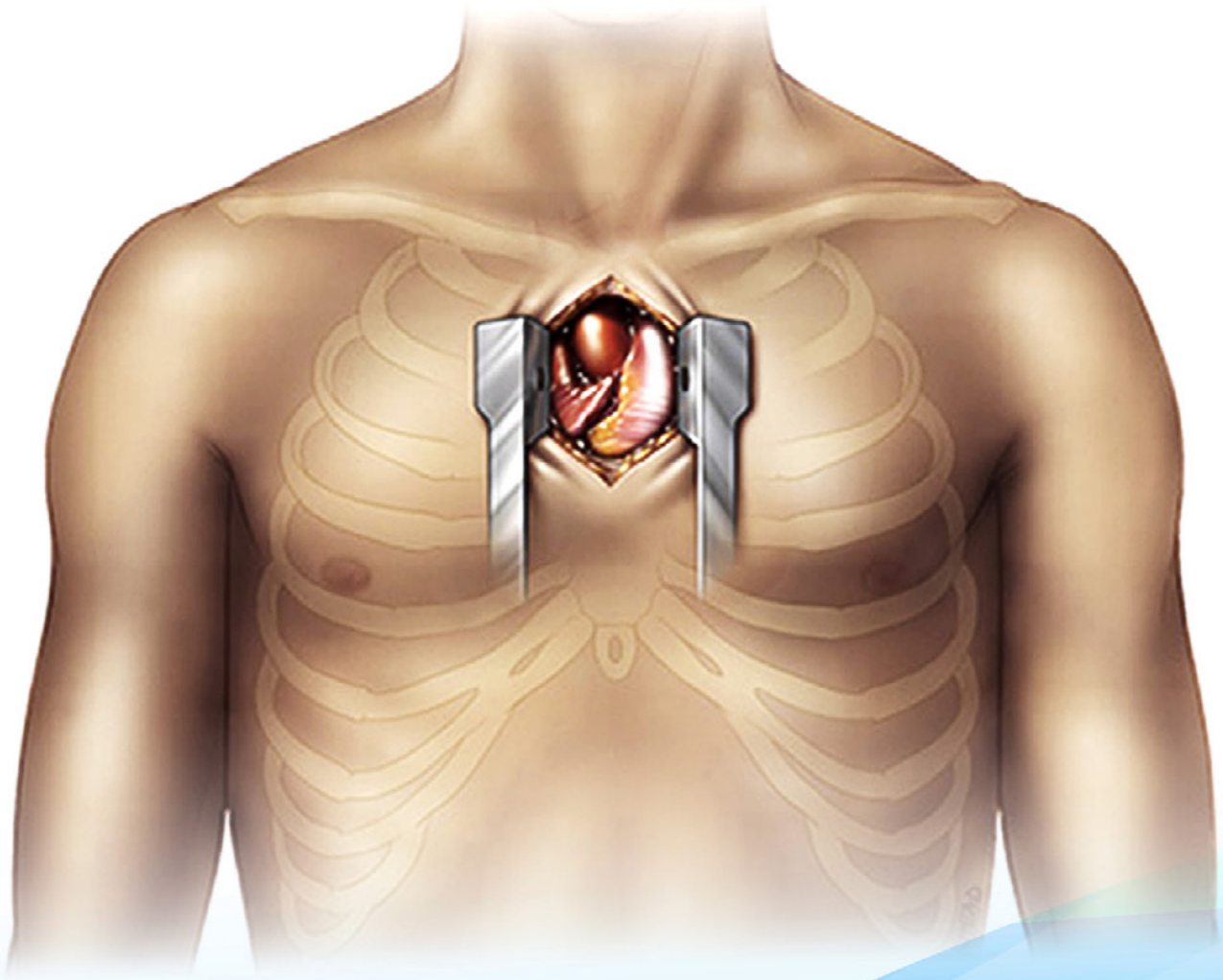
HeartValveSurgery.com

MINIMALLY-INVASIVE HEART VALVE SURGERY



Cedars Sinai

Featured Speakers

Dr. Dominic Emerson

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Learn More.

