[MUSIC PLAYING]

PAUL GARDNER, MD: So this afternoon's session is kind of switching gears to a different area of access for endoscopy to adding this to the retromastoid approach. Obviously the retromastoid approach is the long-standing approach. It's well known and has been used for many different types of pathologies. And so adding in endoscope is not going to create a new approach. But it does have some value for it.

So, again, the main concept is that we're introducing the endoscope into the surgical field, which just gives us a different perspective. It gives us a potential to see things deep in the view that we wouldn't see. The same analogy really holds true to the posterior fossa, not just to the endonasal portion of the skull base.

Obviously, one of the perhaps simpler, and certainly Pittsburgh based procedures, is microvascular decompression for tic douloureux or trigeminal neuralgia. Here's the anatomy. You see it's looking on the left side. And you have, typically, a large superior petrosal vein complex. And then there's the trigeminal nerve with varying degrees of compression. The endoscopic view, two things that you'll notice is, first of all, there's a much wider field of view. We can work past the vein to see things at both the dorsal root entry zone but also to look for distal compression.

There are theories that compression can only occur at the proximal segment. It is definitely the most common segment. But there are very rare cases where distal compression can also result in trigeminal neuralgia. Here's an example of a man who has had, because of his age, he hasn't been treated for quite some time, about 10 years, with typical trigeminal neuralgia. Obviously, Dr. Jannetta, at least in the US and in Pittsburgh, is predominantly responsible in sort of the lineage from which, I think, all of us here who are guest faculty have learned posterior fossa surgery. And endoscopy has been applied throughout the years developed from there.

Potential advantages for endoscopic MVD are improved visualization. You can do a smaller exposure. I generally still use a similar small size exposure with a microscope. So I'm not sure it adds a lot but certainly less cerebellar retraction and neural manipulation. But the visualization and the potential to not have to retract as much to get that visualization, I think, are the two big potential advantages. Again, I don't use a different craniectomy for my retromastoids. You need less exposure to see. But you also need room for the endoscope. So it's kind of a wash from that perspective.

The initial steps we'll go through in the lab. Because your landmarks really are for the transverse and the sigmoid sinus. The sigmoid sinus is the digastric groove. And we'll go through transverse sinus in the lab. And your craniectomy really extends from the transverse sigmoid junction. And then the first step I usually do is open the cerebellomedullary cistern in order to allow relaxation of CSF. Positioning, and there are a lot of logistics to bringing in an endoscope arm. I think the best Pneumatic arms currently on the market are the ones that, at least stores markets or cells.

And this is one that clamps onto the bed rail. The one issue with this, you can see the arm as it extends out from a lateral position, is right next to the endoscope arm. And so you have to make sure that's properly padded and protected, or even held up in place or placed in a sling in order to allow the endoscope arm to move in. You'll also see in the lab and then in our case on Friday, there's a UniArm, which rolls in just like a microscope, which is a little less logistically difficult. But it does take up more floor space. So it sort of depends on what the advantages are for you. And then we do a full lateral positioning with an axillary roll and taping the patient in place and then just a small shave behind the ear.

So I'll go through a small. Series this is only up to the 2013. We sort of continued about this rate with endoscopic cases. This is very early in the learning curve for these. And I'll just kind of go through some results. Again, I showed you this case. And this is a guy who had Gamma Knife et cetera. But here is, starting off by letting off CSF low down from the cerebellomedullary cistern. This is, again, a right side so the petrous apex is out here. And I'm just trying to get the scope in a decent position just to let off some CSF down here. Open up that arachnoid cistern.

And so this is being done with dynamic endoscopy, not a scope holder. Sometimes you can do that. But you need the same assistant every single time. I've gone, since I work with residents often, I've gone more to an endoscope holder. Because I don't have to train the holder every time, I just find different positioning. Now, I was trained to always take the superior petrosal vein and, essentially, almost always in the setting of a microvascular decompression doesn't lead to any problem whatsoever.

But I know John's technique is to almost never, unless he absolutely can't avoid it, to take the superior petrosal vein. And I think I've gained more respect for veins over time. And I kind of have switched to that. And part of that is from the endoscope. Because the endoscope allows me to see around that vein a little better, whereas with a microscope I find a little more difficult to access. Here you do take-- that's the way we were trained. And I have not seen a problem with it.

