

Craniofacial Procedure to Treat Encephalocele and an Arachnoid Cyst
Children's Hospital Boston,
Boston, MA
January 28, 2009

Welcome to this "OR-Live" webcast presentation, live from Children's Hospital Boston, in Boston, Massachusetts. During the program it's easy for you to make referrals, make appointments, or request more information. Just click on the buttons on your webcast screen and open the door to informed medical care. "OR-Live," the vision of improving health.

Well good afternoon. Welcome to Boston. This is the Children's Hospital of Boston Craniofacial webcast. We're going to be discussing a very interesting case of a frontal encephalocele and an arachnoid cyst. I'm John Meara from the Department of Plastic Surgery, and we're fortunate enough today to have Dr. Ed Smith from the Department of Neurosurgery, and David Walton from Partners in Health.

Ed, I'm going to let you lead off, and maybe you could walk us through a few of the slides just to lay some ground work for us about the frontal encephalocele.

Yeah. This is a case of a young boy from Haiti, and we'll talk in a minute about how he came up here to Boston, I think. And then maybe David can talk a little bit about that in just a second.

Uh-huh.

But essentially what we have is a young child, and if you look at the slide we have up there, who was seen down in Haiti to have this large deformity in between his eyes. This is something that was noticed since birth and seemed to get progressively larger over time. As you can see from the graphic, there is a hole, actually, in the skull and this resulted in brain protruding out in between the eyes. And I wonder, Dave, if you can talk a little bit about how he came up to Boston so we were able to see him when he arrived here at Children's.

Absolutely. So Dumanel lives in Haiti, actually in rural Haiti. And Partners in Health is a 501C3 public charity that's based in Boston, focused on health care actually, remediating health inequalities amongst the poor in developing nations and right here in Boston.

And Dumanel initially came to our attention about a little over a year ago when we were partnering with Operation Smile and actually focused on finding patients with cleft lip and cleft palates. However, we had a radio announcement where we were actually seeking patients with any kind of deformity, facial deformity, and actually that's initially when Dumanel came to our attention.

Actually, John Meara, who is here with us on our panel, in addition to several other surgeons, immediately identified the deformity as a frontal encephalocele, and given the complexity of the case knew that we needed to get Dumanel to Boston rather than doing any type of surgical intervention in Haiti. And thankfully, we have a great relationship with children's Hospital Boston, and after several months of getting visas and passports, et cetera, Dumanel actually came up to children's hospital Boston to have his operation.

David, thank you. And I think later in the presentation I'd like to talk to you a little bit more about Partners in Health and the collaboration. But now, Ed, maybe you could talk to us a little bit about frontal encephaloceles and our approach to these.

Sure. So as was mentioned by David, one of the things that was found here was that he had this encephalocele, this mass in between his nose, and there are many different kinds of encephalocele. What an encephalocele is essentially a bit of brain herniating or pushing out through a whole in the skull to some place where it's not supposed to be.

There are many different kinds of encephaloceles. The two most common are either in the nose here in the front, which tend to be more common actually in Asia, and then the kind that is more common here in the United States, which is the occipital encephalocele, or here in the back of the head. They're pretty rare. You're looking at about between 1 in 5,000 and 1 in 10,000 births.

But in general, when they're seen, people tend to recognize that something abnormal has gone on, and the diagnosis is usually made with an imaging study like a Cat scan or an MRI, and then they get referred up here, and many times the treatment for them is surgery.

When Dumanel was diagnosed down in Haiti, fortunately he was able to be brought up here to Children's, and sometimes these can be very complicated cases to manage. We'll talk in a few minutes about how Dumanel not only had this very large encephalocele but also had another surprise, which made his management a little bit more complex.

So one thing I think would be good to talk about now a little bit is looking at what we found when Dumanel came up. In terms of what we saw, I think you can see on the slide here before surgery it was evident that he had this large defect -- sorry, large mass in between his eyes. This is what led to the initial diagnosis and had him brought up here to Children's.

As part of the evaluation, as I mentioned, what is normally done is we get an imaging study; a Cat scan or an MRI, to try and look at how big the encephalocele is, get an example of what the bone has grown like so Dr. Meara can plan his approach.

And if we look here on this imaging study here, we not only see the defect between the nose, which is the hole where the brain came through on the image on the left, but we also found that Dumanel had a little bit of a surprise for us, and you see on the image on the right a very large area of black empty space, which is an arachnoid cyst.

And in listening to Dumanel's history when we talk with him, it became apparent that he also had some weakness on the opposite side of his body, and this led to us talking about a little bit about how we'd manage him surgically and really highlighted sort of benefit of having a team approach, which maybe John can talk a little bit about how we got into the process of planning his surgery and what we went through and the steps to do that.

Well, thank you both, you know, for laying a little bit of ground work. Let's start looking at the surgery, and I think we'll discuss the surgery, and then I think I'd like to revisit some of the things that we talked about. This will show you as he enters the OR here, so this is getting him prepared. This is one of our OR nurses, and you really get a good shot of the mass in between the eyes there. That is one of our anesthesia folks there who is working on getting him prepared. And, Ed, very briefly, any anesthetic issues particularly to these patients?

So obviously with any child that's undergoing surgery, one of the things that is important is children aren't just little adults. And we benefit here at Children's, obviously, from having trained pediatric anesthesiologists that all they do all day is deal with children. The physiology is different.

What's particularly important, though, is that one of the things about Dumanel is that he has this intracranial problem, this large cyst, which is putting pressure on the brain. And so it's very important that

as part of undergoing anesthesia and all the shifts that happen with blood pressure and, subsequently, brain pressure, that you have a team that's dedicated, and we work with a very close team of neuro-anesthetists to help us with this.

And what you saw there just briefly was the head frame that holds him in place so that nothing scary happens while we're operating, and then once we had him in position, we started on the incision so that Dr. Meara could do his work on the forehead and I could do my work intercranially. And, maybe John, you can comment a little bit about what was going on with the incision.

Absolutely. Very briefly, this is called a "coronal incision," and it goes from ear to ear. And you notice that it's not a straight incision, it's wavy, and we do that specifically so that it's less obvious. Once the hair grows back in, it's much less obvious than a straight incision. And so we're incising right down to the bone, and we'll be elevating a flap that involves skin, subcutaneous tissue, and the periosteum.

And one thing I might want to comment on here is just from the word go is there are two sort of important goals with surgery here. One is the very important repair of what is a very disfiguring problem for Dumanel, not just in terms of how he looks but in terms of the control his of his vision, his ability for his nose to grow well. I mean there's a lot of important things that have to do with his well being.