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YouTube

Please note: A complimentary video playback of this eBook is now available on YouTube at this link.

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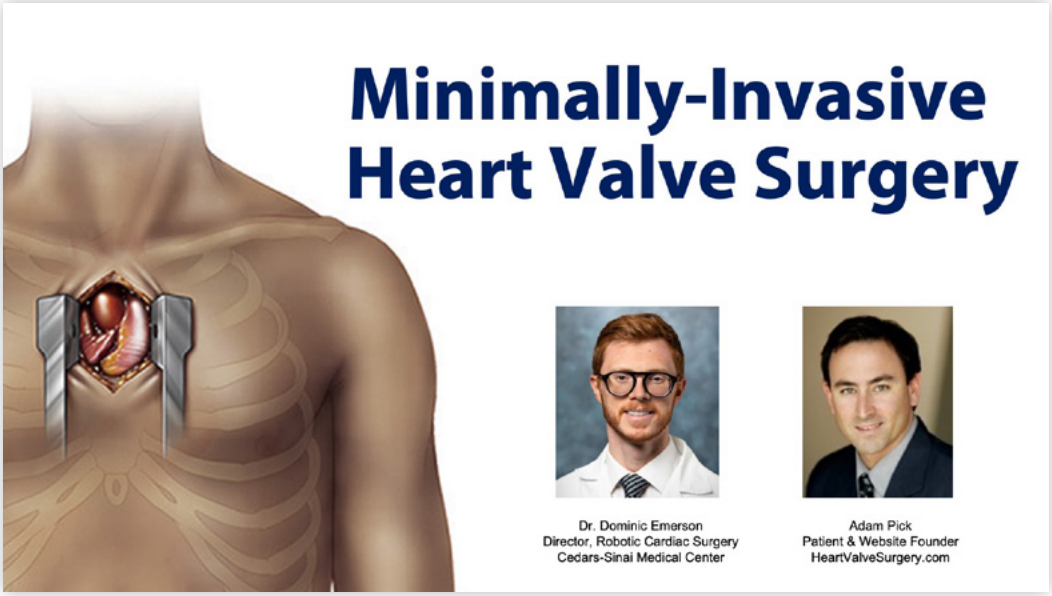
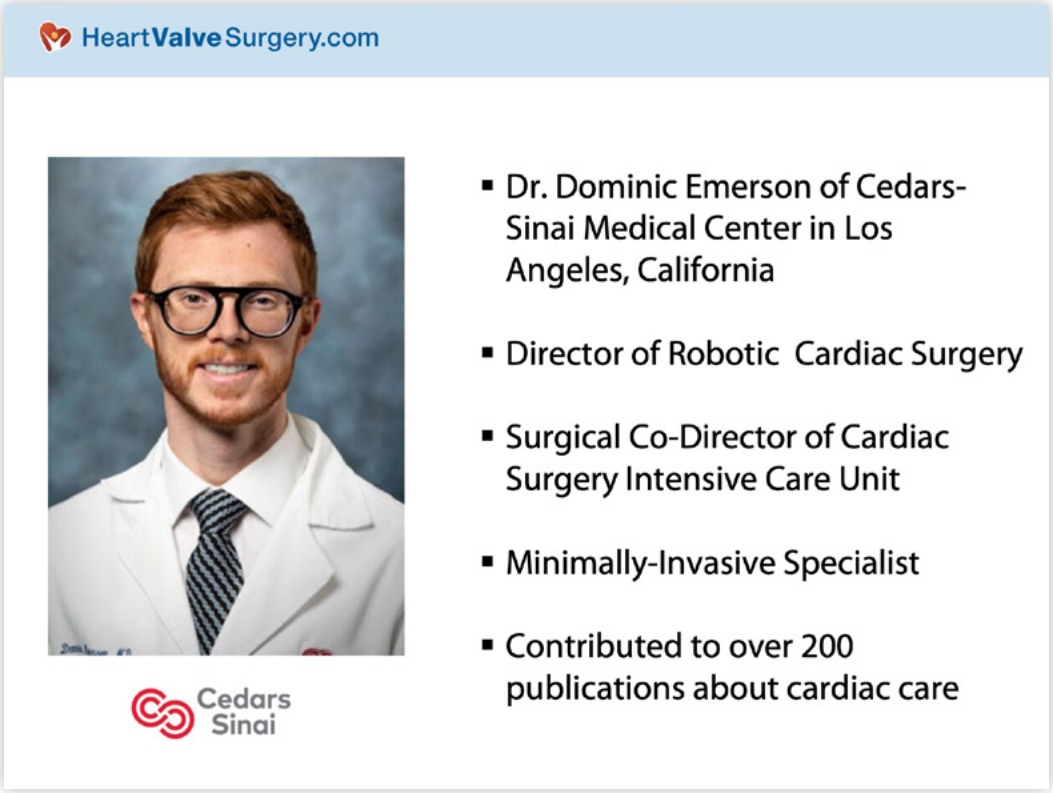


