



THORACOSCOPIC SYMPATHECTOMY FOR TREATMENT OF HYPERHIDROSIS
UNIVERSITY OF MARYLAND MEDICAL CENTER, BALTIMORE, MD
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NARRATOR

Most people perspire while exercising. Many adults even become a little damp when anxious or nervous. But thousands of Americans sweat profusely when doing something as simple as writing a letter or typing on a computer. You are about to see a new and innovative procedure that can treat people who suffer from hyperhidrosis, excessive sweating of the hands, underarms, and feet. This minimally invasive procedure is being performed by surgeons in the operating room of the future, a technologically advanced surgical facility at the University of Maryland Medical Center in Baltimore, Maryland.

MARK KRASNA, M.D.

Hello. I'm Dr. Mark Krasna, Chief of Thoracic Surgery at the University of Maryland Medical School.

KING KWONG, M.D.

Hi. I'm Dr. King Kwong, Assistant Professor of Thoracic Surgery at the University of Maryland School of Medicine. Welcome. Today we're going to talk to you about thoracoscopic sympathectomy surgery and its various indications, principally hyperhidrosis.

Hyperhidrosis is a true medical condition where patients experience excessive sweating. Usually the locations in the body that are affected are the hands, the axillae, and the feet. There are various indications for surgery for this condition, as well as some other conditions, as shown to you on the PowerPoint slide. Some of the other medical indications for thoracoscopic sympathectomy surgery are hyperhidrosis, reflex sympathetic dystrophy, upper extremity ischemia, and also minimally invasive splenectomy for pancreatic pain.

The majority of the patients who get thoracoscopic sympathectomy surgery do so for hyperhidrosis. Who gets hyperhidrosis? Well, we know that in the literature approximately 20% of the patients have familial cases, but 80% of cases are fairly spontaneous. They may be the only person in their family who has hyperhidrosis. We already discussed some of the symptoms and locations.

Who gets the surgery? Oftentimes, the patients who have severe conditions of hyperhidrosis and who are refractory to medical treatment are eligible for consideration for surgery.

Some of the medical treatments that have been used for hyperhidrosis include topical agents that contain aluminum chloride; iontophoresis, which is a device developed previously by dermatologists; and also, more recently, Botox injections. Unfortunately, most of these medical treatments have a fairly low success rate and, for those severely affected patients with hyperhidrosis, thoracoscopic sympathectomy has yielded excellent results. Today we're going to talk a little bit more about the minimally invasive thoracoscopic surgery, thoracoscopic sympathectomy. I want to go over some of those aspects with you now, followed by Dr. Krasna will show you a video for which he'll show you some of the actual operation.

In the past, most chest surgeries needed large incisions on the chest, which required a posterior thoracotomy. In the last 10-12 years, we have developed minimally invasive techniques that allow us to use small, tiny, inch-like incisions in order to access the very complicated structures inside the chest, to allow patients to recover quicker and to undergo a similar operation using much smaller incisions.

The thoracoscopic sympathectomy surgery requires general anesthesia, just like the larger standard operation. It also requires single lung ventilation, in which the anesthesiologist places a double lumen endotracheal tube and can selectively ventilate one lung, thus allowing us a perfectly still operative field inside the chest to perform delicate surgery. Occasionally we insufflate carbon dioxide in the chest in order to push the lung gently away so we get a clear, crisp picture. Lastly, the patient is placed in what's called semi-Fowler's position, which Dr. Krasna will describe to you in a moment.

We use special instruments in order to perform this thoracoscopic surgery. There's an operating thoracoscope which we will show you in a few moments. We use special trochar ports to allow us access into the chest so that we can accommodate this using tiny incisions. Then we use what is called hook electrocautery in order to do the critical parts of the operation. Again, we'll show you some of that instrument and how it's used in a later segment.

We specifically divide the sympathetic chain inside the chest in order to treat the different symptoms that patients may experience with hyperhidrosis. Oftentimes we divide two levels for each of the conditions, but that can vary, depending upon the patient's symptoms, and we adjust for operations accordingly. As you can see on the PowerPoint presentation, for treatment of hyperhidrosis of the hands or palmar hyperhidrosis, we usually divide at what is called levels T2 and T3. For the underarm or axillary hyperhidrosis, we focus our surgery on the level of T4 especially. Then for the feet, it can be quite variable and you see that displayed on the PowerPoint slide.