And the second goal of surgery is to control the cyst inside the brain and make sure that if it's decompressed appropriately and also to disconnect the tissue from the brain. So we have two very different aspects of how we do it, and one of them is how we fix the frontal bones. And I think this is part of the repair of the bone, and maybe John can talk a bit about what that goal entails.

Sure. What you'll see us doing here is actually marking with a sterile surgical marker on the frontal bones here. And these are the osteotomies or cuts that, Ed, you're going to be making in just a few minutes. You can see here what I'm marking is called the "frontal orbital band O." That's the straight line just above the orbits. And then what I'll be showing you in a few minute is other marks where we'll be making on the new forehead.

And I think we have a minute or two of this footage, so I actually want to go back for just a minute and talk to Dave while the audience is watching this. David, give us a brief over view of Partners In Health and, you know, how we've collaborated with you and just to give the audience an idea of what you're doing down in Haiti.

Absolutely. So Partners in Health, as I mentioned previously is a 501C3 charity. We, for the purposes of this discussion, I'll focus on primarily what we do in Haiti, although we are working, again, in countries around the globe. It was originally founded by Paul Farmer, Ophelia Dahl, Todd McCormick and others in 1983. And over the past 20 years, we've really been focused on remediating health inequalities amongst the rural and urban poor, including a program here in Boston.

But in Haiti, again, we're really doing what we call "horizontal" -- actually much more than just horizontal care. Meaning, you know, I'll compare and contrast what we do versus what, say, you know, Operation Smile came to do for that particular trip. Meaning Operation Smile came, you know, we're collaborating with them, and they came for a very specific purpose, which was to focus on cleft lip and cleft palate.

But obviously people have all kinds of surgical issues that need to be addressed from cleft surgical cleft palate to acute appendicitis, to a frontal Encephalocele to, you know, any number of conditions. And so, you know, we're focused on everything, anything that comes through the door; prenatal care, primary care, vaccines, really the basic tenets of public health. Did you want to comment?

Well let me just interject for a minute so the audience can see what we were doing there. That metal device that I was using is called a "Marchack Template," and I'm using that to make a new forehead. So that Marchack template is really an idealized forehead, and we slide that around on the skull and then mark out what will be essentially a perfect contour.

And Dr. Smith is going to remove that bone for me, then, to work with that on the back table. And you can see those two lines that I'm pointing to right there. That's extra bone that's going to eventually be moved -- or removed. And you can see how I was indicating with my fingers that we're going to slide that frontal orbital band O together to decrease the width in that area.

And, you know, just following up on David Walton's comments, I think it's really important to highlight the fact that, you know, Partners in Health does a wide diversity of procedures down there, and the very special part of our collaboration is we're able to work with them to provide an area of expertise, which in our case is cleft and craniofacial care. And so it's a very nice collaboration. You know, here at Children's Hospital, this type of care is certainly part of our mission, but we could not do that without Partners in Health. So we're very grateful to the collaboration there.

Now here we're marking out the rest of the frontal bone. In and in a few moments here, Ed Smith is going to be performing the craniotomy and removing that. And actually up in the other -- on the right hand of the screen, if you could take a look at the slides, you can see diagrams of what I have marked out on the skull. So you can see the lines where we're going to cut the new frontal segment and how we're going to bring that frontal orbital O together. And then after -- while Dr. Smith is performing his craniotomy here, and I'll let him describe that, I'm going to be on the back table working on these bone segments.

So in looking here now what we're doing, this is an aspect of the operation called the "craniotomy," and the goal here is to try to remove the skull over where we'll be working. We have to be able to get to the encephalocele to where the part of the brain is that's coming out through the nose, and that allows us to disconnect. And we'll talk about that more as we get to that.

The other thing we need to be able to do is to get to the arachnoid cyst, this big bubble that's inside the head. Now arachnoid cysts are something that are generally pretty common, and we tend to find that about 1 to 5 percent of people in if United States have a cyst. They probably never know they have it. They live to a hundred years old, and they do great.

In Dumanel's case, we think that interestingly, he had this weakness on the opposite side of his body because it's a very large cyst and seems to be pushing on the brain. The other thing is probably he had a little bit of almost a pop-off valve. And by that, I mean the cyst was growing over time, we think, and instead of making him very sick very fast with headaches or weakness, getting worse very quickly, he was able to decompress a little bit by having some of the brain actually go out through the Encephalocele. And when we talked to dad, he described how the encephalocele was getting bigger over time.

In order to try to treat this arachnoid cyst, when the ones that are symptomatic, the ones that do cause problems, what we have to do is somehow deflate it to make the water inside of it, the spinal fluid that even has inside their brain, get into the normal pathways of spinal fluid. And the analogy I would give you here is kind of like if you had a balloon inside your sink, and normally water can flow around the balloon and drain down the bottom of the sink. But if the balloon fills up with water by itself, eventually over time it's going to clog up your sink.

The goal of surgery here today once we remove this bone, as you see that we're doing here in the surgery, is to identify the arachnoid cyst, deflate it, and then under the microscope we're going to try to create some tiny holes in this balloon, this arachnoid cyst so that it can drain the spinal fluid in the normal pathway, and hopefully by doing that we will allow him to lose the pressure on his brain and hopefully cure the arachnoid cyst.

When people are found to have arachnoid cysts, most of the time we do nothing. Generally kids are found to have it when they fall on their bikes, they hit their head, they get a scan, and generally they really have not much to worry about. It's important though, if you have a child who might be symptomatic where they have worsening headaches, they're vomiting, they may have weakness or change in their vision, what they need to do is get evaluated.

What we would do if we thought there was a problem, which is just what you see here in the video, where we're stripping the lining of the surface of the brain, the dura or the meninges, away from the bone, and you can see us using an instrument for this. And the idea is to kind of remove the skull from the underlying tissue kind of like you might pull, for example, an orange peel off of the underlying orange.

We have to be pretty careful when we do this because there are some important blood vessels under there. But I think you'll see in just a minute as we're working together is that what we can do is give this piece of bone to Dr. Meara, and he is going to be able to use that to configure the forehead. And he'll talk to you about that in just a moment.

And then what we're going to see is the lining of the surface of the brain, and we're coming on that right now. And again, that's called the dura. Once this is all freed up, we'll be able to do our work as neurosurgeons to drain the cyst, and then Dr. Meara can do his work in treating the encephalocele.

