Speaker 1:

Welcome to Optimal neuro/spine podcast, a podcast about optimizing our brain and spine in health and disease. Each episode, leading neuroscientists, neurosurgeons, educators, patients, spine care, and quality improvement experts discuss their research, experience, emerging science, surgical advances, and insights about how to optimize neurological and spine care. Now, here's your host, Dr. Max Boakye.

Dr. Max Boakye:

Welcome to the Optimal neuro/spine podcast. My guest today needs no introduction. He's one of my colleagues here at the University of Louisville, Dr. Haring Nauta. Dr. Nauta has had a long and distinguished neurosurgical career. He obtained his medical degree, an MD-PhD, at Case Western University, where he completed that his PhD in neuroanatomy. He subsequently continued to the University of Toronto where he completed his neurosurgical residency. Subsequently, he did some additional work at a brain research institute in Zurich, where he worked along with Dr. Yaşargil. He published a number of papers with Yaşargil, including papers on the spinal subarachnoid space that has been heavily cited. He subsequently was on the staff at Johns Hopkins, where he was a associate professor of neurosurgery and radiation oncology and initiated a program in stereotactic radiosurgery, and was a leader of the Vascular Neurosurgery Program. From 1993 through 2009, he was a professor and chairman of neurosurgery at the University of Texas at Galveston.

Dr. Max Boakye:

Dr. Nauta joined the University of Louisville in 2009 as the residency program director. At the University of Louisville, he specializes in brain and spinal cord tumors, lumbar stenosis, cervical disc disease, Chiara malformations, syringomyelia, hydrocephalus, video surgery, and procedures for pain. It's a true pleasure to speak with him given his extensive experience in neurosurgery, either as chair or program director. We wanted to focus this interview on his observations about neurosurgical residency, neurosurgical training, and improving quality of neurosurgical training. In addition, would like to speak to him about his exciting work on the treatment of pain using the procedure called punctate myelotomy, as well as speak to him a little bit about some of the research questions that he's currently looking at. Dr. Nauta, thank you for coming on and look forward to a good conversation.

Dr. Haring Nauta:

It's good to be with you, Max.

Dr. Max Boakye:

Excellent. First, I would like to start, what is your clinical practice like? What do you do? What do you like doing? What does your practice currently consist of?

Dr. Haring Nauta:

Yeah, well I'm 75 years old now. So, my practice has changed quite a bit. We have younger faculty, who are very eager to do the sorts of cases that I prided myself in doing younger, like the long AVM cases and the very difficult skull-based tumor, that kind of surgery. It's very important, I think, for retention of your faculty, that you allow people to work on cases that they're not all that many of them. So, if I was hogging those cases, we might have more problems with retention of the very good faculty that we've been able to hire here. Not only that, but these cases take a long time. So, as you get older, you value

more and more the cases that are problematic in some way, but generally things that can be done in a shorter timeframe.

Dr. Haring Nauta:

So, currently, I'm interested in areas that are not well served and those include, what to do about facial pain in patients that don't just need an obvious MVD? And so, I've been working more with trying to apply glycerol stereotactic techniques to glycerol rhizotomy, and see where we can go with that. I have some other research interest with facial pain.

Dr. Haring Nauta:

But the other area where I'm working increasingly... The challenge is not to become irrelevant, as you get older. The other aspect of my practice that has grown is trying to see how shunts for normal pressure hydrocephalus, how those indications might be expanded for patients with degenerative brain disorders. The notion is that, from the battle days, when we had just fixed pressure shunts, we very much needed to separate out the patients with a communicating hydrocephalus from patients that had primary brain atrophy. And it was very important. Because, if you shunted a patient with primarily brain atrophy and put in a low pressure fixed pressure valve, there was a very good chance that the ventricles would just collapse, and there was of a high incidence of subdural hematoma that was then difficult to reverse.

Dr. Haring Nauta:

And so, if you look at the literature on normal pressure hydrocephalus, a lot of it is on trying to identify patients that do well. And the bottom line from those studies is that, if you apply rather rigid criteria to eliminate the patients with atrophy, that the results are good. That's fine. But now that we have variable pressure, programmable shunts, and I think what we're finding is that if the shunt is put in more or less barely working, that the incidence of subdural hematoma is really quite low. And then, what that lets you do is it lets you see if shunts for patients with some degree of brain atrophy are helped by the shunt.