Lastly, we also perform this surgery for facial sweating or blushing, in which we have to divide fairly high on the sympathetic chain, at the T2 level or slightly above. We

sometimes treat thoracic outlet syndrome or reflex sympathetic dystrophy, RSD, with varying division of levels between T1 and T3. For chronic pancreatic pain, the levels are much lower in the thoracic sympathetic chain, as shown to you on the slide.

I think at this point I'll turn it over to Dr. Krasna.

MARK KRASNA, M.D.

Let's go to the setup picture in the operating room. We'll start with the beginning of this case. This is a patient who is positioned for sympathectomy. What you see here is the patient in a sitting position, what we call semi-Fowler. The arms are stretched out to the side. There's a little bump or roll behind the patient's shoulders and this is actually flexing the patient, arching their back a little bit, if you will. Now what we're going to do is find the location and make our incision right into the chest wall. We usually start first on the right side and then go over to the left side.

What I have here is something called a trochar. We made a 10 mm incision, literally as big as my finger. Using the tip of this trochar, we enter into the chest. You can see it's very blunt. There's really very little danger to the inside of the chest. We remove the inside part. Then we take something called a thoracoscope. You have heard about laparoscopy, such as minimally invasive gallbladder surgery and cholecystectomy. This is a similar instrument. We use this in the chest. It allows us to look through the eyepiece that is hooked up to the video camera, as well as operate from the center, so the trochar goes into the patient's chest. We then insert the scope through the trochar. Lastly, we have this video camera that is hooked up. While we're looking in the chest and we see the video screen, we then bring up a device called the hook cautery and this is what's going to actually allow us to do the division. As you can see, the tip of the hook cautery probe, if you get close up there, it's a little L-shaped and that L-shaped hook allows us to very delicately dissect the area right around the sympathetic nerves. We put that through the center of the scope. This is called an operating scope and at the bottom of our scope, you can see the hook cautery probe. Basically, with one single incision, you can see and do the procedure at the same time.

If we can just look for a moment at the slide presentation that Dr. Kwong prepared, schematically before we get into the chest, what we're going to see is a view of the lung collapsed, as well as the sympathetic nerve that is lying to the side of the lung. As you're looking at these arrows, they're pointing out where the normal sympathetic nerve is, so we're going to be operating from the very top of the chest to the second rib and third rib level. This is a close-up view of that. You can see again the white arrows are actually pointing to the sympathetic nerve.

Let's go back to the intraoperative picture now. So now we put the scope inside the chest. We'll clean the tip of the scope for a moment. Once we get a good view of the inside, we actually can see the vessels at the top of the chest. Here's the scope going back into the trochar, just like I showed you. Now, with the scope inside the chest, you can see the superior vena cava. That's the large vein in the front of the chest with the phrenic nerve

on top of that. Now we're looking down in the chest and all through this one incision. We're now going to be looking to the back of the chest. This is the internal mammary artery. We cleaned off the tip of the scope again. Now we have a look at the back of the chest. You can see the subclavian vein and then all the way in the back there, you see the chest wall. Now we're looking at the first rib and the second rib. The first rib has that little artery and vein, the supreme intercostal artery and vein going over the first rib. Then the second rib, you can actually see in this case a really good example of two parallel nerves. Actually, this patient has three parallel nerves. There's the main sympathetic chain and then there's two additional small branches. We need to divide all the branches in this particular patient or this patient's hyperhidrosis of the hands is going to recur. Now we're looking lower. This is the T3 level or the nerve over the third rib. In this patient, what we're going to do is divide the T2 nerve and the two collateral nerves, as well as the T3 level that you see just beneath it. Right in front of the nerve there, what you see is a vein. That's the intercostal vein from the second level.

KING KWONG, M.D.

Thanks, Dr. Krasna. I'm just going to go over some of the highlights of the thoracoscopic sympathectomy operation and then we're going to go back to the video, where Dr. Krasna will describe to you some more of the operative technique. To summarize, we use the Bovey electrocautery, which is able to divide the sympathetic chain and also coagulate so that there isn't any bleeding inside the chest. We are also very keen on having complete division of the sympathetic chain, including any accessory nerves of Kuntz. As Dr. Krasna showed you very nicely in that last video clip, there can be these variable accessory nerves that are missed if not looked for and sought after. The transected ends of the sympathetic chain are subsequently separated and cauterized. You'll see that on a subsequent video clip that Dr. Krasna is going over. Lastly, for surgeries involving generic hyperhidrosis of the hands, axillae, and so forth, we try to avoid the first level ganglion, the stellate ganglion, which may potentially, if affected, produce something called Horner's syndrome, which we'll go over later.