Adam Pick: Hi, everybody. My name is Adam Pick, and I'd like to welcome you to the webinar titled, "Minimally Invasive Heart Valve Surgery". If I have yet to meet you, I'm the patient who started HeartValveSurgery.com nearly 20 years ago. The mission of our website is very simple, we want to educate and empower patients just like you. This webinar, which has had registrations from over 600 patients in countries all over the world, was designed to support that mission.

During the webinar, you're going to be in what's known as "listen only mode", but I would strongly encourage you to submit your questions throughout the webinar, and I'll explain why as we look at the agenda for today. What's going to happen? I'm going to introduce our featured speaker. We're going to talk about heart valve disease, what it is, what it isn't. We're going to have a great discussion about optimal treatment and algorithms used to define what that treatment is. We're then going to do a very deep dive into minimally invasive approaches.



Dr. Emerson has put together a neat description of the patient experience. We're then going to get into an interactive "Question and Answer" session, and at the very end of the webinar, I'm going to ask you to complete a very quick five question survey.

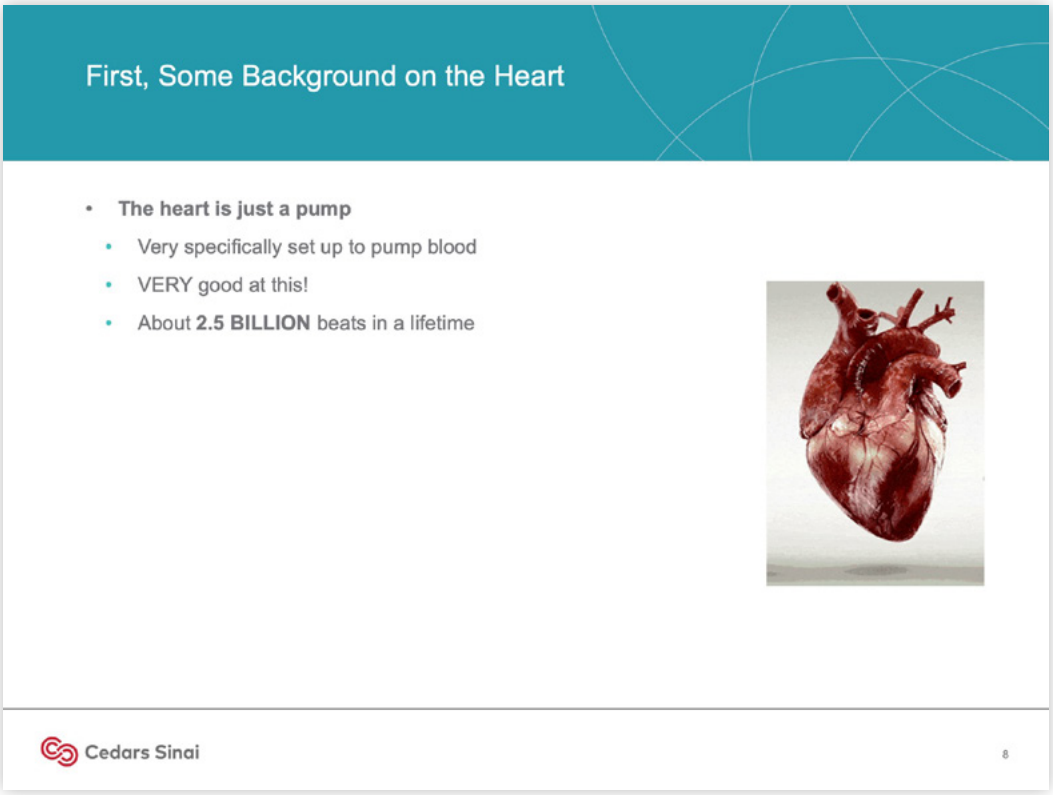
As for the featured speaker of today, I am honored and humbled that he's taking time away from his very busy practice. Who is he? Dr. Dominic Emerson is at Cedars-Sinai Medical Center in Los Angeles, California, where he is amongst many things, the Director of Robotic Cardiac Surgery. He's also the surgical co-director of cardiac surgery intensive care unit. He's a minimally invasive specialist when it comes to valve therapy, and I've learned that he has contributed to over 200 publications, research journals about cardiac care.