SPEAKER 1: What will get control of the embolism?

PAUL GARDNER, MD: It's one in 200, whatever it is.

SPEAKER 1: All right.

PAUL GARDNER, MD: So here you can see a really big double loop of the SCA on the back side of this. You can see, this you could probably-- obviously, you're going to see this well with a microscope as well. But you wouldn't have quite this visualization. I can see for sure that I'm padding this on the back side of the nerve. And then the rest of the technique is really very much the same. But the width of view and the visualization that you get there is really quite ideal.

You can see really that is one of the things you can get is double vision, both from six and from four. And you can see in this view, I can see six in the depth, so I'm not going to put in too much felt there. And I could see four if it were in my view, so I wouldn't cause any damage to that. It's not sagging below the tentorium as it can sometimes. So he did quite well. This is a case of an atypical trigeminal neuralgia. So V1 distribution, burning type of pain. And in my experience that tends to be more venous compression.

It also has a lower chance for improvement. I think partly because some of it is misdiagnosis. But here, this is the left side. So there's the left petrous. There's the left tentorium. We see a little bit of mild compression from an SCA loop. But when we look on the back side, so one of the issues here is look at this huge hump of the trigeminal porus. You can't even barely see the nerve here. But working with the endoscope I don't have to worry about drilling this down. I can just sacrifice this vein that's compressing the nerve from the deep side.

You can also decompress these veins. But usually some of the smaller veins, if you examine them carefully, you can sacrifice one of those veins as long as you don't get any perforators on the brain stem when you're coagulating it. This is an up-angled bipolar, which is very useful to have an up-toed bipolar. And then I'm just decompressing the back side of it to make sure that vein is no longer in contact. So I did about 16 of these up just over about a year, year and a half. And the SCA was offending in most, as you would expect.

And most patients had excellent outcome. One patient with atypical had no improvement. I did have this patient who had had multiple glycerol rhizotomies. And I wish I had the video of this. But literally the entire posterior fossa was black from the tantalum from the glycerol rhizotomies. And you couldn't tell what was a vein, what was arachnoid, what was an artery, everything was literally black. And I ended up cutting into the SCA. I don't think this was something I would have done better with a microscope. I think this was just a very bizarre case. And he had an SCA infarct from that and a very complicated course from it.

SPEAKER 2: [INAUDIBLE]

So that was actually probably my second case I had done. And it's the only time that I converted to microscope. And part of it was I just freaked out. And I wanted things to be as I was used to. And I think that's absolutely fine to do that. I think at this point, I wouldn't do anything differently. I wouldn't switch. But I've gotten the hang of where I need the endoscope relative to my instruments, which is, I think, John will talk about this more. And he'll show you in the pro section, where you put your instruments relative to the endoscope is equally, or more important, in the retromastoid space as it is in an endonasal surgery.

And so that's very key is understanding where do you move the scope when you need to get to a certain spot. And I just was unsure of myself so I switched to a microscope and ended up having to partially coagulate it. So it doesn't tend to be as much of an issue with sliding the scope. I think it has to do with the trajectories of bleeding. But the biggest issue with it is more what you said. If you don't an experienced assistant who can flush the scope for you, you can really struggle.

Hemifacial spasm, I think the lower we go and the more complex things go, the more important it is, or I think, the advantage of the endoscope show up even more. So trying to see that dorsal root exit zone, this is 9 and 10 on the left side. Seeing the dorsal root exit zone of 7, which is really where the vascular compression is, is improved with the endoscope.

So here we see that big trunk of vertebral. And you can see the dorsal root compression here, even in this cadaver. So here is a case of typical hemifacial spasm. Again, this is the left side. So here are the lower cranial nerves, see 9, 10, and 11. We are just working just past 8 here and just releasing some of the arachnoid on the flocula. You can see a little branch a loop of PICA coming over the-- actually it probably is an ICA loop.