MARK KRASNA, M.D.

Let's go back to the intraoperative shot now, where we're actually doing the sympathectomy. We've introduced that cautery probe. You can actually see the tip of it now, pointing to the first rib and that supreme intercostal artery. Now we're looking at the second rib, where you see the main sympathetic chain as well as the two branches, the two collaterals. Dr. Kwong called it the nerve of Kuntz. We really pay attention to this because, if missed, this could be cause for a patient to end up with recurrent hyperhidrosis.

Once we've identified the level, and that really is the whole key to the operation, we then insert the hook cautery and use the hook cautery to elevate the pleura that's overlying it. So using the tip of the cautery probe, we're actually going to lift that up. Once we lift it up and divide the pleura over the nerve, then we're going to go ahead and actually divide the nerve, so if we could go to the next intraoperative shot, that's what we're about to do

right now. Here we're using the cautery probe. We are scoring or opening up the pleura. Once we've incised the pleura that's overlying the nerve, we're now going to lift the pleura. We do this routinely out of caution to avoid damaging other parts of the nerve and also to avoid damaging the joint between the rib and the transverse process of the vertebra. You can end up with a lot of pain there if you're not careful and get damage either to the joint space or the periosteum. So here we're dividing the pleura, going medial from the nerve site, out lateral. We generally always divide the nerve branches that we can see. In the case where we don't see a really obvious nerve of Kuntz, like we do in this patient, we will still divide the pleura for almost 5 cm laterally, again the idea being that if there are small nerve branches there that we're not able to actually see with the scope, we want to make sure we divide those small branches by opening up the pleura. We've now opened up the pleura over the main nerve. We've opened it over the middle small branch and this is the larger lateral branch. Now we're incising the pleura laterally. Notice also that I'm really trying to avoid any injury to the somatic nerve, which lies right underneath in the intercostal groove.

Next we're dissecting, using that same hook cautery probe, the same instrument, we're actually dissecting the nerve around. We'll cauterize that little bleeder for a minute. It seems significant because it's magnified. That's very little bleeding, actually. Now we've mobilized the nerve and we're putting the hook cautery behind it. We're going to lift the nerve up and, using what's called a cutting current, which is not going to transmit as much, we put a little tension on the nerve and cut between the two edges. Now, the main chain to the nerve has been successfully divided. What we're now doing is pushing the two edges apart and cauterizing the edges as well. What that's going to do is prevent the nerve from regenerating and healing back to itself. I think it's important not only to cut the nerve, but to cut it, separate the edges, and then cauterize it.

Now we're going after those two lateral branches to the nerve of Kuntz, the first one, that little middle one. We're almost around it with the cautery and then the same thing, we're going to divide it using a cutting current, push the edges apart, and then use the electrocautery to cauterize the edges. Again, notice that we're staying on the middle part of the rib. That's the safe zone so that we're not going to damage the intercostal nerve.

Because this operation can be done so well and so safely, we're very aware of some of the small problems, like cosmetic problems as well as the pain. The last thing we want to do...I'm just adjusting the light intensity here for a minute to decrease that glare...the last thing we want to do is get an injury to either the periosteum or to the intercostal nerve that's underneath it so that we're not going to cause any pain from the operation itself. Otherwise, with just one incision on each side, the operation is relatively pain-free.

Here we are, dividing now the last of the accessory bundles and we have surrounded it with the hook cautery. We're lifting up and now we're going to cut the edges. We'll take out a little bit more of the pleura laterally before we do that. Now we've got it isolated. This is the last branch. Carefully divide it using a cutting current and then we'll push these two edges apart and cauterize it. One of the things we look for while we're doing this are additional branches and also we're very careful to see if there are accessory veins.

There have been reports of severe injuries to surrounding structures, including significant bleeding from the branches of the azygous vein. As you can see, we're very cautious to keep away from those veins. We want to see where they are and make sure we're not going to inadvertently snag them.