Cedars-Sinai Patient Success Stories

Adam Pick: I could go on for a long time about his accolades and achievements, but what I'd like to do is show you this. These are the smiling faces of patients from the HeartValveSurgery.com Community, whether it's Wendy or Layla or Steve or Rich or Jerry, who have gone from our website learning about their valve disease and treatment options, and have gotten extraordinary results at Cedars-Sinai Medical Center in Los Angeles. It's these smiling faces which encourages me to continue developing educational content.

I was lucky to be with Dr. Emerson just last week, where we're putting together a whole new educational series for patients about valvular disease. With all of that goodness being said, I would like to welcome Dr. Dominic Emerson. Thanks for being with us, Dr. Emerson!

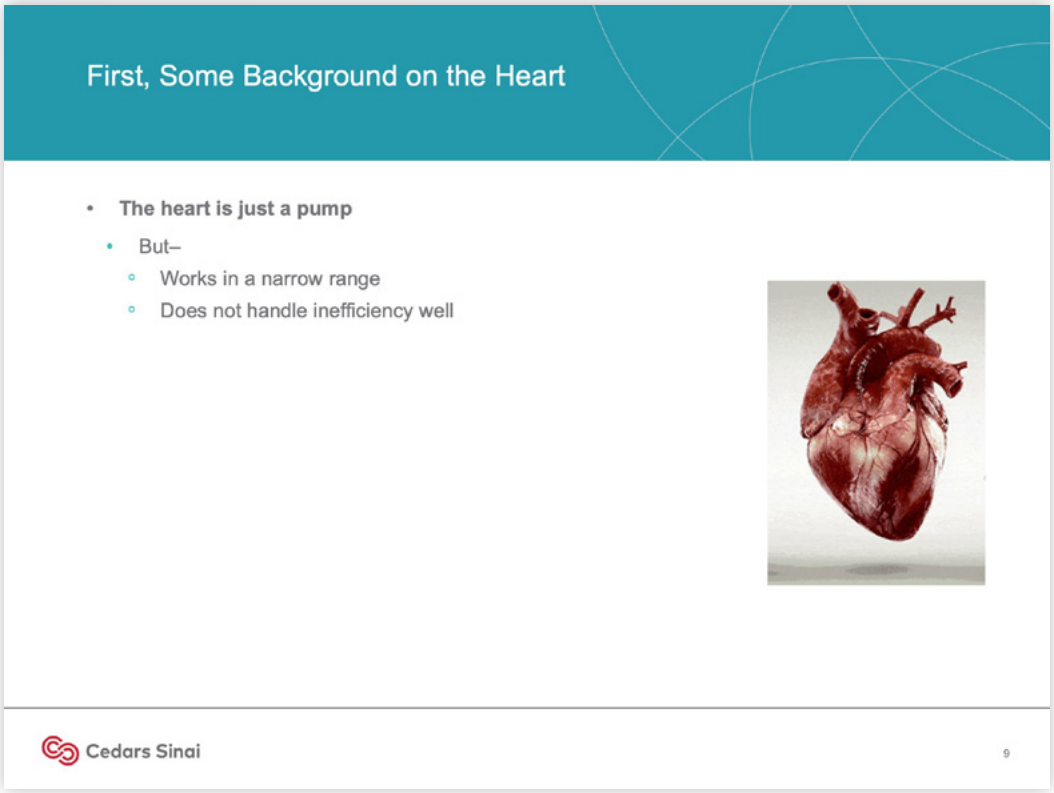
The Heart Is A Pump



Dr. Dominic Emerson: Thank you so much, Adam. Thank you again for devoting so much of your life to this. I mean, having these resources available to patients and helping share your story and everybody else's story