One other thing I might just mention in terms of the arachnoid cyst is being able to identify the ones that are problem causes and which ones aren't, and clearly in Dumanel's case, this was the story.

I wonder a little bit now, John, if you might want to talk a little about what you might be able to do with the bone or where you're going to be as we go through this, and then I can talk a little bit about maybe what we're going to see as we drain the cyst.

All right. Well, let me just say we have some interesting e-mails coming in already, and maybe we can touch on a few of these while people are watching. We have a comment from Aaron here asking, "What is the risk of this developing later on in life into cancer?" And, you know, my understanding is that there is no risk. But what's your understanding of that?

Yeah. So I don't know if that's regarding specifically the arachnoid cyst or specifically the encephalocele. Clearly, the arachnoid cyst is not cancer. This is a cyst, a bubble, a lining of the surface of the brain. This is something you're born with, as best we know. And really there's no concern this will develop into cancer or any kind of problem. It's kind of like a birthmark.

And as you can see here, the reason that those cause problems is because they put pressure, you almost see like a tight balloon there, and what we're doing is a putting a little needle in to drain the fluid.

In terms of the Encephalocele, again, this is presumably -- initially this might have been normal brain in gestation and before you were born, but the brain once it's herniated out, once it's gone where it's not supposed to go, it's no longer functional brain. It will not develop into cancer or tumors or anything bad, but it is something that can cause problems like we talked about. So in terms of Aaron's question specifically I would comment that I don't see any worries about cancer or tumors, but they can cause problems, and those are the things we're discussing here in the video now.

All right. So really the goal of the surgery is to redirect the CSF fluid from the arachnoid cyst standpoint. And then the goal for you and I, in terms of the encephalocele, is to remove that portion of non-functioning brain and to reconstruct the calvarium in the nose.

Yeah. So right here now, I think, for example looking at the arachnoid cyst part of things, once we're able to drain this fluid out and we've relieved a lot of the pressure, I think you get a sense of from when we opened up how tight that was and how much pressure that might have been putting on Dumanel's brain.

You can see in this syringe there what the spinal fluid looks like. It looks just like water. But by relieving the pressure immediately, it makes it easier for us to work around the surrounding bone to relieve the pressure on the brain. And then in a few moments what you'll see is we're able to open the cyst up, and once we are able to open up the cyst, you'll see this sort of thin membrane over the surface of the brain. That's why it's called "arachnoid." It kind of looks a little bit like a spider web.

I think what we'll see right now on the video when we talk about the arachnoid cyst, this opening, this lining of the surface of the brain, this dura, and you can see now that it's deflated, we're able to easily handle it. And as we open this up, you see spinal fluid leaking out, and here you see the sort of membrane of the actual cyst itself. This was the bubble that was causing the problem for Dumanel, and the hope here is that by decompressing this, we can cause some relief to the brain make things hopefully feel better for him.

I would comment that there are a lot of different ways to treat this. Sometimes you can treat it with fenestration, which is what we're doing here. As I mentioned, you make a little hole to drain it. Sometimes you can put in a shunt or a little tube to drain the fluid. And many times you don't need to do anything.

Right here what we're doing is opening a tiny hole in the bottom of the cyst. And if you look at the graphic right now you have on the slide, you can see how we're oriented all the way to the right where you see the child's head, and then what we're looking is that red structure right there is a major artery called the "carotid artery," and you see that I'm sort of picking this filmy substance, this arachnoid, basically, off the carotid artery. This is the inside part of the bubble of the arachnoid cyst.

And the hope is here, as you can see there, by opening this bubble up, we're going to be able to allow the spinal fluid to drain through this hole at the bottom of the bubble. And you can see again on the slide some arrows indicating the space I'm working on between the eye nerve, the optic nerve up above, and the carotid artery, the big blood vessel down below. And as I work in there, you can see that you make a nice hole, and the hope this will allow the spinal fluid to drain away.

Well, Ed, thank you. You're too modest to say this, but this is certainly the most elegant portion of the procedure. And I think what if audience needs to know about is that, you know, the potential complications of this not working and the potential issue with shunts and shunt infections.

And, you know, David, I'll ask you since you really have a good understanding of the Haitian health care delivery system, you know, with a child like this who has a shunt, you know, what do they have available to them in Haiti, and is that a potential problem?

Well, that was one of our concerns kind of coming into this procedure is whether Dumanel would actually need a shunt and come home to Haiti with a shunt. The ability to care for a child with a shunt is actually difficult, I think, in general even here in the United States, but especially in Haiti. There are so many complications that can arise and, again, many emergencies that can arise in children with shunts.

You know, Ed can speak to this much more than I can, but I can tell you that from the standpoint of managing shunts in Haiti, it's actually very difficult. And if there isn't a neurosurgeon on hand to deal with some of these complications, which we don't have, except in the capitol city, which can be difficult to access, shunts can be pretty dicey in term of management.

Uh-huh. I would comment that, you know, shunts are a great thing, and if children need them they can do very well. One of big issues here I think specifically with Haiti is that although shunts are great and they save a lot of kids lives, they're mechanical tools and they can break, that can clog. If you have access to a health care system nearby where the tube can be fixed and the shunt can be replaced, hopefully it's not a problem.

Obviously, in Dumanel's case, the big issue is that he does not have easy access to this, and that's what made us a little more hopeful that be doing the kind of work you see here on the screen, by opening the cyst up, by allowing it to drain, we can try to avoid using a shunt. There are some cases you just can't get around it and you need shunts. But we are very fortunate with Dumanel to be able to attempt this type of drainage, this is called "fenestration," and fortunately it seemed to work out pretty well.

You know, I think there's a lot of different things about his health-care delivery which is very important in terms of how you manage this. So maybe, John, we can talk a little bit about the strategy of how we

scheduled the surgery in terms of what steps we took and how we worked around figuring out which parts to do and in what sequence.

Well I think that's important because I know you and I were concerned about whether we should do this sequentially, whether you should deal with the arachnoid cyst and then wait and then come back and do a secondary procedure, or whether it was fine to just do all of this at once.

Obviously, you know, in terms of length of anesthetic and number of procedures, we were hoping that this was something that could be handled at first -- or at once, I should say. And I know that you spent some time talking with your neurosurgical colleagues. And what was their feeling and what was your feeling about, you know, the pros and cons of combining them versus, you know, doing them separately?

Yeah, so again, a little bit of a tough question. You know, one of the nice things, we have a nice multi-disciplinary approach to looking at it here at Children's. We also have a big group of neurosurgeons, all of who are pediatric fellowship trained -- I mean pediatric board certified pediatric surgeons, and we were able to sort of put our heads together and say with this complicated problem and say, what's the best way to address it.