Dr. Haring Nauta:

If you think about what causes the symptoms of NPH, they're synonymous with ventriculomegaly. In other words, the fibers that have to go maximally around the enlarged ventricle to the mesial hemisphere, where the leg area and the bladder control areas are, those are affected differentially the worst. And the other functions with the upper limb, and the speech, and thinking, and that sort of thing are relatively less affected with the ventriculomegaly. So, the ventriculomegaly remains a part of the brain degenerative disorders.

Dr. Haring Nauta:

And so, what determines the size of the ventricle is the pressure within the spinal fluid, trying to make the ventricle bigger. And then, the resistance of the tissue turgor trying to make the ventricle smaller, keep it from expanding. And so, there is a point where, in the brain degenerative disorders, where even normal pressure starts to win against the degenerating brain and it's diminishing turgor. So, when the ventricle gets big, you have a ventriculomegaly syndrome super imposed on what may be a slower or faster decline overall in the degenerating brain. If you can shunt the degenerating brain, it can be palliative for some relatively long period, because you can eliminate the ventriculomegaly component superimposed on the degenerating brain.

Dr. Haring Nauta:

And so, I'm really encouraged that I think right now our data are showing that the shunting for degenerative disorders can be palliative and keep people walking and mobile for an extended period, usually six months to several years before the degenerative condition, of course, which we can't stop, the degenerative condition dominates the picture again. And the benefit of eliminating the ventriculomegaly fades into the background.

Dr. Haring Nauta:

The things I think I should be working on are things that other people don't really want to do, and other people don't recognize as a problem, because they're more interested in doing cases that they find gratifying. Some of these things we do are not always gratifying. Like I said, in my effort to remain relevant, I think I'm trying to work in those border zone areas of neurosurgery.

Dr. Max Boakye:

Another area, in addition to hydrocephalus, as you mentioned, taking care of things that young neurosurgeons generally try not to do, you've been very interested in the treatment of neurosurgical pain. In particular, you, one of the leaders in a procedure called punctate myelotomy. You're probably the world's expert on this procedure. What is punctate myelotomy, and what kinds pain is it designed to treat, and what have the results to date?

Dr. Haring Nauta:

Yeah, well the short answer is that it's designed to treat visceral pain, ideally of a hollow organ, of endodermal origin, and below the belly button. The punctate myelotomy interrupts a pain pathway in the dorsal columns. Now, everyone was taught in medical school that the dorsal columns are for the so-called epicritic functions, like vibratory sense, position sense, two-point discrimination, that sort of thing. And the pain is carried by the anterolateral quadrant system. The problem is that we had a problem in that visceral pain was never well treated by any kind of ablative procedure. In other words, you could do anterolateral cordotomy. You could do bilateral anterolateral cordotomy by staging the lesions. You could avoid the Ondine curse syndrome. But that was still was not effective for midline origin and visceral pain.

Dr. Haring Nauta:

And so, we had a clinical problem, which was what to do with midline and visceral pain. And it's not a small problem, because a lot of cancers originate in the viscera. They can spread secondarily, of course, to mesenchymal structures, and the body wall, and even the extremities. But the point is they start out as midline structures, the viscera and the cancers.

Dr. Haring Nauta:

So, we had a clinical problem. We didn't have anything interrupting the known pain pathways didn't really help that. And then, we had another set of information, which was that we understood the dorsal columns. The cell bodies of origin for the dorsal columns is in the dorsal root ganglia at each segmental level. So, these are the axons in the dorsal column were primary sensory afferents. And the first synapse is in the dorsal column nuclei. So, it came as a surprise when anatomical studies showed that retrograde tracers injected into the dorsal column nuclei labeled cells in the base of the dorsal horn, right near the

canal of the spinal cord. And this system was not trivial. I mean, these cells were seen at pretty much all segmental levels and they formed a significant cluster.

Dr. Haring Nauta:

So, we had a pathway, and then people studied that pathway. And that pathway was known as the postsynaptic dorsal column pathway. In other words, the axons ascending from this pathway had already synapse. Their cell bodies were not in the dorsal root ganglia at each level. They were in the base of the dorsal horn near the central canal. So, this postsynaptic dorsal column pathway, people looked at pain to see if the pain was a significant function. But the pain they studied was extremity, cutaneous pain. And it didn't seem to have much of a rule there. In a sense, we had a pathway looking for a function, and then we had a clinical problem, visceral pain, looking for a pathway because the anterolateral quadrant system didn't seem to convey the pathway. Interrupting it didn't seem to help.