that goes on your website really I think gives people a tremendous ability to understand what to expect with valve surgery and what their course will look like, and just find a community of support, which I think is really important for anybody who's battling any disease. Thank you for inviting me to do this.

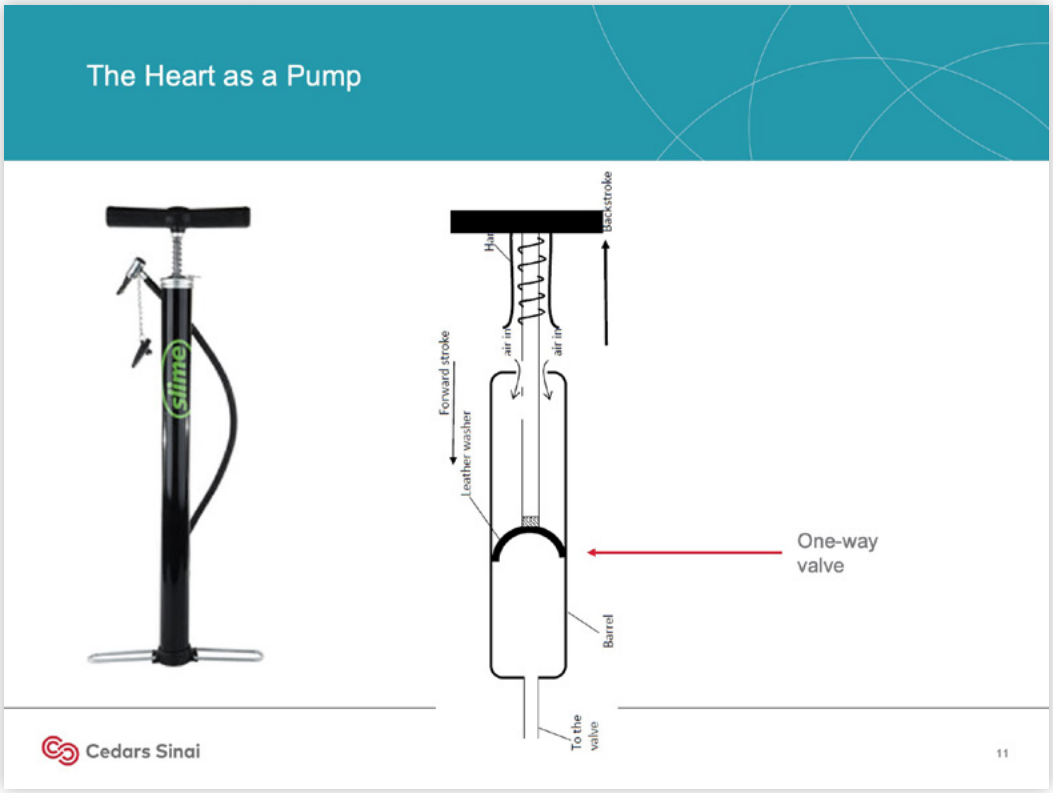
Just to talk a little bit about minimally-invasive valve surgery and specifically what should patients like you, listening now, and this is a bit of a broad topic, but I wanted to try to bring in a couple different aspects of really what the valvular disease process is and then talk about some of the options we have for surgical management of these diseases.

First, a little bit of background. The heart's just a pump. It's a very specialized pump that works for a very, very long period of time, and it's just a pump that happens to move blood around. At its fundamental core, you can think about the heart just as a pump like any other pump that you've ever heard of, whether that's something moving water through your car or something like that.

