maybe, we could talk about a specific disease state. Carotid stenosis stroke is such a common problem in the United States. What do you have to offer in those kind of problems?

Dr. Michelle Smith:
Yeah. No, I agree with that. It's so common. So, for acute ischemic stroke, endovascular techniques and technology have come a long way. So if a patient, for example, is not eligible for IV tPA, which is the FDA approved standard, then they often would make it onto my Angio Suite for endovascular treatment, especially if they're within about an eight-hour window. And it's great because often we're able to thread those microcatheters up into the blocked brain arteries. Occasionally, we still use intraarterial tPA but I'll be honest with you, the majority of the time, we're able to use mechanical embolectomy devices and extract that clot within 20 minutes of a patient being on the table.

There's a lot of new mechanical extraction devices. Probably the most recent are the stent retrievers, where it's the form of a self-expanding stent that's on the end of a microwire, and once you put that microwire and microcatheter beyond the area of the clot, you unsheathe the stent and what it does is, it presses that blood clot against the wall of the artery, you leave that open for about 10 minutes to allow blood flow to recirculate again and then you're able to actually pull the whole system back and it has the clot contained within that stent.

Dr. Lee Freedman:
That's interesting. And do you leave any residual stent to keep the artery open or everything is taken out?

Dr. Michelle Smith:
It's interesting you'd ask that. So, with the current stent retrievers, everything comes out and we're usually able to extract the whole clot. There's other types of stents that we potentially could leave in if we wanted too, but the current stent retrievers are not FDA approved for implants, so everything comes out.

Dr. Lee Freedman:
Is there data yet in terms of intravenous tPA versus intraarterial getting right up there next to the clot?

Dr. Michelle Smith:
Yeah. So, the most recent data had come out, three major studies in New England Journal of Medicine last February, and what it did is it compared head to head IV tPA against endovascular within the acute phase, like, within the first three to four hours, that's almost not fair. And what was interesting is there were no significant differences between the different groups, both in complications and with outcomes which some might tell us, oh, well, there's no benefit of endovascular. But what's interesting is often we use endovascular when someone's not eligible for tPA or if they're outside of the window to give tPA. So even though these studies stated that endovascular isn't better than tPA, I think there's a role for both.

Dr. Lee Freedman:
And I imagine time is of the essence in these type of interventions.

Dr. Michelle Smith:
Absolutely. I mean, you know, we like to see great pictures where we have good recanalization and good flow, but what's important is the actual patient clinical outcome, that the earlier that, that revascularization happens that, that is associated with improved outcomes.

Dr. Lee Freedman:
So keep encouraging our patients to know the warning signs and to get into the emergency rooms if something is brewing.

Dr. Michelle Smith:
Exactly. You don't want to just sleep off, you know, an episode of aphasia.

Dr. Lee Freedman:
If you're just tuning in, you're listening to Medical Breakthroughs from Penn Medicine on ReachMD. I'm your host, Dr. Lee Freedman, and joining me today is Dr. Michelle Smith, Assistant Professor of Neurosurgery at the Hospital of the University of Pennsylvania. Dr. Smith, why don't we turn to aneurysms, maybe not quite as common, but certainly a potentially very dangerous problem. How do you approach the presence of aneurysms and treatment of those?

Dr. Michelle Smith:
Correct. So, I guess certain patients show up with ruptured aneurysms so we treat those, obviously in an emergency fashion, and then more and more patients are being found to have incidental aneurysms. They might have an MRI for migraines per se, or maybe they have a strong family history of brain aneurysms and the MRAs today are such good resolution. They're picking up very small aneurysms. So often, I observe aneurysms that are very small and relatively low risk with patients getting serial or annual MRAs, but when an aneurysm is an appropriate size or location or risk factor for rupture, you know, we go ahead and counsel on treatment.

And again, certain aneurysms in certain patients for different patient reasons are only eligible for endovascular treatment or for open microvascular treatment, but when all things are equal and a patient could have either, I really counsel them that they have the choice, and you might imagine that nine out of ten times, people don't want their head cut open. So, they go ahead with an endovascular treatment. So, the main form of endovascular treatment is really the tried and true coil embolization of an aneurysm.

So that's when I'm able to navigate the microcatheter all the way up into the neck of an aneurysm and because the other end of that catheter is outside of the body, I'm able to push through it these little tiny platinum coils and we do what's called packing the aneurysm with coils. And once it's completely packed with coils, the blood can't possibly get into that aneurysm anymore and it protects it from bursting. So that's the mainstay of aneurysm treatment, but the technology has also come really far with that.

So, certain aneurysms, for example, that have wide necks and maybe have branching vessels arising from the base, require some adjunct. So, they might require stent-assisted coil embolization or balloon-assisted coil embolization where a balloon is temporarily blown up while the coils are forming a basket and then eventually at the end of the case, the balloon is taken out as well.

Probably the most recent, and one of the most exciting forms of endovascular treatment for aneurysms, is what's called a flow diversion device. You know, I guess the brand name is called Pipeline Embolization Device, and it almost...we're not really supposed to call it a stent, but it's almost like a stent only with really fine knit mesh. So when you deploy that across the neck of the aneurysm, it diverts the flow from going into the aneurysm and the flow goes in the normal laminar direction. So you get stagnation of flow within the aneurysm and then chronically over six to twelve months, that aneurysm completely shuts down. So, it's nice because we don't have to use coils with that so sometimes if coils were going to cause mass effect, you know, you don't need to use them anymore.