Dr. Haring Nauta:

These two avenues came together in the work of Willis and others, Hirschberg et al. And Gildenberg was involved in this also early on, although they didn't quite understand the anatomy of the postsynaptic dorsal column pathway the way we do now. But the observations were that, if you made a midline myelotomy, you could really improve, pelvic visceral pain, rectal pain, vaginal pain, certain bladder pain, colonic pain. And the observation was that it not only helped the visceral pain, but it seemed to have effects on pain, not just at the segment level of the lesion, but everything coddle to the lesion. And so, in effect, those observations also needed an explanation. This all came together when Dr. Willis and his group with and Al-Chaer, and Dr. Westland as the anatomist, Karen Westland, it became clear that if you had a model for rectal pain, and the model they used was a Fogarty catheter in the rectum of a rat, that if you inflated the balloon and then recorded from the thalamus, the sensory thalamus, you could see that the responses in the thalamus were proportional to the balloon pressure.

Dr. Haring Nauta:

And then, if you interrupted the anterolateral quadrants, not much happened to that neuronal activity in the ventral thalamus, ventral tier nuclei. And so, in desperation, they cut the dorsal columns. And sure enough, the signal dropped out completely. If you do it then in reverse order, if you do first the dorsal column lesion, and you see a tremendous drop in the activity in the VPL nucleus of the thalamus, the sensory thalamus, and then you look at what's left, there's only about maybe 5% of the neuronal activity left. If you then add the anterolateral quadrant lesion, the remainder of that activity goes away. So, for the viscera, it seems that this dorsal column pain pathway is the dominant conveyor of the pain for the viscera. And that includes the female midline organs, and the bladder, and the rectum and the colon.

Dr. Haring Nauta:

Studies have been done at other centers for gastric cancer, which is, I understand, is much more common in Asia, and people report good results. Only they make the lesion higher up. The pathway extends, of course, along the length of the spinal cord, so you could theoretically interrupt it just below the dorsal column nuclei. But you are interrupting an ascending system. So, it makes sense to make a small transverse cut or crush. And I think what we brought to it, what makes it punctate myelotomy is that it is a transverse cut, not a cut in the sagittal plane. The original midline myelotomies were directed at the crossing fibers of the anterolateral quadrant system at the segmental level. And it was really Hirschberg who noticed that it didn't seem to matter that you made the lesion not deep enough to

interrupt the crossing fibers, and that the effect, again, as already noted by many people earlier, that the effects extended for caudal to the segmental level of the lesion.

Dr. Haring Nauta:

So, it's clear that we're interrupting this postsynaptic dorsal column pathway. And I think, the reason this has been discovered only relatively recently is that this postsynaptic dorsal column pathway was well hidden in the dorsal columns, which we assumed already had this different function. And I think there's some maybe more general revelation there that, "Hey, some of the problems we have may be due to things that we think we know that, that aren't completely true." And we thought that we knew proof positive. Of course, everybody, every medical student is taught that the dorsal columns are for the epicritic sensation and that pain is anterolateral quadrant system. It took quite a lot of work to figure out that, that wasn't the case for the visceral pain, that visceral pain runs up this postsynaptic dorsal column pathway. So, the punctate myelotomy is really an operation to very focally interrupt it, that pathway.

Dr. Haring Nauta:

Fortunately, it's right on the midline. And it does not require lesioning more lateral parts of the dorsal columns, which are, of course, important for proprioception, vibratory sense, and that sort of thing. So, you can make these lesions to interrupt the visceral pain pathway without bothering ambulation. We've done lots of lesions. We've never had anyone downgraded to where they couldn't walk or became incontinent. And for the most part, sexual sensation is also preserved. Sexual sensation seems to be a more broadly distributed phenomenon. And certainly, interrupting the dorsal columns as punctate myelotomy, just this very midline part of the dorsal column doesn't seem to have much effect on that.

Dr. Haring Nauta:

So, we've had limited interest in it, because most patients with cancer don't want to consider another open operation. It's the niche indication for this procedure includes the patients who are... They have visceral origin pain, midline pain, ideally of a hollow viscus. They are well treated to the extent that they're not having trouble from recurrent disease. And for that reason, if they have a lot of pain, they don't see themselves as dying anytime soon. And they may have a sense of prolonged survival, but the narcotics that it takes to control the pain are so overwhelming that they have no life. They're either asleep with the narcotics or they're in pain. And so, these people, then, see this as a limbo that they're doomed to. I think the punctate myelotomy provides them a way out, because the really obvious evidence that the operation works is that the need for narcotics drops dramatically in these patients. That's the punctate myelotomy.