Our goals were to try to treat the cyst, treat the encephalocele, do it with a minimal number of operations and have him be shunt free at the end, which, for those viewers who don't know what a shunt is, it's a little plastic tube that goes from the cyst down to the tummy and then drains the fluid to the belly, and not actually where the food space is, but in another area that can reabsorb the fluid called the "perineum."

And so what we did is if you look at the graphic up here on the slide, you can see the large cyst on the left labeled "before," and then our thought was that at the same time during surgery, if we're able to open this up, it would allow for better healing for the child, reduce the number of operations he might need, and the hope here was to treat the cyst first, disconnect the encephalocele, the part of the brain that was out where Dr. Meara had to work, and then with that in place, leave in a little drain, a little tube, and you'll see that in a few minutes here in the video.

The goal of leaving in the little tube would be to allow us to assess whether the drainage worked, if the cyst actually deflated and then also would allow to reduce any tension on the incision, so that as things healed Dumanel would be able to not have any pressure on his suture lines or anything like that, and you can see on the slide here a marketed decrease in the size of the cyst on the after image and also you can see that the brain is much more relaxed. Previously the brain was pretty squished before we trained the cyst, now it's much more relaxed.

At this point we're just finishing up on the video, sort of coming around where the last little bits of the bubble, this arachnoid cyst were, and at that point, we're able to talk with the Dr. Meara about his strategy for, you know, what he's working on at this time while I'm working on the brain.

So at this point in the video, you have successfully managed the arachnoid cyst and you're beginning to do the dissection of the encephalocele from the inside, and I think we have a few more shots of that.

In a minute or so, David, I want to get back to Haiti, and I wonder if you could comment on, you know, what is the role of surgery in Partners and Health? How important is that? You know, how should we work together in providing surgical care?

You know, surgical care, we feel, and I think most people feel, surgical care is one of the tenets of health. You know, I am an internist, and there's only a limited amount that I can do medically. But if someone has a surgical issue, wherever they may be, whether they're denizen of Boston, Massachusetts, or rural Haiti, you know, they need the expertise of a surgeon. So, you know, having surgical care from something like this or, say, to someone having appendicitis is really a basic service that one needs, really, to consider one's self-having access to care.

And so we strive to do that in the central plateau of Haiti with our Haitian staff. We do have Haitian surgeons who, you know, working several of our hospitals across the central part of Haiti. But we are currently, again, in collaboration with Children's and with you, John, looking to increase the capacity to do surgery. Not something, say, like this surgery, but, you know, something a little bit more basic in terms of general surgery and of some of the other things we can do, and also increase our ability to deliver this kind of care.

And so that's why I think this collaboration, not only the collaboration that we have with Children's to send children who have very, very complicated issues here to a center of excellence to be able to do these surgeries but also having people like you and other come down to Haiti, help our Haitian surgeons with different ways of looking at things and allowing us to increase our capabilities of taking care of the Haitians, our own medical staff, taking care of people of Haiti.

That's a great point. And I think one of the most important things is to highlight the fact that, you know, what Partners in Health has done is has provided surgical care, for example, that's appropriate for that venue and collaborated with academic medical centers for care that really can't be provided in that venue, so think it's a wonderful collaboration.

Now, Ed, going back to the video, can you just give us an idea of what you're working on at this moment.

Yeah. So if you look at the graphic now we have up here in the slide, essentially what we're looking at is the front of the brain is off to the left of in the video and the encephalocele, the part of brain that isn't healthy and isn't, you know, functional anymore is off to the right.

What we're trying to do with these little blue, essentially tweezers, called "bipolars," is to cauterize the tissue between the healthy brain on the left and the unhealthy brain on the right, represented by the dotted line, as you can see on the slide. The hope here is that by disconnected these two, I can free up the part inside the brain, and John can work on his part outside. So I think we're going to come back to these pictures in a few minutes, and we have a couple of questions now maybe to address here in the studio.

Sure. Sure. Let's just take a moment for a break here. I have an interesting question from Antonio. He said, "What is the earliest age you would do this procedure?" And that's a fantastic question. And I think part of it depends on the individual patient in the sense that some of these children with encephaloceles are born without adequate skin coverage, and so that's a bit more of a neurosurgical emergency.

In Dumanel's case, he was fortunate to have excellent skin and subcutaneous that was covering that. So I think from my perspective some of it depends on the way patients present and whether they have exposed brain or whether they have excellent covering. Ed, any other additional comments about timing from a neurosurgical standpoint?

So obviously I think you've hit the nail right on the head. One of the big questions is if there is an opening, if there's something where the child is symptomatic then we would be more inclined to treat it earlier. And obviously we have children we treat very shortly after birth while the mother is still -- while the child is still in the nursery.

On the other hand, there are other kids like Dumanel where we can delay, it in a fashion. We don't want to wait too, too long. But sometimes if they're a little bit older they can tolerate anesthesia better.

When you talk about the arachnoid cyst, it can be treated any time it is symptomatic, if we have the luxury of waiting, we try to wait until they're at least a year or two old, and the reason for that is that the little holes that we make in the arachnoid cyst to let the fluid drain are living tissue. And if we get them too young when the child is growing very quickly, sometimes the work we do to those holes up can seal right back up again as the child grows.

So the timing of surgery, if we're forced to do it, we do it whenever it needs to be done. But if we have the luxury of waiting for a little while, sometimes we'll try to do that later on. And so usually about anywhere from about one to two years of age.

All right. Great. I think it would maybe be also useful to just compare and contrast what the workup would be, say, if Dumanel was born here in the United States and you saw this deformity right after birth versus really what we're able to do in Haiti, and I can just to start that conversation.

You know, when Dumanel presented to us during the screening process, you know, we readily and immediately identified this lesion. But, again, there's only about two functioning Cat scanners in Haiti. There is no capability for MRI, and so obviously part of the workup on our end was to get a Cat scan, which we did, and some basic blood, but other than -- and some basic imaging in terms of X-rays, infectious workup to make that he was a good candidate for surgery. But really, after that, we were hamstrung in our ability to work up Dumanel any further.

So can you just give me an idea of what you would do for Dumanel, say he were born here in Boston in terms of the work up?