And just releasing, you get some very thickened arachnoid here over 9, 10. And you have to take time to recognize that and release it. I think, again, I can see very clearly here what's arachnoid, what's nerve fiber. And you can see here, actually see 7 peeking out behind 8, which is not something sometimes you can see with a microscope. I can very clearly see this small loop that's compressing the dorsal root exit zone. I'm not having to retract the cerebellum. I don't have any retractor in place. I'm just working around the flocculus.

And I can then decompress, look from my lateral spread to disappear. And so I think it gives me a very direct view. Again, the endoscope is pressed up against the petrous bone, angled down back towards the brain stem. And my instruments come in then on the cerebellum. And they sort of all triangulate together in order to work with my instruments below the endoscope. So again, another 10 cases with hemifacial spasm. And essentially everyone got, not complete relief, but near complete relief. And everyone got some degree of relief.

I did have two mild facial palsies and hearing loss in three patients, only one with complete hearing loss. One patient did require a feeding tube due to temporary dysphasia. If you get a very large vertebral artery with a small PICA loop, you have to lift the vertebral up and pad it on the back side of 9, 10. And John, I don't know if you guys have that same experience. But those are the ones where I really worry about dysphasia. Because you're putting a lot of material and you're doing a lot of manipulation around 9, 10.

So geniculate neuralgia is not very common. It's very difficult to diagnose. But I do think there is-- this is one case where I can pretty-- I clearly see a difference in that. I can find nervus intermedius better with an endoscope. Because it tends to hide between 7 and 8. And so if I have an endoscope right next to there, I can look around 8 and see it long before I dissect it. So here's a case of geniculate neuralgia. It's a right side. You can see 11 coming up here and 9, 10.

Again, that same thick arachnoid, same hesitancy of dissection. And here again, the endoscope is plastered against the petrous ridge. And I'm dissecting below it. You can already see the 7, 8 complex. And look, you can just see nervus intermedius in the depth there. Now this child did have-- it was actually a 15-year-old with geniculate neuralgia. He did have some degree of throat pain but primarily deep ear pain. And John and I were just having a long discussion. If it's pure geniculate, do you really need to decompress 9, 10 at all?

Well, he had a pretty significant-- I mean, there's a vessel loop here between 9 and 10. So you see a whole complex here. So I did decompress this. So I was able to decompress-- you know, and this is pretty careful dissection that you have to do here. And I found it was quite doable with the endoscope. And I didn't find that it was a limitation. So I after I decompress 9, 10, here I can already directly see nervus intermedius. I can lift it up. And then I can cut it.

So the visualization of nervus intermedius is often very challenging. But working with the endoscope, I found it to be, that part, to be actually much simpler. I've never had any difficulty spotting it right off. And he did quite well. Similar kind of section of the nervus intermedius and all the geniculates, it's PICA essentially in all of them. And everyone got at least some degree of relief. Either were still requiring some meds or no meds at all. To be expected, not surprisingly, there is some voice hoarseness or 9, 10 or 10 dysfunction in these cases.

So I do think endoscopic MVD is safe and effective. And, for me, it's really been a foray, a way for me to get more comfortable working in the posterior fossa. I've advanced that in only a few cases to RMC for tumor. And, I think-- I know John has much greater experience, both with MVD as well with tumors and so I'm looking forward to hear his thoughts on it. Here are a couple of cases. This is a purely endoscopic case. I think this one here, I think he may show this case later. So I may skip through this.

But this is actually a very wild tumor. This ended up being a tumor growing purely within the superior petrosal vein. So it's absolutely bizarre. You can see the setup here. So a patient in three-pin fixation, lateral flexion, shave the retromastoid area. Just an MVD incision for this. Lateral retraction of the dura. Releasing CSF, again, this is the left side so these are lower cranial nerves. Releasing CSF from the cerebellomedullary cistern.

Here's the tentorium. There's the lateral petrous on the left side. You can see a little SCA loop here. And then you see tumor just-- actually, I'm sorry, this is cerebellum overlying it. But you see tumor in the depth here completely filling the superior petrosal vein complex, really very, very wild case. So here's while I'm just dissecting around the edges of the tumor and then finally releasing it from within the walls of the superior petrosal vein. That's what that capsule of it essentially, or walls of the superior petrosal vein.