Dr. Haring Nauta:

And I think it's probably an underused procedure, but you can't be pushing an open operation on patients who have cancer and maybe have already had surgery, and they just don't want anymore. A lot of such patients just want narcotics and that's fine. But if they see themselves with a prolonged survival and not tolerating the narcotics or having no life on the narcotics, and then the operation gives them an opportunity to eliminate the pain and the narcotics with all that side effects. These people generally get a lot of their life back. If it's for malignant disease, of course, there's the likelihood that eventually the malignant disease will surface in some other way. So, it's very hard.

Dr. Haring Nauta:

I think it's hard to gauge pain procedures for cancer, because the cancer itself is a moving target. What we've done lately is we've applied the operation to certain kinds of benign pain, and that took some soul searching because, if you do anterolateral cordotomy for benign pain, the advice was always that, after a prolonged interval, that the pain would come back. And when it came back, it was often in a peculiar way that was very difficult to treat by any means at all, the so-called post-cordotomy dysaesthesia.

Dr. Haring Nauta:

We're dealing with a different pain pathway here. When we've used it for visceral pain, people who have a either rectal origin or bladder pain. Their pain seems to be dramatically relieved for a really prolonged time. I think, the overall problem of pain is that pain is probably a signal. And the system that carries it is like the internet. It's almost designed not to have a lot of resiliency, redundancy, and alternative pathways. So, for a lot of structures, if you try to do a interruption of a pain pathway, you end up with pain that comes back relatively quickly in a three to six month timeframe. If you interrupt a pain type that uses only, or so predominantly, this one pathway, then the benefits can be quite prolonged. And I think the evidence that hollow viscus, the viscera, used the postsynaptic dorsal column pathway is so dominantly that when you interrupt it, you really do have a prolonged effect. In other words, the internet spoiler functions are not as prominent.

Dr. Max Boakye:

How long does it take to do the procedure and what does the typical length of stay for the procedure?

Dr. Haring Nauta:

Yes. Now, let's get realistic with this procedure. The patients that want it are patients on really big doses of narcotics, and are not well controlled, even on the big doses. So, the challenge is to get postoperative pain control in patients who have severely downregulated opiate receptors. In other words, they have a high degree of tolerance for the pain medicine. So, our solution to that, I won't say we have a solution, because it's an open operation. And the open operation, by the way, seems to be more reliable and effective than any percutaneous thing that's been reported. People have tried needles with CT scan guidance, and the results reported haven't been as consistent. We did the operation open originally because we wanted to know what we were doing for sure. And we wanted to know that the pathway was actually interrupted so that we could correlate the benefit with the procedure accurately.

Dr. Haring Nauta:

But anyway, so we continue to do it open. We do a small laminectomy of one level, at a thoracic level, usually well above the level of the pain. There's an MRI scan that looks for how fat is the cord and how deep do we need to go. Usually, the depth in a normal spinal cord is about five millimeters from the dorsal surface down. But some spinal cords are relatively atrophic or more flattened and you don't need to go as deep.

Dr. Haring Nauta:

Okay, so these are all details. But basically the operation takes probably part of an hour for the exposure. And then, you have to, with a microscope, separate the septum posticum, because the septum posticum goes right to the dorsal midline in many places. You really need to free that up. Then, you need to see the entry zone on both sides so that you can measure between them accurately.

Dr. Haring Nauta:

We've more lately been using a very tiny stimulator, and then recording from the nerve. You remember, the dorsal column has the primary afferent. So, when you get into the, just slightly lateral to the postsynaptic pathway, you're into primary afferents. You fire them retrogradely, you can pick that up with a NIM. One way or another, you can pick it up in the peripheral nerve. And so, you pick it up on the right side and the left side, and then you know where the midline is. And then, you can also see the midline. I think, by the way, the blood vessels perforate right at the midline. But you need to put a number of things together to feel confident that you're crushing the right part of the dorsal columns. The main clue is that the midline is about halfway between the root entry zones on either side. We refine that a little bit with the view of the vessel perforation and the stimulator.