So as you've heard at least from a neurosurgical perspective, there are really two or three things we want to look at. One, we would want to get a sense in terms of what the actual lesion looks like. Sometimes there's actual brain, an encephalocele that's out where you see the mass on the forehead. Sometimes it's just spinal fluid. And that obviously makes a very different kind of surgery. So we get a Cat scan or an MRI in order to see that. We'd also want to get a sense of what the bony anatomy is like, which is relevant not just to myself as the neurosurgeon but also to Dr. Meara from a plastic standpoint.

And the other thing I would comment on is that we have the benefit here at Children's to have a lot of multi-disciplinary teams where it's not just the surgeons looking at them, but if necessary, if the child is a little older, sometimes psychiatry, you have anesthesiology, you have a lot of different folks, sometimes otolaryngology. These are sometimes complex lesions, and we have a lot of different teams that work together to try to provide coordinated care.

One of our hopes, I think, in working with Partners of Health, is to try to provide this sort of coordinated care and multi-disciplinary efforts that we have here at Children's, and hopefully bring some of that sort of multi-disciplinary work to the folks that need it all around the world.

All right. Well thank you. Let's go back to the video and discuss where we are in the procedure at this point. So Dr. Smith in this portion is removing the encephalocele. So it's important to note that he's working on the inside, and he's going to separate the encephalocele from the functional brain, and I think we mentioned before that this encephalocele is not functional brain. And he's going to be removing this and then repairing the dura.

And then after that, we're going to go to the outside and will be reconstructing some of that.

So, Ed, in terms of this portion of the procedure, is there anything in particular that the audience needs to know about?

Yeah. So I mean I think what this does is it really highlights what the root of the problem is. I think anyone can really see on the video here on the left-hand side you have a nice healthy looking brain, and on the right-hand side you have sort of a grayish abnormal tissue, and that's sort of what we're dissecting here with the bipolars, the little cautery equipment.

The hope here is that we want to preserve all the healthy neural tissue that we can, but we have to at some point amputate, disconnect the unhealthy nonfunctional tissue in order to be able to close up the spinal fluid space. And so what we're doing here is with the bipolars, cauterizing the unhealthy tissue, amputating it so we can remove it. I won't remove every last bit, rather, I'll just try to get the stump, essentially, that is, up to the hole that goes through the bone.

Once I'm able to do that, that will allow me to repair the lining of the brain, the dura. One of the concerns with these children who have encephaloceles is a leaking of spinal fluid into places you don't want it to go. In Dumanel's case, obviously one of the concerns is whether it would leak under the skin, which could affect wound healing, or if there was any connections potentially down in the nose.

One of the other kinds of encephaloceles that we see and is also somewhat common in the United States, there's sphenoidal encephaloceles or nasal encephaloceles. These are holes that you may not see outside but can be inside the nose itself. And the problem there is if there is a hole in the lining of the spinal fluid -- lining of the brain and the spinal fluid can leak in the nose and spinal fluid can get out, then germs can get. So this is a pretty critical portion to be able to establish a boundary and then be able to seal that boundary so that we keep the spinal fluid where we want it and not let the brain go where we don't want it to go.

So the important part is really the repair of the dura and making sure that you have watertight closure right over the area that I'm going to be reconstructing the bone.

Exactly. And this is something where I think you and I work in tandem in the hopes of being able to decide where the boundary would be to be able to say this is the point where we can close things up pretty well. You see they're removing some of the tissue.

And then what we're going to do here, I'm picking up the lining of the brain here, the dura, the meninges, and by establishing an edge there, we'll have a sharp edge, which we can sew to and establish that closure. We see with encephaloceles in other parts of the brain, for example occipital encephaloceles, we can sometimes be able to reduce the risk of spinal fluid leaking after surgery. Now I see John, you might have a question for us to address.

Well I have a few more interesting questions here. Michele asked us a couple. How long did the procedure take, and what does the future hold for the child? And I think in terms of length of time, the actual operating time, I believe was four to five hours from the time we started until the time we finished. And then there were like one or two days of ICU observations.

In terms of what the future holds, you know, I think we already know, since we've seen Dumanel back in Haiti, actually, in December, that he's doing extremely well. And the motor function on his left side is improving. I'm curious. What are your thoughts about extensive improvement of motor function.

Well, you know, the hope here is that since he has a healthy brain and we have obviously been able to decompress his cyst quite a bit. If you take a look, for example, at the slide now, you can see that the brain had relaxed quite a bit. His underlying brain is healthy, and the hope is that he would regain pretty much all his function. Now in all cases that's not always possible to do, but specific to Dumanel, I think he's got an excellent prognosis.

David, we have an interesting question here. It says "How long will the child receive follow-up care from Haiti." And I think it would be helpful for the audience to understand the accompan'ture system in Haiti and what a wonderful idea that was and how you can provide incredible follow-up coverage.

Sure. So first of all Dumanel, we have a series of seven -- actually nine clinics and hospitals, soon to be 10, and Dumanel came from an area right outside of one of those clinics. And so right when we identify a child or an adult with a problem such as this, or really, any kind of chronic medical condition, in this case we just need -- he doesn't have a chronic medical condition, but we needed to obviously do follow up on a continuous basis pretty closely for the next, you know, indeterminate amount of time. And so we have a system of people who work for the hospitals who live in the community.

They do a number of things. They're called -- essentially they're called "accompan'tures" or "community health workers." And they help us; the physicians, nurses, et cetera, be able to treat patients in their homes essentially. And so if someone has a chronic disease like HIV or tuberculosis or heart failure or

diabetes, these community health workers who are actually people in the town or village in which the patients live, can help administer these medications.

They can directly observe therapy, meaning the patients will never miss a dose because the patient -- because the community health worker is observing the patient take the dose.

In Dumanel's case, he is not getting continual medical care in the sense of getting medicines every day, but he is getting frequent follow-up appointments both by the physician in the clinic, and we have people going by his house at least once a week to make sure that he's doing okay, to make sure that he doesn't have any harrowing signs or symptoms that would be worrisome for us, that would require him to come back to one of the hospitals for us to do an additional workup and then potentially coordinate over e-mail or phone or Internet with the staff here back at Children's Hospital.

I've actually been very impressed with how thorough your follow up is. You know, for example you were mentioning to me earlier that Dumanel had a cold, and his physician called you directly on your Haitian cell phone and made contact with you. And, you know, that's remarkable. Within hour you knew exactly what was happening to him, and he lives how many hours from Conch.

He lives about eight or nine hours from our kind of -- what is equivalent of a Tertiary care facility where we see our most complex patients.

It's a fascinating model and it's been highly successful. So I guess the point to make here is that we're very comfortable in the sense that we do have adequate follow up and we have a system that can provide that type of follow up.