Because it was encapsulated, here you can see the distal-- there you see the distal trigeminal nerve after that completely decompressing the trigeminal nerve as well. Because she presented with some neuralgia. This is the way I was taught it. Mel, do you decompress these patients with face pain and tumors or you just remove the tumor?

SPEAKER 2: Well, do you think-- when they come in [INAUDIBLE] syndromes, then [INAUDIBLE] is the best one.

PAUL GARDNER, MD: Yeah. What about you, John? Just take the tumor? Yeah, I think probably get away with tumor. I've just never-- I always feel compelled to do the MVD as well.

SPEAKER 3: I had a great case of a patient with an acoustic neuroma [INAUDIBLE]. And we [INAUDIBLE] a two-centimeter [INAUDIBLE]. It wasn't very large. And a pre-op revision came [INAUDIBLE] nuclear surface of the [INAUDIBLE] nerve. So the assumption is that the tumor was the cause of it. And so we get into the case. And in surgery, [INAUDIBLE] see this clear white [INAUDIBLE] tumor with the nerve that was really [INAUDIBLE].

PAUL GARDNER, MD: Yeah.

SPEAKER 3: [INAUDIBLE].

PAUL GARDNER, MD: I think it's worth looking at. And if you see-- I think your idea of if you see compression, maybe deal with it. But so epidermoid tumors, I think, are probably the case where I've found the greatest value for an endoscopic assistance. And if you look at it, your trajectory for retromastoid approach, epidermoids like to intercalate with every cistern they possibly can. There is no true long axis for these tumors. So working around corners into these tumors really can make a big difference.

Here's a very simple case. This a woman who presented with some vertigo and a straightforward case completely done with a microscope. No reason really that I have to use an endoscope for this. But just to show you the view that I would get, this is the view with the microscope. You know, working again, this is on the left side. And this is the view with the endoscope at the end of that. So just the width of view and the fact-- how well I can see the dorsal root exit zone just gives you some idea of the improved visualization you can get.

A 45 degree endoscope, of course, gives you even more ability to work around corners. So where I've found this most useful is in the prepontine cistern. Again, your direct trajectory is very difficult to look across midline. Cases where it extends up into Meckel cave. It can be very difficult to see with a microscope, even when you split the tent. And then working out toward middle fossa, it can be very useful. Here's an example of a recurrent tumor extending up towards middle fossa.

And here's an endo-assisted epidermoid. And you can see, again, it goes all the way up to prepontine cistern. And I find it very difficult sometimes to see that or to see on the deep side of the cranial nerves. You know, these tumors tend to be growing ventral to the cranial nerves. And so doing a dorsal approach like a retromastoid doesn't give you full access to the entire tumor.

So here I resected as much as I could with a microscope. Let's see. And here's our microscopic view. Again this is the right side. Here's the tent up top. Here's the 7, 8 complex. Peeling tumor off the brain stem. But you see, I can't see this brain stem plane all that well. And I certainly can't see behind 7 and 8. Once I put in the endoscope, I can really see this brain stem plane much more nicely. I'm working next to 7, 8, below 5, which has been pressed up against the tent. And now I can really see the brain stem to dissect this directly. It's not a blind dissection.

And with an epidermoid, if there's no plane there, you can do some real damage to perforators if you're not careful. So I sort of force myself, I do everything that comes easily with the microscope. And then I always set up an endoscope on these. And I mean, look at this tumor that's hidden behind this artery. There's no way you'd be able to see or access that if you didn't have the endoscope in there for that kind of visualization. So I found for these cases, this made a big difference. This is purely a retrospective review. But these are similar size tumors.

And the first seven cases were done with purely microscopic. There was only one case with a complete resection. And then seven endoscopic cases, four cases had complete resection. This is statistically significant. There were no new cranial neuropathies. So a little less damage and a little better resection. The endoscope can make that difference of 10% to 20% in these tumors, like epidermoid, which, for some of these patients, may mean if not complete lack of recurrence, another decade of lack of recurrence. So I think for epidermoids, it makes a real difference.