Dr. Haring Nauta:

We use a crush lesion. We put in a jeweler's forcep to a certain depth, and then crush, and then let go, taking care not to spread the forceps to injure more lateral parts of the cord, so that requires some attention. Surprisingly, the somatosensory evoked potentials generally do not disappear with that lesion, because the more lateral parts of the dorsal columns are not interrupted in any way. So, their function is preserved.

Dr. Haring Nauta:

Then the dura has to be closed water tight. And we use a lot of local anesthetic. And if we can get Exparel, the slow release, I think it's in the liposomal local that you get slow release of the local anesthetic that that would probably be useful. We use a lot of local anesthetic, and then close. And then, there can be a postoperative problem with pain control. And in one case, it was bad enough that we had to use ketamine for a few days. But generally, the pain of the operation is more or less settles down in about a week. And so, it depends how much pain control the patient needs.

Dr. Haring Nauta:

We've seen as little as a three-day stay. And we've seen hospital stays that have been in the range of a week before there was enough pain control to just manage with oral anesthetics. But fortunately, the pain is initially confusing, because the patients have operative pain. They can feel like, "Oh, gee, it didn't work. I'm still in pain." But then, as the operative pain goes away, they realize that their original excruciating pain is gone. And at that point, they're usually quite happy. The need for pain for the postoperative, the operative site pain, is usually limited and can be weaned fairly quickly after that.

Dr. Max Boakye:

I want to shift gears a little bit, Dr. Nauta, and now get into residency training. I will put on the website a link to additional information on the punctate myelotomy for those that are interested. Let's talk about residency training. So, you mentioned early that you are 75. I imagine you started residency maybe in your twenties or early thirties. So, you've had almost six decades in neurosurgery. You've seen the evolution of residency training over the years. Neurosurgery training traditionally has been one of the more difficult residencies in medicine. Various metaphors has been used to describe neurosurgical training, Band of Brothers, Navy Seal, Message to Garcia. As you reflect back, what are your current thoughts about the appropriate metaphors for neurosurgical training these days?

Dr. Haring Nauta:

The training has become a lot more professional. The ACGME, I think, has done a lot to make it more standardized and to eliminate some of the worst abuses. When I was training, the chairman, the faculty,

there was no higher authority than the faculty. In the British system, each individual surgeon is, sort of, the last word for that case. I think, in the American system, there is a little more of a hierarchical control, sometimes. There will be chairmans who influence the way more junior faculty, at least this used to happen, where a chairman would influence the way more junior faculty would conduct their clinical practices and their operations. So, with the ACGME, there is a lot less tolerance for the kind of abusive behavior, the sorts of things that somehow we tolerated it in those days. And I'm not sure that we should've, but the culture was that the chairman and the faculty, if they threw a scalpel, well, what can anyone do? And that's just them with their frustration and the burdens of their practice. And we, as trainees have to tolerate that. We definitely don't see it that way anymore.

Dr. Haring Nauta:

I think if the faculty now are abusive to trainees or to staff, then that's pointed out and there's remediation and that sort of thing that goes on. So, the first thing I'm seeing is that there's a lot more insistence on professional behavior. I don't think people are allowed to be the bad actors that we somehow tolerated a long time ago.

Dr. Haring Nauta:

And then, the other thing is that the residents, themselves, of course, there's this constant problem with the supervision versus independence. It's a polarity in that they're either extreme, either too much supervision, constant supervision, or allowing autonomy without any supervision. But those extremes are a problem. They are very obviously a problem.

Dr. Haring Nauta:

But in between, unfortunately, you also feel that there's a problem. Some people will say there's too much, others will say there's too little autonomy. And it never seems to be ideal. I don't know that we're managing that any better today. But I do think that it is certainly more uniform the way that we train people and that there are certain case numbers that are required. I think that actually we are much more organized and much more methodical in making sure that certain limits are met, certain thresholds are met, for a training.

Dr. Haring Nauta:

And then, there's the problem of, what is the right amount of call? When I was in training, we would be on call every other night. And then, when one of us went on vacation, we accepted that we were just going to have to be in the hospital every night for that period that our colleague went on vacation. And you could say it's brutal. I think it was. It had certain rewards in that we felt very close to the situation. When you're in hospital a lot, you certainly feel very on top of the patients and you know the situation very well.