So let's go back to the video for a moment there. You know, we're on the portion here of reconstructing the forehead, and you'll notice in the slides, and I think you're seen these before, there are certain areas that we cut and removed. And you can see bottom left how we're going to replace those bones. And you can see in the video the actual bones that are used there.

And notice in the what we call the "frontal orbital band O" there's going to be that central section that's going to be removed. And Dr. Smith alluded to that earlier in the sense that the eyes are too far apart because of the protrusion of the brain. So we're actually going to be removing a part of that bone and moving or sliding the orbits together so that the medial portion of the eye is closer together, that the medial portions of both eyes are closer together.

So here you can see I've done that, I've removed the bone, and I'll be putting those pieces together. And here, on that greater frontal segment there, you can see the markings from that marchack template, and this is the idealized segment that we're going to be using. It has the right convexity, and will be connecting that piece to the band O. So by the time you remove that and we actually suture that to together with the band O with resorbable suture, you have a very stable construct.

And then you'll see in part of the video where we are actually using plates and screws, but the interesting thing to mention here is that, you know, maybe a decade ago, Ed and I would have been using titanium plates and screws, but now we're using resorbable plates and screws that are actually made out of the same material that the suture material is made out of. So after 12, 18, 24 months, that plate and screw actually just disappear, which is nice because then you don't have a foreign body in there for the rest of the child's life.

So that's the new frontal segment there that was marked out with that template that you can see in the bottom left corner. And this is how things are going to fit together. And actually you notice in the slide there on the right side of the slide, that is after we have connected these segments back together, and those blue/purple sutures are what are called "PDS sutures," and those actually hold those segments together, and it's remarkably strong. Those sutures are quite strong.

And then on the side of that band O, in a moment or two, you're going to see the plates that are used to rigidly fix that entire construct to the remainder of the calvarium.

And I might comment here, John, you know, certainly this is an unusual case that we see with Dumanel. One of the things which is nice here at Children's is we have the Craniofacial Clinic. I know that a number of us from the Neurosurgery Department, including my colleague, Mark Proctor, who has a lot of experience with these cases, yourself, Gary Rogers, a number of other folks, all have worked together in these very complex cases, not just with nasal encephaloceles but many different types of cranial deformities.

And I think this highlights one of the nice things that we have here at Children's, where it's not just one person dealing with one problem. We have a whole bunch of different folks with different specialties working together, and it makes it a lot easier to sort of tackle either garden-variety stuff that comes in off the street or complex stuff that comes in from halfway around the world.

And I think this was a case with Dumanel that required a whole lot of thinking from many different groups, but we had the infrastructure in place to sort of help us address that from the word go. I don't know if you want to comment at all about any of the other types of cranial deformities or skull deformities that maybe you see in your practice here at Children's.

Well I think that's a critical point, and another point that's close to that is the techniques that we're using here in terms of cutting the bone, removing the bone, putting the bones back together, the rigid fixation. These are techniques that you and I and Mark and Gary Rogers are using for a number of different things.

So whether it's a tumor that we're removing this the brain or in the skull base, whether it's an encephalocele, whether it's something called "Craniosynostosis," the techniques are very similar, and we're just modifying them and adapting them to the pathology. So I think that's an excellent point. So even though this is an extremely rare condition, we are doing things similar to this on a fairly regular basis.

So here you can see there is a new piece of bone we have introduced here, that and that's going to be the nasal reconstruction. And I want to touch on one issue here, and that is, one of the deformities that this type of encephalocele causes is something called the "long-nose deformity." And so when you're reconstructed the frontal orbital band O and the nose, that's an important thing to address in reducing the length of the nose, reducing the excess skin.

And so we'll see that in just a few minutes, and actually you can see the slide. You can see the completed reconstruction on the left. That's a CT scan and the diagram on the right. But I think we should go back to the video just for a moment here. Ed, what portion are you doing right here?

Well, so this is the part we talked about earlier, which is the dural closure. As you remember, the dura is the lining of the brain, and this is obviously a very important barrier that keeps the good stuff for the brain in and the bad stuff from the skin out. This is something that's pretty routine for pretty much any kind of neurosurgery that we do. It was obviously a little bit more complicated in Dumanel's case because he had a hole in this lining of the brain where the encephalocele came out.

Through some work with amputating the encephalocele, the bad part of tissue that wasn't working, we were able to establish a new boundary and seal this up. And I think you can see this almost leathery covering over the surface of the brain.

One of the concerns that we thought about specifically in Dumanel post-op and in my of the patients that we treat is that our worry is that if this suture line that we're making doesn't hold water super well, then fluid can leak out through the seams basically and build up pressure underneath the scalp, and that pressure can inhibit healing and make the hole repair at risk.

So as you see at the bottom of the video screen here, there's that white tube, and I mentioned earlier there was an external drain, a catheter that we left in the spinal fluid space. What this does is drain the

fluid out and try to keep the pressure nice and low inside the cyst cavity that used to be there, in the hopes that this suture line that you're watching us sew together here can heal up well.

I think that this is something that, whether it's a surgery for an encephalocele like you see here, or for any of the types of brain tumor surgery or other types of craniofacial repairs where you have to remove part of the tissue surrounding the brain, this is a very important part of the structure -- part of the repair and something which, you know, we work together with the plastic surgeons quite a bit.

I have another interesting question here. We've touched on a number of issues. But Abu Bacher asks, "What is a common complication encountered in this type of operation?" And I think, Ed, you mentioned a number of things, so CSF leak, infection, which you mentioned, the importance of adequate closure. There could be infections of the bone.

We also touched on the fact that one of our concerns was re-accumulation of the arachnoid cyst and the requirement for some type of a permanent drain. I think those were probably our major concerns and, you know, I think as we discussed yours and my major concern was the re-accumulation of the arachnoid and the reliance on a permanent drain. Are there any other major risks that we need to be concerned with?

Well I think any time you operate on the brain, maybe not as much with Dumanel, but in other surgeries on the brain involving tissue that isn't quite as healthy, you run the risk sometimes of seizure if the brain is irritated by the operation. And then the other issues in terms of, you know, infection, and then bleeding, obviously, in the surgical cavity or at the site where you remove the edge of the brain.

As an example of that you see we're putting up some stitches along the lining of the brain attaches to the skull, and the purpose of this is to make sure that the site where the cyst was isn't so deflated that it leaves an extra sort of potential space that can fill up with blood. And so on the one hand we want the brain relaxed so that there's no pressure hurting the brain, but we don't want it so deflated that it creates an abnormal cavity that can fill up with blood or old tissue. So those are some potential complications from a neurosurgery standpoint that we have to manage.