That actually looks pretty good now. We've basically divided all three of the branches. It doesn't look like there's any significant bleeding. We'll make sure that last edge is cauterized, then we're going to pay attention to the next level, which is going to be the T3 nerve. Now here you can see what I was talking about with the vein. Here's a very large vein. This is the T2 vein that's going down to the azygous, so now with the cautery, I'm very carefully incising it just lateral to that branch of the azygous vein. It's a very large vein, so you want to make sure you're not going to get into it and just open the pleura a little bit over the nerve here, just like we did above. At this level there doesn't appear to be as many significant collateral branches. It does look like one small one right there, so we're going to go ahead and divide that as well at the T3 level. If we had already divided these at the T2, if I don't see an extra vein, we're not going to divide it a second time, like we did the T2. So now we're finishing the pleura over T3. This is the nerve as it passes over the third rib. Again, we're just dissecting a little bit, so we don't put too much tension. We're pulling and cutting, and now we push the edges apart and cauterize them.

One of the things to keep in mind is if we use too much tension, if we pull too much, we can actually cause an adjacent injury. When you do this at the T2 level, I think this is probably why some people end up getting Horner's syndrome. We really want to be careful not to do that. You don't want to transmit too much cautery current onto the T1 ganglion and you also don't want to pull too much on the T1 ganglion or the patient will get Horner's syndrome. Dr. Kwong is going to talk about that in a little bit.

Here we are with the accessory branch, pushing the edges apart. That pretty much is done now, so our second side looks good. We've got the T2 level. It's completely divided at all the branches. The T3 level is divided. No bleeding. We're going to go ahead and this shows the rest of the chain going down to the azygous vein below. We'll go ahead and pull the scope out of this side in a moment.

KING KWONG, M.D.

That's very interesting. It's amazing the quality of video that we get with the digital equipment that we have and to see everything in magnification. Do you have any other tips in order to identify the proper levels?

MARK KRASNA, M.D.

The key thing is identifying where the T2 rib is. If you're looking at the sympathetic chain at the apex of the chest, the danger is that you'll be fooled into seeing the stellate ganglion, which is a T1 ganglion, and thinking it's a T2. If you divide the stellate ganglion inadvertently, you may end up getting a significant Horner's syndrome. As you can see here on the slide, it's showing you at the top of the chest there are several good

hints in order to avoid this. #1 is we actually look for the supreme intercostal artery vein, which I pointed out to you on that right side very clearly. #2, if you notice, the angle of the rib is different, just like when you're looking at the ribs from the outside of the chest cage and the ribs from 2 and below are more parallel and horizontal. The first rib is more vertical. If you look carefully, you can actually identify the differences in that rib. The third very helpful thing is looking for the fat pad. There's almost always a fat pad underneath the first rib and that can really be your tip-off. Once you identify the first rib, the final thing that I do, and you'll see in a later cut, is actually put a probe in and actually feel the rib. You can actually palpate that this is the T1 rib and not the T2 rib. Then of course you're sure where 1 is and you can go to 2 and 3. Again, I think some of the major complications that people have reported with this, as straightforward as it can be, is not getting the anatomy right, either getting the wrong level or actually getting the wrong nerves and dividing things that were thought to be the sympathetic chain but were not.

KING KWONG, M.D.

I agree with you, Dr. Krasna, finding the right levels is definitely key. We often do this surgery bilaterally, which means we do this operation on both sides. We just saw a portion of the operation done in the right chest. If you can take us through the left chest operation with the next video clip.

MARK KRASNA, M.D.

This is a view from the left side. We've made an identical skin incision. I'm not going to show that to you again. Now we're inside the chest cavity. This is a beautiful view on the left. You can see the subclavian artery coming up into view there and right away that highlights something you need to watch out for.

This is what I was talking about. This is called a probe. This is a simple blunt-edged instrument which isn't going to cause any damage. Not only do we use it for pointing and teaching, but we also use it, as I said, to actually feel the rib. That's what we're doing right here. We're feeling that first rib. There it is. Now we're going to identify that and separate it from the second and third rib and we're going to use the other indicators that I mentioned, which are the fat pad, the location of the supreme intercostal. That's a good view, for a moment, of the aortopulmonary window.

There's the sympathetic chain going over the heads of the ribs. You can see on this side you need to be careful, very careful, about watching the tip of your cautery probe as you're dividing the nerve because otherwise you may actually endanger the subclavian artery and that would be a really, really tough complication.