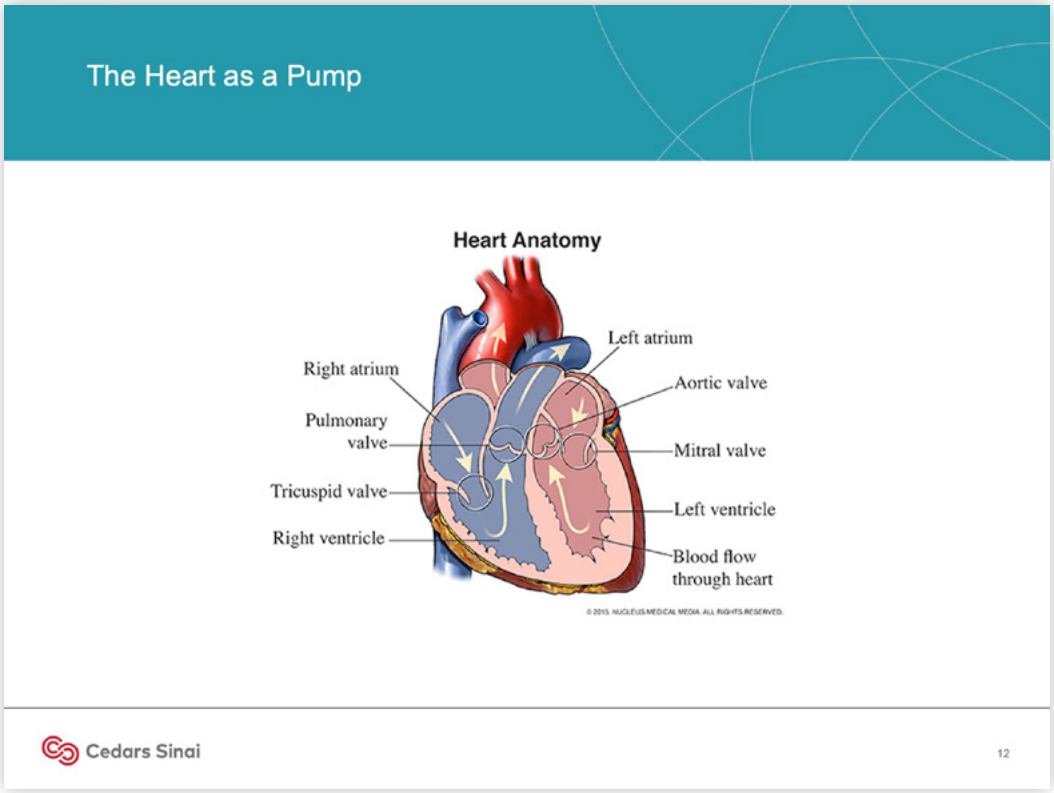


Because it's so good at its job, your heart can beat around two and a half billion times in your life, and that's really, really impressive, and it can do that very, very, very well.