What you see here in the video is a little piece of Gelfoam, a kind of tissue that helps us deal with healing and reduce the risk of spinal fluid leaks. And then, again, you see me handling the drain there, which we're going to tunnel out so that it's under the skin a little ways to reduce the risk of leaking.

And I think, John, I don't know if you want to comment at all in terms of how you tend to deal with these in terms of your closure and making sure you work around them when you are working on the skin there.

Well, I guess there are a couple issues here, and one is, you have now put a drain that goes through the dura, and when we close the skin, we also put a drain that was on top of the bone. So, you know, you and I remember we discussed issue of, you know, removing the outer drain first and making sure that we left that second drain in to be sure that the CSF problem wasn't an issue, and also just a very practical issue, when we're closing this wound up and you have that CSF drain and you also have the subcutaneous drain, you have to be careful that you don't put any sutures through that or keep that locked to the skin. So, you know, we remove these things on the floor, on the ward, and you want to make sure that that's not tethered inside.

While we're still on this portion of the procedure, actually Joanne just e-mailed us, and she said, "If the arachnoid cyst could not be completely removed, what are the statistics that it could refill?" So when you were talking to your neurosurgical colleagues, did you have some idea of maybe what percentage chance this had of working as well as it did?

Yeah. So a couple of things, so first of all with the cyst, it isn't always necessary to remove every last bit of the cyst. Sometimes, just like a balloon, if you just put a hole in it somewhere the balloon will deflate. Obviously the bigger the hole, the less likely it is to fill up again. But, you know, one of our concerns is

just making sure we have a good fenestration and a good opening, and that's something that you determine at the time of surgery.

The risk factors for trying to figure out if a cyst is going to be recur or become a problem center on a couple different things. First of all, the age of the child, and as I mentioned, kids under the age of one or two years are at slightly higher risk; the size of the cyst, the bigger the cyst, the more concern you have about the ability of the brain to handle all that extra spinal fluid to reabsorb it. And then if there's anything else associated with the cyst, for example, if there was any bleeding prior to the surgery, that protein and debris can sort of clog up the little pores and absorb spinal fluid.

In general, and again, depending, you know, on what literature you read and where you go, a rough estimate would be to say about two-thirds of patients to three-quarters of patients who get cysts fenestrated, have a lifetime or long-term cure, and about a quarter to a third end up needing a shunt. Again, there's a lot of specific variables that change from case to case, but that's a rough estimate.

All right. Well let me just describe briefly what we're doing here, and then we have a few more question and I want to get, Dave Walton involved again. You know you heard me mention the long-nose deformity issue here, so what we're doing is, number one, dissecting down to the encephalocele that Dr. Smith as now removed from the brain; and number two, removing some of the excess tissue so that we're not left with that long-nose deformity.

So in the coming minutes what you're going to see is my team is dissecting around the external portion of the encephalocele, and we'll be removing that, and then we'll be removing some of the skin and closing the nose over that bone graft.

We have a lot of excellent questions coming in today. There's a lot of interest, in particular, in the closure that you discussed and the complications surrounding drains, and I'll ask you a couple of them this rapid sequence. Do you use any adjunctive measures to seal the dura, fibrin glue? Do you ever use a sealant on the suture line, that's the second question? And what are the complications when you remove the catheter and there's no more draining? So I guess they all revolve around the CSF issue, removal of the drain, that type of thing.

So in general, we try not to use fibrin glue, or any type dural sealants if we can avoid it. The idea being the fewer foreign materials you have the better. But there are times where you maybe can't get the dura as strong as you'd like if or if you're concerned that it's in a location that it's difficult to reach, that you will use fibrin glue to help out.

In terms of removing the drain, one of the concerns sometimes is either if it's within a rebuttoning tissue, when you pull it out you can irritate tissue and cause some bleeding. So a number of our patients sometimes are on blood-thinning medicines or aspirin, you want to make sure that's under control before removing the drain. Usually the risk of that is very, very low in order of single percentage points or less.

In terms of the risk of spinal fluid coming back, one of the worries is if you aren't able to absorb the spinal fluid well, then spinal fluid can leak out along the track from the catheter. We tend to have a good sense of whether that's a problem or not because with the external drain, before we remove it, we can challenge the child by raising or lowering the drain and seeing if fluid comes out or not through the drain. So we usually have a pretty good way to assess prior to removal, as we did with Dumanel, to know that he would be a candidate and probably would fly with the drain out.

You know, David, I think it's important for our audience to get a better sense. I know you've come to know the family very well. What are the, you know, so to speak, barriers to entry? What did they have to do to get to see us? How difficult is it? You know, what, in terms of monetary significance, you know, to the family, what was done, because I don't think people really understand how significant or how difficult it was for this family.

It's a great point, John, and thank you for bringing it up. Dumanel, I got to know his father pretty well, who actually came up with him for the surgery. And, you know, we always ask these kinds of questions because he comes from -- although he's near to one of our hospitals where we initially met him about six or seven hours away from where he lives.

And you know when we first met him, I was very curious as to how he came to arrive for the Operation Smile screening. And, you know, he had said since Dumanel was born he had noticed this deformity and had been to a variety of places around both Port-au-Prince and other parts of Haiti and really was told that there's nothing that can be done. And so like any concerned parent anywhere in the world, you know, he really refused to accept that as an explanation.

However, there family is extremely poor. They are farmers that I do subsistence farming, and so -- excuse me -- most of the care in Haiti is fee-for-service. And so whenever -- you know, he spent many, many months looking for a solution, further becoming impoverished because he had to sell -- if he had any money, it quickly went into these, you know, medical consultations, and then he had to sell off, you know, his possessions, which in rural Haiti, include livestock or land, et cetera.

And actually Recondo, he actually had to sell two of his cows, which -- or, you know, you could think of a cow or any kind of livestock as the bank of these farmers because, you know, if they need to buy -- if they need to send their kid to school or if they need to do something, you know, that requires something of monetary value, they then sell these items that can, you know, generate some income for them.

But, again, it was really all he had. He sold the two cows, and he sold some of his other possession its, really with no answer whatsoever. And so thankfully he was able to come to the hospital where Operation Smile was working, and again, we quickly identified the issue that he had.