As we described earlier, we're going to start more lateral than is the location of the vein and the nerves so that we can identify all of the branches and divide those branches together with the pleura. Here we're starting from lateral to medial on the left side. We're coming a little bit closer here. We're lifting up the pleura and dividing it. Here you see very clearly the head of the rib overlying the transverse process. Now by lifting up the

pleura, we're going to get the sympathetic nerve, the sympathetic chain, just beneath the pleura. This is a little tricky because, you can see here as we're doing it, there's an artery that's actually a branch of the intercostal artery and there's an intercostal vein right beneath it. Also notice we're being very careful with the tip of the hook, not to bring it too close to the left side of the screen because that's exactly where the subclavian artery is. Now we're twirling the end of the hook, getting that edge started. Now we're going to slide the hook right underneath the sympathetic chain at T2. As we sometimes have to do, we may have to actually divide the artery. It looks like we've slipped around it. Okay, so we'll leave this artery and go ahead and divide it. Again, this is using the cutting current to divide the chain. We may divide that artery with it, but we may not have to. We push the edges apart and then cauterize them. So we cut, separate by pushing the edges apart, and then cauterize it. There's a little bit of oozing there that we're going to control. Again, this is magnified. There's actually very, very little bleeding here.

Now, as you can see, we're looking laterally for any additional branches. There really are no significant nerve branches laterally in this patient.

Again, notice that we're staying either in the center or the top of the rib so we really can avoid getting the intercostal nerve and we don't want to damage the somatic nerve, if you can avoid it. Now, this brings us to the rib below and we're going to do the same thing here. We're going to incise the pleura. Especially if there's a question of an accessory nerve laterally, we'll actually incise that pleura laterally, then bring it in.

What you see here is finishing that last piece. We're just dividing the nerve at the T3 level. It looks like there might be a small branch here in the pleura, so we're going to divide that pleura and make sure we include any branches with it. You can see we've actually preserved the vein and the artery and, of course, the rest of the structures, the subclavian and aorta, are all visible and intact. There's the T3 level and there's our T2 level. Let's check for bleeding one last time. I think that looks okay.

At the end of the procedure, we're going to remove the scope, keep the little trochar that we showed you earlier in, and just put a small tube in the chest, a chest tube, just to drain out any of the air and carbon dioxide that we've put in during the procedure. By doing it this way, at the end of the procedure, that actually allows us to have the patient breathing normally with two lungs at the end and not have to have any chest tubes in the patient, so these patients actually wake up in the operating room. They go to the recovery room without any tubes in the chest whatsoever and usually we're able to send them home by lunchtime.

So, King, I'd like you to just go over some of the results we've had here at Maryland that we've actually published several times now. I believe we actually have the largest academic experience in North America. Let's go over some of the objective data from our most recent reports, if you would, and then we'll take some of the questions that we've had.

KING KWONG, M.D.

Sure, Dr. Krasna, I'd be happy to. As you see on the PowerPoint slide, we recently reported a series of patients who underwent thoracoscopic sympathectomy for hyperhidrosis. It's the majority of our experience but by no means includes every single person here. In this recent paper, which was presented at a national surgical meeting, this study included a review of 202 of our patients, where approximately 97 men and 105 women were included, who underwent thoracoscopic sympathectomy surgery. This was evenly divided, roughly 48% and 52%, in terms of men and women. The mean age of our patients during this time period was an average age of 29, with a range from as young as 9 years to as old as 65 years old. Overwhelmingly, the majority of patients underwent this patient as outpatients, meaning they didn't have to stay in the hospital overnight, and our median hospital stay was about half a day. The median follow-up for this cohort series is roughly 2.6 years.

MARK KRASNA, M.D.

One of the things we've really evolved from the time we started this program in the early 1990s with thoracoscopy, we really went from using one side at a time with three incisions, to doing both sides, and eventually doing both sides just with one incision. As we've become less and less invasive in this technique, we've actually decreased the length of stay. Whereas they would always stay overnight and then 23 hours, really now I would say easily the last 150 patients have all been in the hospital, I would say, only until about noon.

KING KWONG, M.D.

Yes, it's really amazing. Most of our patients comment on how they were able to spend very little time in the hospital and actually get home shortly after lunchtime and able to be up and about that night and feeling very little pain.