Dr. Lee Freedman:
And forgive my ignorance with the coils, as you're putting them in is there ever downstream embolization of those?

Dr. Michelle Smith:
So that would be, you know, a quoted complication, but it's extremely, extremely rare. You know, it's a…maybe one of the most frequent although very, very infrequent probably, less than 1percent of the time, complication with the coiling is that you could perforate the dome of the aneurysm while you're placing that first coil. But as I tell my patients, you know, if your aneurysm is going to rupture, that's a perfect time to have it rupture, in a completely controlled setting. So, in that situation, we simply complete packing of the aneurysm dome with coils and that stops the perforation.

Dr. Lee Freedman:
Very interesting. And with time, are we talking about something that clots over and endothelializes? Or what happens with time with these coils?

Dr. Michelle Smith:
That's exactly correct. So, the initial coil mass not only prevents the blood from getting into there, but a thrombus forms within the coil mass and then your body does form a new…I tell my patients, "Your body does the rest of the work". It forms a new layer of skin. So it does new endothelialization within the vessel lumen. And I equate it for my patients to, you know, when you get a cut on your hand and you get a scab and then eventually new skin forms underneath the skin so your body is doing a similar thing. But we do have to watch these coiled aneurysms and _____ (11:03) clipped aneurysms chronically over time because coiled aneurysms have up to a 20 percent rate of recanalization, so that's one of the downsides of this minimally invasive treatment. But the thing is, if it recanalizes, usually we can just simply put more coils into it. So, it's not a big deal. It doesn't necessarily mean it's the same risk of bursting.

Dr. Lee Freedman:
Very interesting, and so that implies to me that there does need to be some follow-up when an aneurysm is treated by placement of

coils. What is the typical follow-up?

Dr. Michelle Smith:
Usually I get a baseline MRA scan because obviously that's a noninvasive scan. At the time someone's being discharged, and they usually are discharged the next day, after an endovascular treatment, and you compare that to the longer hospital stay and longer recovery course with open craniotomy and clipping. And then at three months, we check an MRA again just to make sure there's no recanalization there. If I'm concerned about something, I'd bring someone in quicker. But otherwise, we check an angiogram again at six months and then usually at eighteen months, potentially three years and five years and then it gets spaced out and they eventually graduate, but we do keep an eye on our patients.

Dr. Lee Freedman:
It sounds like it, and it sounds like with very good reason with that 20 percent requiring retreatment with the coiling. Are there times when you absolutely have to do an open procedure for an aneurysm?

Dr. Michelle Smith:
There are times. There's also times where there's some gray area, but there are sometimes when we definitively have to do an open procedure. So certain aneurysms, for example, usually MCA aneurysms, bifurcation or trifurcation aneurysms are best served by open treatments and that's because there's so many branch vessels arising from a really wide base of an aneurysm. It almost universally looks like that, that it's almost impossible for me to stent the _____ (12:55) branch artery and put an adequate coil mass in there and it's a very straight forward surgery so those patients are usually much better served with open craniotomy and clipping _____ (13:04) very well. And actually the upside of going through a craniotomy is there's only up to 5 percent recurrence rate with the clipping.

Dr. Lee Freedman:
And what is the recovery time after a typical open craniotomy aneurysm repair?

Dr. Michelle Smith:
Yeah. If it's an elective surgery, patients do really well. So they usually spend one night overnight in the Neuro ICU, and then they usually spend two more days on the Neurosurgery floor, and then they're usually discharged home and back to their baseline. You know, patients do tell me they feel kind of fatigued, you know, and just off a little bit for three or four weeks afterwards, but recover very well. And it's interesting, gone are the days when we, you know, shave half the head for an open surgery. We shave about an inch of _____ (13:53) line and I pay a lot of attention to this. We always shave behind the hairline so even when you have that little absence of hair, patient's can still fold the rest of their hair over, and you can barely notice they have an incision there. It's really wonderful.

Dr. Lee Freedman:
That sounds like a major improvement and very important for patients.

Dr. Michelle Smith:
Yeah. I mean, really this is what patients notice. I notice that we just did major brain surgery and clipped their aneurysm but they notice those things.

Dr. Lee Freedman:
And then, since you are perhaps touching the endothelium or affecting the endothelium and working in the brain, is there any role for a post-procedural anticoagulation or any anti-inflammatories such as steroids?

Dr. Michelle Smith:
Correct. So there really isn't and there hasn't been and we haven't found…occasionally I'll put some local papaverine on a vessel if I'm concerned that it had some spasm at the time of surgery, you know, visually. I also routinely perform an intraoperative angiogram, because we can truly see whether the aneurysm is completely gone. And if, for example, we see a little remnant at the time of, I can just reposition that clip because I tell my patients we don't want to do this twice, but we usually don't need any anticoagulants or steroids for this. Patients do really well without that.

Dr. Lee Freedman:
Well, I very much want to thank Dr. Michelle Smith for being with us today and outlining for us the exciting field of cerebral vascular neurosurgery with a special focus on ischemic stroke and the treatment of aneurysms. This is fascinating and keep up the very good work that you're doing.

Dr. Michelle Smith:
Thank you so much Dr. Freedman.

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