You bring up the issue of him selling the cow. But I think it's important to highlight the fact that the value of a cow there is about the average annual income in Haiti, so he was willing to give essentially two years of per-capita GDP, which is a, you know, huge sacrifice, and it shows you what he was willing to do.

I want to get back to the video just for a moment, and what you see me doing there is a quick twisting a wire. And what we're doing is here is performing a medial canthipexy. And I alluded earlier to the fact that we need to move the medial aspect of the eyes further towards the midline because of their displacement.

So this is titanium wire, which is very innocuous. The body doesn't react to this. And I'm using that to pull those medial canthi together, and then I actually reinforced it here with PDF suture to make sure that those medial canthi did not drift laterally. And I think at the end, there is a good picture that shows you where the subsequent position of his medial canthi were.

And you can also see how much excess skin and subcutaneous tissue there is, so that also goes to the point that I mentioned before that, you know, you can't just open these up, remove the encephalocele and then close that skin. You'll have far too much skin and you'll end up with that long-nose deformity. So surprisingly, you actually have to take away quite a bit of that nasal skin and try to put those incision lines in areas that are going to be relatively cosmetic. And, you know, one of the potential, you know, pitfalls of doing this is not adequately removing soft tissue and not adequately shortening the length of the nose.

So here you can see a situation where we are finishing up the medial canthipexies. And let's come back to the studio just for a moment. And, you know, we have a few more excellent questions that maybe we could touch on.

Saman asks, "Removing some of the brain tissue, would it damage any of the special senses?" And I'll let you field that.

Yeah. So obviously what senses are affected depend a little bit on where the tissue is that's removed. In Dumanel's case it was a frontal encephalocele, so it's located here, obviously in the front as you saw from

the pictures. The main nerves that are involved in that region are what are called the “olfactory nerves” or the smelling nerves, and those run along the base of the skull and head out into the nose. Fortunately with his case, we were able to preserve the olfactory nerves, and as best we can tell, although he’s a young child, he should have his full sense of smell.

In children with larger encephaloceles and sphenoidal encephaloceles, sometimes that’s a risk either for the smelling nerves or if they’re further back, some of the ones that are involved in the nose, for example, may affect the eye nerves and vision. So in those cases, it’s very important to get a sense of what the child’s function is like before surgery and have a good sense of what it is you’re trying to preserve and protect.

One question I just can’t resist. Sandy asks, “Why is there such minimal blood loss?” And I think the answer is, Ed, that you’re such a tremendous neurosurgeon and you never have much blood loss.

We just cut those parts out.

Let’s go back to the video. I think we have about five minutes left. So we’re getting near the end here. We’ve reconstructed the skull and we talked earlier about how we put those pieces back together. Now we’re actually going to replace these back in the patient, and this is where I was talking about the resorbable plate. So once I get this in the position with which I’m happy, I will use two plates on the lateral aspect of that frontal orbital band O just to maintain its position. You know, when bring that coronal flap back, it tends to pull that whole segment back, so I use those rigid plates to keep that exactly where we want it.

And the other thing I’ll mention is that whole construct that I’m holding, in a moment, that will have the bone graft that provides support for the nose. And you’ll see that towards the end, and I had shown that final CT scan, which showed that bone graft. And that’s critical because if encephalocele came through an area where there should have been nasal bone, and I believe you can see the slide now. So on the left is the ultimate CT scan, and you can see the nasal bone graft, which essentially replaces what should have been there, which are nasal bones.

The other thing I’ll highlight in the upper left-hand corner of the screen, which is the upper right-hand corner of his skull, you can see the drain, and that’s the drain that Dr. Smith put in.

Now if you take a look back at the video for a second, you can see those plates. They’re clear plates. They look like plastic, but they are actually the same material the suture material is made out of, PGLA and PLLA, and those will resorb in 12 to 18 months or so and there will be nothing there. That gives the body adequate time to reform and redeposit bone in those areas.

So in terms of beginning to close up our discussion here, you know, in terms of recovery time, I think you can see the slides on the right, the recovery time. As we mentioned, Dumanel was in the ICU for two days, and then, you know, stayed in the hospital for another week or so after. So it was not terribly lengthy. We did keep in Boston for, I think it was, what, about six weeks, Ed, or so?

Yeah,. And again, one of the concerns here in follow up, although he clinically looked great, was the concern about whether or not the cyst would recur, and sometimes that can be a little insidious, so we had to keep an eye on things with scans and also his clinical exam. So that was one of our concerns, I think, in terms of surgery follow up, making sure not only was the incision healing well, was he, you know, having any problems with infection or fluid leaks but also to make sure inside the head that there was nothing going on that we were missing.

And in terms of, you know, following up on these other issues here, the follow-up care we discussed. The reason that I feel comfortable and the reason that, you know, Ed and I feel comfortable doing this is that we have an excellent partner in Partners in Health, and they’re able to monitor this patient and make sure that the post-op management is appropriate and that is very comforting, given the issues that Ed Smith has mentioned.

In terms of long-term management, you know I think our anticipation is that given that he's not had repeat problems with the arachnoid cyst, that he most likely will not have further problems.

And, Ed, you already discussed issues with return of motor function. And I guess I'll just comment here. You can see in the video that's the drain that, Ed, you were mentioning and that's the drain that we subsequently took out. That's the CFS drain, and we're actually suturing that in place.

In terms of other questions, we're getting a few questions here. James says, "What is the most challenging part of the procedure?" And I would definitely say, Ed, it was your part in terms of the ultimate success of this procedure, you know, your part was definitely the most important in terms of his ability to live a long life without having subsequent neurosurgical issues.

David asks, "Is there any inevitable neurologic damage after the surgery?" You know, and I guess my comment would be in this case, no, everything went very well and, Ed, you already commented on the potential return function.

So here you can see there's a slide, David Walton and I were back in Haiti in December, and that's a picture with he and his father.

And I guess to wrap up, you know, I would just like to thank all of you, first of all, David, we have mentioned the partnership with Partners in Health, and I just have to reiterate the fact that this case and the others like it would not occur without your help and Lou and Paul Farmer and all the people at Partners in Health.

And also, I'd like to thank you, Ed. As I mentioned before, you're part of the case was absolutely critical, and without having your expertise, you know, this also wouldn't be possible, so thank you both. And I would like to thank everyone who watched today, and thank you for coming to Boston with us.

Thank you for watching this "OR-Live" webcast presentation from Children's Hospital Boston, in Boston, Massachusetts. OR-Live makes it easy for you to learn more. Just click on the "request information" button on your webcast screen and open the door to informed medical care. "OR-Live," the vision of improving health.