On this next slide here, there's a breakdown for the cohort of patients. 175 of these 202 patients underwent surgery for hyperhidrosis. 21 patients underwent this surgery for the condition facial blushing, which is more rare than hyperhidrosis but requires much more precise surgery. Do you want to comment on that, Dr. Krasna?

MARK KRASNA, M.D.

Briefly. There are a lot of patients throughout the world who present not only with facial sweating but actually a significant degree of facial blushing where, even without provocation, their face turns absolutely beet red. Actually, there's an international organization of patients who suffer from this, called Red. What we have devised for that subgroup of patients is to do a very high sympathectomy. It includes the T2 level and the very bottom of T1. The danger there, of course, as we showed earlier, is if we go too high up toward that first rib, the risk is that we're going to actually divide the nerve above the T1, in which case we'll be dividing right through the stellate ganglion and those patients may get what's called Horner's syndrome. In Horner's syndrome, you'll actually end up

with lagging of the eyelid and a large pupil on one side. We have been very fortunate to have very, very few of those. I think it's because of the meticulous dissection at the very bottom of the ganglion at T1 and including T2, so we do that for patients with blushing and sweating of the face, but it's really the minority of patients and it's really only select patients that we'll choose for that procedure.

KING KWONG, M.D.

Here is a slide summarizing our results with these patients. Out of these patients, we did approximately 397 surgical procedures. Most patients obviously had bilateral procedures done. Synchronous bilateral procedures were done in 194 of these patients. The early experience, for special situations other than bilateral hyperhidrosis, there were six patients who underwent the right side alone, one patient who underwent the left side alone, and one single patient underwent bilateral surgery but staged in different settings.

The compensatory sweating, which is something we'll talk about a little bit later, rate is roughly around 40% in our series. In all the western series, that is in the United States and Europe and the western world, the average incidence is around 50%, so we're coming actually slightly below that but I think that's well within the average experience. Interestingly enough, in the Asian countries, the incidence of compensatory sweating can be as high as 90%. We don't quite understand the differences in data there, but our experience here at the University of Maryland is quite commensurate with the western experience.

MARK KRASNA, M.D.

Let me just comment on that before we go to this next slide. I think the other thing about compensatory sweating, as you see in the numbers, there were few patients who had the compensatory sweating to such a degree that actually inhibited their function afterwards and basically regretted having the operation. In fact, out of the last 400 procedures, there were only 2 patients like that, so we're running a below 1% incidence, which is well below what has been reported nationally and internationally. I think the key to that, frankly, is not just the surgical technique. We really do spend a lot of time with each patient in the consultation ahead of time. Part of what we try to get them to do is understand the risks before going in for this. Actually, we counsel patients not only ourselves and with our nurse, but we actually counsel them to talk to other patients who have gone through the procedure, even if they do have compensatory sweating. When a patient comes in and understands that that's a side effect but that side effect is not going to be as debilitating as the primary problem was, usually they're okay with that and I think that's probably a testament to the fact that you're really doing a good job in consulting these patients and explaining to them what to expect.

KING KWONG, M.D.

That's absolutely right on the money, Dr. Krasna. We've got such a great team of support staff as well and nurses who help us counsel our patients that I think it really helps

patients to understand before the surgery exactly what they should be expecting and have fairly reasonable expectations. Just like everything else in life and medicine, nothing's 100% perfect, but our patients actually have been blessed with a lot of good results.

On this next slide, we see a list of complications over this series of patients. We're very fortunate here that we've had a low incidence of major complications. There have been no deaths, no mortalities here at the University of Maryland with this procedure, a testament to the expertise of our support team and so forth. There's been one pneumothorax, one effusion, and only two patients with Horner's syndrome, giving a 0.5% incidence, which is much lower than the 1-2% reported in the literature elsewhere. We also evaluated and followed up our patients in terms of how satisfied they were with the surgery and almost 100%, without fail, of our patients had very high satisfaction immediately after surgery. Roughly 35-40% of the patients have some degree of compensatory sweating and the majority of them had very mild compensatory sweating that did not require any additional treatment. A few had a little more significant compensatory sweating.

We also looked at this series of patients on a very objective basis by following them up over a period of time. We looked at their quality of life via an index both preoperatively and postoperatively. This allowed us to sort of have an objective measure of how much impact we were making in the lives of these patients with this type of surgery. As you see on the screen here, the severity of the quality of life is worse as you get to higher numbers, so a severity level quality of life index of 3 is the worst you can have and quality of life index of 0 is basically you're living a normal life. The majority of our patients perioperatively had a fairly severe or moderately severe condition, as you can see.