Dr. Haring Nauta:

What is a problem now is that, without spending more time, you simply can't learn as much as quickly as I think we did when we had this more intense exposure. So, I think the solution may be to strike some compromise in terms of length of training, the required threshold minimums. It's going to take a little longer to train. When I was training, my residency was five years. And now, it's seven. So, you gain more reasonable work hours, but it takes you a little longer. And I think that's a trade off. I don't say one system is necessarily better than the other. I somehow tolerated the abusive work hour situation. But I wouldn't necessarily recommend it above the system that we have now. I think generally we're turning

out people that are pretty well trained, and it's happening under circumstances that I think are more uniform from program to program and within a program from resident to resident. Also, it's more uniform and it's more livable, I think, for the residents. Just take a little longer to complete their training.

Dr. Max Boakye:

Regarding the development of leadership in residents, over your decades of experience, how would you define leadership? What makes a good residents leader or chief resident? And can you usually tell who would become a great leader? And what is the evolution of experiences, during residency, that creates great leaders and some traits that should be cultivated?

Dr. Haring Nauta:

Yeah. Well, this isn't my definition of leadership. Someone, I forget who it is, said, "Leadership is the ability to inspire people to do what they otherwise would not do." If they're already doing it, they don't need leadership. If you have, like the military, absolute control where your orders must be followed, I would argue that that's not so much leadership as it is hierarchy. And so, leadership is the ability to inspire people to do something better. And largely, that involves them wanting to be like you a little bit, that you are fair and competent. And they see that, because of your fairness, if you say something is important to do, they accept it as something that is a part of the order that everyone will benefit from that somehow. Fairness is definitely part of leadership. If people feel they're being treated unfairly, it's very hard to get them to follow.

Dr. Haring Nauta:

It's funny, Max, my experience with leadership goes back to elementary school. I was somehow managed to confuse the teachers into thinking that I was a strong leader and that I should be the captain of the street crossing guard patrols. And what I discovered, very rudely, at that tender age, I think I was 10 or 11, is that people don't just do things because you tell them to do it. They have to understand why it's necessary. They have to want, in some way, to do that. And there are just so many aspects to all the different situations that I think what makes the leader a leader is that it won't be one time, but it will be consistently that people will look to this person as someone to follow when there are problems and the solution isn't so clear, and that person is able to inspire people to do what needs to be done, to achieve a better situation, a better outcome.

Dr. Max Boakye:

There's been an epidemic of burnout among residents. What is your advice to residents, particularly those who struggle in the junior years? And what is the role of emotional intelligence?

Dr. Haring Nauta:

Yeah, what I have not mentioned, I mentioned that when I was training, there was an abuse of work hours and time, days on call, nights in the hospital, all that, but I was not abused by what I see as the primary abuse today is all of this work on the computer. Somehow, the computer is able to catalog and recognize that notes aren't being written and automatically send reports to people that are monitoring the adequate documentation. We really didn't have any of that. We would write notes more or less on ICU patients. When I was training in the seventies, we would write notes on ICU patients. We would write notes on postop patients. We would write an operative, brief operative note. We would write a note if something substantial happened. I think a large part of the burnout is that you come there and

the things that would stimulate you, like dealing with patients, talking with patients, seeing the gratification that you get from seeing people get better.

Dr. Haring Nauta:

Some of that still happens, but the overwhelming experience of the more junior level residents now is all the chart work that they have to do, and at the computer desk. I think there's a certain mind numbing part of that. I don't think it's the operating. At least, in my experience, when we were operating intensely, it didn't cause burnout. We felt like we were making progress towards our goal. But I can imagine that being yoked to the computer for long hours every day, that would be... Just it would feel oppressive to me. It happens that I have to do a lot of computer work on my clinic day. I feel it quite intensely then. And it makes me ever more sympathetic to the, especially the junior level, residents that are tasked with doing a lot of that documentation. That's part of the burnout.

Dr. Haring Nauta:

And the other part is, I think, the various things that are going on in people's lives and the expectation that wives and girlfriends maybe have a little different... Just as we accepted an abusive work environment, I think the people around us maybe did or didn't understand it. But probably more people understood that's the way it was and that there were rewards afterwards. I think, one of the most dangerous burnout stages is finishing the residency and expecting that everything will now be fine. That it's just the residency that is the hard part. And I'm not arguing that it isn't a hard part, but certainly being a young faculty has its challenges. Every phase of the career has its challenges, each a little differently.

Dr. Haring Nauta:

I was mentioning before that, for me, the challenge now is to not become irrelevant, keep my interests in new things and going, and still be able to bring to the residency value in teaching. And for me, that has migrated a little more towards the didactic things and some of the teaching still for the cases that I do do.