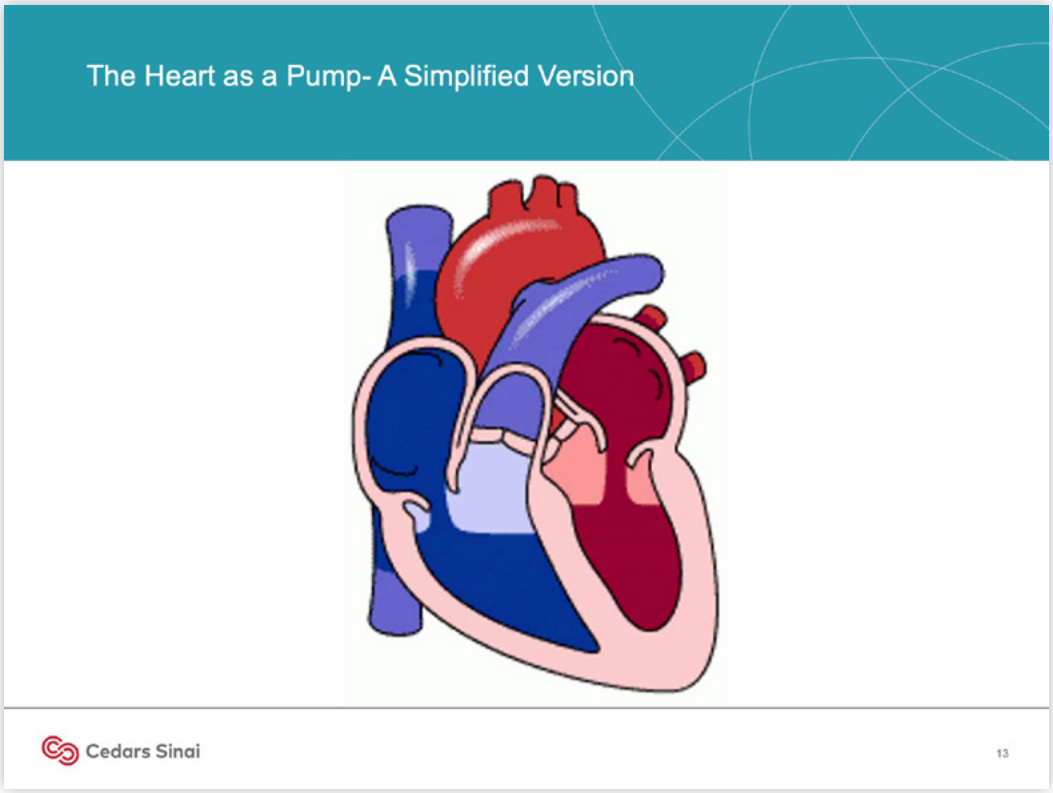
It works in a very narrow range of function and with that range, the heart becomes very inefficient. Once a valve's not working or because it's leaking or because it's tight or because the blood supply to the heart itself is compromised in one way or another, the heart really becomes very inefficient and that people notice quickly as symptoms.



To carry that analogy a little further of the heart as a pump, if we imagine the heart is something like this bicycle pump which is very similar in some ways to the way that our heart works. The way a bicycle works is that you convert energy, which you're using as that up and down pressing motion into pressure that drives in this case air. But, in the heart you would say just fluid or blood in one way or another. In many ways, that's exactly the way that a heart works.