Postoperatively, here's a depiction of where our patients lie, as they would see their lives. As you can see, the majority of the patients who had severely affected quality of life have a fairly normal life after surgery and the majority of these patients are at 0 quality of life index. That's just an amazing result in terms of a very straightforward surgery that we can do, so these are some very satisfying results. Here's the numerical depiction of that.

MARK KRASNA, M.D.

I think it's an important point to keep in mind, there's no more attention throughout the world literature on sympathectomy, on looking not only at your success in alleviating the sweating, but the overall quality of life, so for instance, if you have 40% of patients who have some degree of compensatory sweating but their overall quality of life is still way, way better than it was, closer to 0-1, clearly that's an indication that the patient's overall satisfaction is better. I think by quantifying this now, we're going to be able to make a difference. We actually first published this scale several years ago at a European meeting. It's a very helpful scale, by grading things from 0 to 3, you can put a numeric value on the symptoms that they present with, the residual degree of their symptoms, and of course the degree of compensatory sweating. I think we should continue to do that in future publications to document that.

KING KWONG, M.D.

This is a little bit of an older slide. In fact, maybe I'll just let you, Dr. Krasna, comment a little bit about the patient results with facial blushing, since we've got a much bigger series than the six patients shown here on the slide.

MARK KRASNA, M.D.

I think the overall incidence of facial blushing, like I said, is much lower than hyperhidrosis, but clearly the results have been very satisfying. There have been a couple of cases of either partial or temporary Horner's syndrome associated with the facial blushing, actually none at all with the patients who had hyperhidrosis at T2. I do think this is still something that we're going to offer, but clearly this is a subset.

I think what we'll do King is let you just wrap up our presentation. Then I'd like to take some of the questions that we have from the website.

KING KWONG, M.D.

Sure. We hope that through our videos and our segment here, you've learned a little bit about thoracoscopic sympathectomy surgery. Endoscopic thoracoscopic sympathectomy surgery is an outpatient surgery. It is safe and effective and can be done, as in our experience here at the University of Maryland Medical Center, with very low morbidity and low complication rate with very high patient satisfaction. We think that the application of this treatment to other sympathetic disorders may be encouraging, but long-term follow-up, of course, is very important, whereas we continue to evolve and develop refinement of this procedure.

MARK KRASNA, M.D.

That leads in perfectly to a couple of questions. Two of the questions that were asked have to do with changes in the technique. Many surgeons around the world have popularized a so-called mini-thoracoscopy, the idea being that if you could put a 2 mm incision in and you have to use three of them, that might be better than just doing one. I've tried that and I think our experience and our patients' experience has been that this hook cautery, which is only 3-5 mm, depending on which scope you use, and the trochar, which is no bigger than my finger, a 10 mm trochar size, is so small that it's not going to cause and injury to the intercostal nerve as long as we're putting it in carefully, the way we do, and really the amount of trauma is minimal. I don't see any advantage to the 2 mm approach. In fact, one of the things I've noticed is that most places that use the 2 mm cautery have to put more incisions in. They make two, three, or even four 2 mm incisions, so if you add them all up, it's close to our 8-10 mm incision anyway, but in addition I actually think that the optics that we have are far better, which is why I think the overall results are excellent. It brings up another question. There is a new technique which has been popularized by certain surgeons around the world, called clipping. The idea of

clipping is to identify that sympathetic nerve, like we showed you, but instead of dividing that nerve and then cauterizing it, just putting a temporary clip across it. The rationale was that if the patient ends up with compensatory sweating and it's intolerable, you could always go back in and remove the clip. Here's the problem: You can go in and remove the clip, but when you remove the clip, in half the patients the compensatory sweating will get better, but in the other half of the patients, despite the fact that you've removed the clip, they still have the compensatory sweating, except now that you've removed the clip, more than half the patients also now have the excessive sweating that they came in with. I think in my view, if we have an overall compensatory sweating rate that's really a side effect, as opposed to a complication, about 40%, and only 2% of those patients are severe, I would say that I'd much rather do the definitive operation which works, we know, literally 100% of the time and accept that 2% risk. I think that's pretty much our preference.