Dr. Max Boakye:

That's interesting. So, you've adjusted somewhat. And I imagine for residents that are struggling, figuring out the appropriate adjustments, is extremely helpful. Looking back at your career, were you able to accomplish all your goals when you were starting out, and have you been able to accomplish most of them?

Dr. Haring Nauta:

Yeah, well it's never enough. I did my PhD work on neuroanatomy of the basal ganglia. And I thought my intellectual interest, so to speak, was in the area of brain organization and internal circuitry, and the, you could say, the surgery of the internal circuitry of the brain. And I had high hopes for using very selective toxins to work almost at the neuropil level. I don't know, maybe some people will enjoy to go into that area. But along the way that I was doing that work with selective neurotoxins injecting in animal models, I could see some success with that. But overwhelmingly, I found myself clinically drawn to the challenge of vascular surgery, of clipping aneurysms and removing AVMs. And at Hopkins, I had the opportunity to work with Gerard Debrun, who was a great innovator in endovascular work. So, we worked on combining open surgery with endovascular things, and we came up with the superior ophthalmic vein approach to the CC fistulas that are compartmented in that anterior part.

Dr. Haring Nauta:

If I look back, I would say that one of the problems that I had in my career is the things that I like to do surgically didn't match exactly what I was interested in intellectually, and had laid a foundation in my PhD, my original PhD work. So, there was a disconnect there that I don't think I've ever completely recovered from. Doing the vascular surgery certainly had its rewards. And I was able to affect a lab bench to bedside approach with this punctate midline myelotomy that we talked about earlier. I mean, that was an operation that has a very good pedigree in the sense that it came from new anatomical information, and then applying that new anatomical information to a clinical problem, and then seeing that it worked. Not everyone has the pleasure of being a part of that kind of lab bench to bedside.

Dr. Haring Nauta:

And I feel very privileged to have had it. I wish there were more of it. You know, I can't help thinking that there might have been if I hadn't been so seduced, if you will, by the beauty of the vascular neurosurgery and the application, the nascent application, of these endovascular methods that I enjoyed being a part of.

Dr. Max Boakye:

That's fascinating and deep. A couple of final questions for you. So, for a young neurosurgeon, this question regards the teaching of neurosurgery. How do they go about developing the skill in neurosurgery? What would be your advice to residents who want to become the very best neurosurgeons, safe, competent, and technically excellent, or maybe even extraordinary? What are your thoughts? Is it just a nature nurture debate kind of thing or-

Dr. Haring Nauta:

No. Well, in some cases, the nature of it is that someone said the key to caring for the patient is caring about the patient. And I think it really helps if you have an innate positive relationship with your patient. You have a very strong reward system to see patients do well. And I think if your reward system is to see patients do well rather than extraneous rewards, like number of cases, and progress up the academic ladder, and maybe even financial ones, if you keep focusing on, "Gosh, it just feels really good when a patient does well. And that's what I want to focus on getting more of," I think you'll be naturally motivated to get better.

Dr. Haring Nauta:

Now, how do you get better? Well, I think the anatomical basis of what we do is what separates us from the medical guys. I mean, in our world, in surgery, you're manipulating anatomy in order somehow to improve the physiology or the pathology of the problem. And so, it really helps if you take a deep interest in the anatomy. And one of the best ways to learn that is to study it, and then go to the cadaver lab and work with it, or work with it in some animal model. Whatever you do, keep working with the anatomy.

Dr. Haring Nauta:

And then, the technical skills with the operating microscope, for me, it was tremendously important that my PhD work in neuroanatomy involved use of the operating microscope, so that I became very comfortable looking forward, and then working with my hands at a different angle than my eyes were looking. For example, getting instruments in and out of the field. There are all these technical challenges

to the microsurgery. But microsurgery is not the only surgery. The spine people, I think a large part of that is of course anatomy, but it's also learning how to guide screws and other things in directions that you can't really see.

Dr. Haring Nauta:

And now, with the computer work, it helps that you are able to keep one eye on a screen and one eye on what you're doing in the wound. And I don't think that that comes naturally to everyone. So, some amount of technical skill is probably teachable in a lab setting with the technology. And I think just playing around with the technology, whether it's endoscopes, or a computer guided probe, or screw placement, or what have you, is it playing with the technology in settings that are not clinical, using a model of some sort, like a hollowed out red pepper. There've been various models that people have used also for suturing and things like that, that can be done in a dry lab setting. The problem with a cadaver lab is that you need ventilation. And there's a certain hygiene requirements, with the isolation requirements, with the personal safety equipment that's required.