Acoustic neuromas, I have not gotten comfortable doing these entirely endoscopically. I know Dan Pieper used to do them this way. But this is a woman with a little bit of extension into the IAC. It goes out pretty far actually. But she has intact hearing. So to try to preserve her hearing, we don't want to drill as much of the porus, which then leaves you with the problem of how do you see the distal aspect of the porus to know you've gotten this last cap of tumor?

Well this is an angled endoscope. Again, if you drill too far into the porus, I've drilled into the cochlea and I'll have destroyed all of this work so far. So working with an angled endoscope and curved instruments, I can work out into the part of the porus that I haven't drilled into to peel out the last bit of tumor. So I don't have to sacrifice tumor resection. I don't have to sacrifice hearing to get this last little bit of tumor. Here we're working right on top of the 7th nerve here, which is why this part's a bit tedious.

But you can see the kind of view I can get and the kind of control we can have. In this case, I have an angled endoscope sitting on the cerebellum. And I'm working out towards the petrous bone. There's finally that last bit of tumor coming out. So that's the advantage that that can give us.

SPEAKER 3: Have you done [INAUDIBLE]?

PAUL GARDNER, MD: With that, yeah. So I've done probably three. And in that situation, I've been able to preserve hearing. Because one of my biggest issues is keeping the-- you know, the otologists want to see the lateral aspect of the tumor. And they'll say, I can't get this without drilling into the cochlea. So we can't preserve hearing. So I finally convinced them to stop short. Let me take a look at the end. And I promise you we'll get that bit of tumor out. So that's been-- it's not a major paradigm shift. But those few patients who have hearing preservation, I think it improves that.

Here's a foramen magnum meningioma. We sort of did a far lateral approach for this. But the issue with this is with a retromastoid approach, you can't really see, and I'll show you in a minute, you can't really see the lower cranial nerves that well or beyond him. So here's the 11th nerve draped over this. So we're working between the 9th, 10th complex and the 11th nerve. We have the vertebral artery out here exposed. So I can resect this tumor with a microscope, no problem. I can work around 11. I can peel it off of the dura. I mean I've done everything I can do from a skull based approach to get as wide of a resection as I can.

But I can't see around the vert. And I can't see around the 11th nerve. I just can't see that area. But when I introduce the endoscope, I can see that dura to know whether or not I've left any residual there. So here is, again, that view with a microscope. As soon as I bring in the endoscope, here's 11. Again, I'm working deep to vert. I can see tumor residual stuck onto the dura. I can see hypervascular dura. Obviously, I'm not resecting the dura completely. But I am getting some residual off of there. And I'm able to coagulate it to at least get a Simpson grade II resection of this tumor.

And that's simply not a view that I could have, or safely access, with a microscope. One final other view, so that's looking out towards the lateral dura. This is a case of an ependymoma in the cerebellomedullary cistern. And this will be a case where I'll look back towards the brain stem to try to see residual. So she presented with progressive headache and significant vestibulopathy. And so, again, did a right far lateral approach. And what I'll show you is here you see the tumor, very adherent. I'm doing all of this with a microscope. I think, as John mentioned, it tends to be a little more efficient.

So I'll get as much resection as I can with a microscope. Some venous bleeding from the tumor. And here I think I've pretty much gotten everything. There's some that's going in the foramen of Luschka here. So I peel the tumor out of foramen of Luschka. I've done a far lateral. I've drilled the jugular tu-- I've done everything I can to get the most lateral to medial view. And I think I've peeled everything out of the jugular, rather out of foramen of Luschka there.

But once I put the endoscope in, I look out towards the lower cranial nerves first. And then looking back now towards the brain stem, back toward the foramen of Luschka, here we see the entry of foramen of Luschka. And sure enough, I've left some tumor here. This chunk of tumor I just couldn't see with the microscope. So now I'm working upside down, more or less. This is under a little PICA loop and peeling this last bit of tumor out from foramen of Luschka. It's just not something I could see, much less try to resect, without the endoscope.

So I think it has a very different learning curve in the posterior fossa. And I use it generally for endoscopic assistance. I do purely endoscopic microvascular decompressions, purely because I don't think there's a reason to switch out between the two. And I think it gives you visualization around corners. Some brain stem structures out towards Meckel cave, out into the porus acusticus and back towards the brain stem to make a safer dissection in those areas. Thank you very much.