The other questions that I see came in and I'll let you address them briefly, but I think we've touched on most of them, revolve around complications. People asked about the complications of Horner's syndrome, what some of the other risks are, and about compensatory sweating. Why don't you just summarize that once more because that seems to be the most common question.

KING KWONG, M.D.

I think we spend a lot of time with our patients, counseling the risks and benefits of any operation and this one is no exception. This is an operation, so there are all the general risks of any operation, the risk of general anesthesia, the risk of potential bleeding, although as you can see, we do everything we can do to prevent that and you obviously see that there's very little bleeding involved with this type of surgery. Risks of getting medications that you haven't had before and having adverse reaction and so forth. Again, those risks are just the risks of having an operation, in general. If you were to get your wisdom teeth removed or cosmetic surgery or something else like that, you would incur very similar risks. In the risks of this surgery, in particular, we're talking specifically in things like Horner's syndrome, which you touched upon at great length already, Dr. Krasna, and that's where the stellate ganglion nerves might be affected or touched upon and tend to produce droopiness of the eyelid postoperatively, dryness of the face and dryness of the mouth on the affected side, and change in the pupil size as well.

MARK KRASNA, M.D.

All that is rare, but if it happens, it actually can be fixed with a plastic surgery procedure called a blepharoplasty. We don't advocate that, obviously, because we see it very rarely, but if something has to be done, it can be fixed.

I want to switch to the last question because it actually leads into a good story which I think would be a good way to conclude, King. One of the questions on the website was how young a patient can undergo this kind of surgery. Although the majority of patients that we showed you in our data ranged in age, the mean age was 29 years old, young

professionals, typically people who meet other people, shake hands all the time, using laptops all the time, people who are trying to use their musical instruments. We had a young gentleman who played the drums and the drumsticks kept flying. He played drums with leather gloves until he had the surgery. We had a cop who is a very good policeman and he had problems with a quick draw because when he would do the quick draw, every now and then the gun would fall out of his hand. That doesn't look good in practice, and that got better after the surgery.

KING KWONG, M.D.

Thos are very poignant cases and dramatic cases, but a large number of patients are just undergoing daily activities and having problems with them, such as not feeling like they can go out and socialize. We've had people that are so severely debilitated that they haven't dated, they haven't gotten married, they don't like to go to church and touch other people because they can't shake hands. When they drive, their steering wheel slips. They can't write. They soil the papers at work. There are so many of those common everyday symptoms that affect these people that it's just amazing.

MARK KRASNA, M.D.

So the answer for probably the parent who asked that question about how young, I'll finish with this. We had a young man who was eight years old when I first saw him. He had terrible, terrible hyperhidrosis. It affected him in school. Every time he would write a paper and hand it in to his teacher, he would get complaints from the teacher that he was smudging his paper. In fact, the principal called the parents in because they felt that he was sloppy. I talked with him and his family at length and we actually had him counseled for a while. I kept trying to put him off because he was so young. Finally, when he was 10 years old and getting ready for middle school, his parents came back with him and they said, Dr. Krasna, we need to do something. We just can't keep waiting because he's not socializing. He doesn't have any friends. He can't play in the gym. He's ostracized in class and even the teachers and the school had given him a hard time. The long and short of it is we did his surgery several years ago now. I remember it vividly because it was Christmas Eve. We did his surgery. It went great. He went home and when I spoke to his mom later that afternoon, before he went home the same day, she was sitting there, holding his hands, crying. I said, what's the matter? Is everything okay? She said, of course everything is okay. This is the first time I've ever held his hands since he was a baby that they've been dry. That made it for me.

KING KWONG, M.D.

That's a great story. We see our time is coming to a close. I just want to mention that if you have any additional questions for us, there is a button for joining the forum, where you can email us your questions. I know Dr. Krasna and I are happy to answer any other questions out there. Obviously we can't cover every single thing.

MARK KRASNA, M.D.

See our website at www.umm.edu/thoracic and you can log on directly and either myself or Dr. Kwong can answer those questions. Thank you very much.

KING KWONG, M.D.

Thank you.

NARRATOR

This has been an internet broadcast of a thoroscopic sympathectomy from the operating room of the future, a technologically advanced surgical facility at the University of Maryland Medical Center in Baltimore, Maryland. For more information, to make a referral, or make an appointment, click the buttons below.