Dr. Haring Nauta:

I think if we could have a training station that involved technical simulators, I think that could be a big improvement for the future. For the time being though you can work on your own models to work on. I remember we did a lot of EC-IC surgeries. I asked the operating room head nurse for a bit of the 10-0 suture. And I would take it to a lab where there was a microscope. I didn't need anything other than just to manipulate. I was sewing two pieces of paper together, or two pieces of glove together. And just the business of doing something under the microscope with your fingers, how to suture in that microsurgical setting where viscus and other tissue, and adherence becomes so prominent, just working with the mechanics of the setting, goes a long way to then making the real life situation easier to handle. If you want to jumpstart these things, you have to spend some time just playing with the equipment.

Dr. Max Boakye:

One final question for you. I'm going to have to bring you back. There are many other things I want to talk to you about. But I'll bring you back later. But one final question. If you had a magic wand, how would you improve neurosurgical training and research?

Dr. Haring Nauta:

Well, you can't get away from the fact that people are teaching each other. Overall, the biggest factor in general neurosurgery training comes from the environment. Let me say that I pride myself in having some influence in how people learn neurosurgery. But I don't think for a minute that what I'm teaching them is where they're getting most of their learning. Most of their learning is coming from the environment of their fellow residents. So, if I had to say there's one thing that we don't pay enough attention to, it's the resident to resident teaching, and then making sure that we're encouraging a culture of resident to resident teaching. And that means encouraging some people to teach more and let their colleagues share the information that they've worked so hard to obtain.

Dr. Haring Nauta:

It also requires the more junior people to accept residents as the source of their information. In other words, we see residents who only want to learn from the faculty or the chairman. And I think that's a big mistake when a resident does not participate in this resident to resident teaching. I think the faculty, if we focus on certain things that we see in that culture, we can really improve that culture, and really

improve the neurosurgical training, and amplify the influence we have through the resident passing on that to their fellow resident.

Dr. Haring Nauta:

When it comes to research, I think the question is a little more difficult. And I may not be the best person to talk about this, because I did a PhD as part of an MD-PhD in medical school. So, having done a PhD, when I was in residence, I published papers... Well, I published my share of clinical observation type work, case series, and other purely clinical observation. But I also had, in my home, I had a means of plotting pathways. And so, I had data, neuro anatomical data, that I was analyzing and writing up that I carried over from my PhD years into the residency.

Dr. Haring Nauta:

It concerns me a little bit that people who are not really interested in research are spending a lot of time, maybe frustrated, trying to do lab projects that they don't necessarily feel personally motivated to do, but they feel that we are forcing them to do the research. I think research ought to come from your own curiosity and your own need to contribute something, add something, make it better. If the resident is, and doesn't feel it, I don't know how I can inspire that other than by trying to work with the resident, figuring out what he really does want, try to stimulate his curiosity as far as possible, and encourage the research to be based on a curiosity that's somehow inspired. And then, you need the facilities, and the money and the time. Time and money are big factors. But it's questionable to me how much research should be done in residency and how much should be done maybe beforehand.

Dr. Haring Nauta:

As I said, I think that opinion is very skewed, because I did a PhD before residency. So, I think that's not going to work, obviously, for most residents who come to research and must get some sort of training and research in one year. I don't have a good answer for how to work with that situation.

Dr. Max Boakye:

That is awesome. I want to thank you, Dr. Nauta, for a really exciting discussion. We touched on many critical things. We talked about your work in hydrocephalus and the punctate myelotomy. And we touched on some of your observations and what you've learned from several decade experience training residents and being chair of neurosurgery for almost 16, 17 years. And your advice to residents regarding how to become more skilled surgeons, and burnout, and how to learn among residents, it's been really a incredible discussion. I hope to all bring you back. I know you also have interest, some additional lab laboratory interests, that I would like to talk to you about in the future, as well as your interest in quality improvement. Thank you for spending the hour here with me.

Dr. Haring Nauta:

Thanks. It was fun being with you.

Speaker 1:

Thanks for listening to Optimal neuro/spine podcast with Dr. Max Boakye. If you enjoyed this episode, we hope you share it with others. Leave us positive reviews on social media or leave a rating and review on iTunes. Check out our website, maxwellboakye.com/podcasts, for show transcripts and other information. Join us next time for another edition of Optimal neuro/spine show.