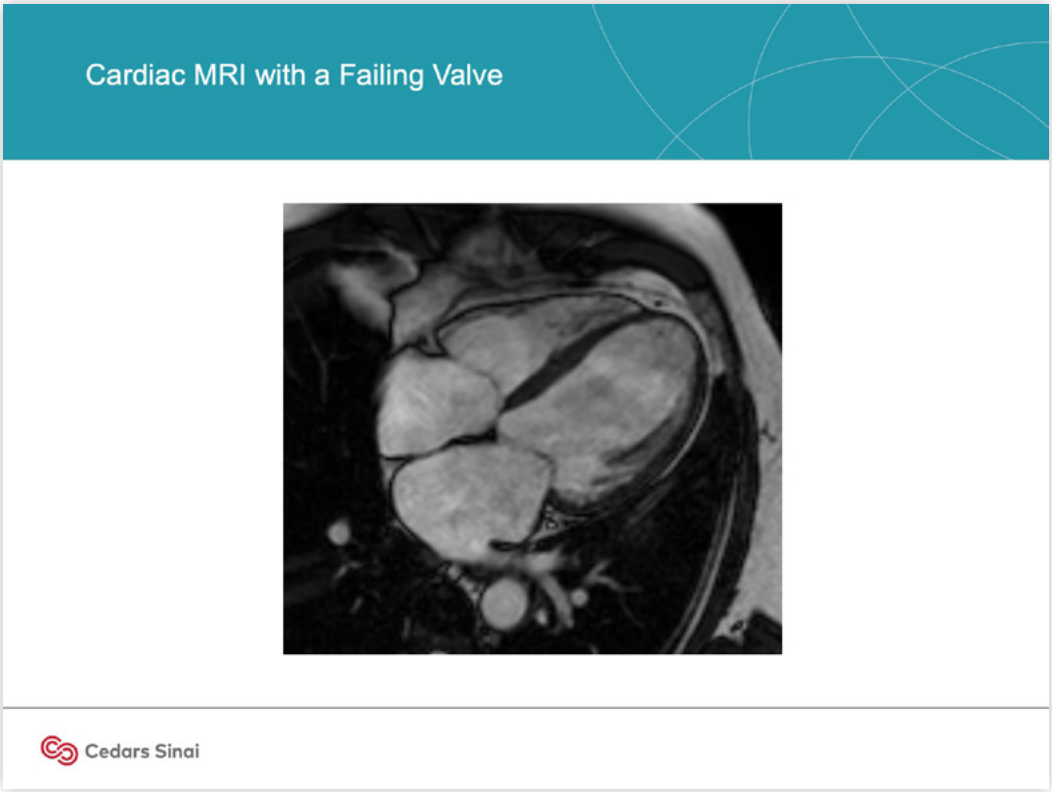


The heart pushes blood forward by squeezing, and the four valves inside, two on the right side of your heart, two on the left side of your heart work to ensure that blood is always flowing in the right direction.

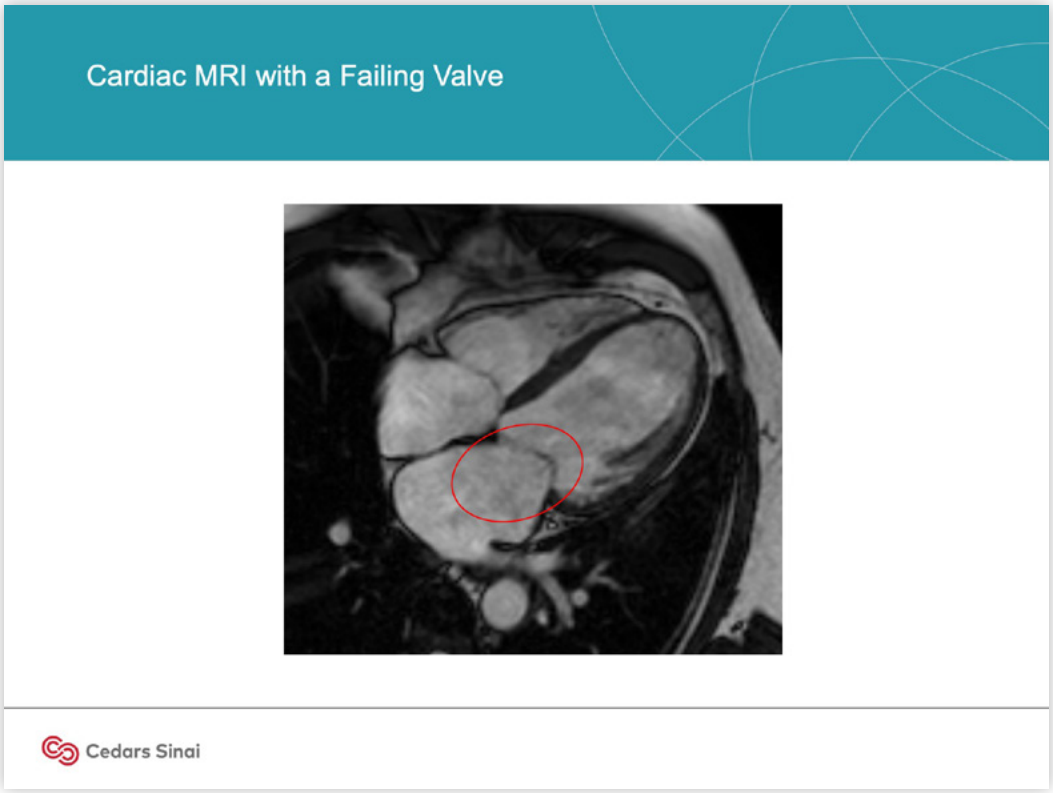


You can see that working and then gif that I actually borrowed from the internet. The valves opening and closing ensures that the blood only moves in the right direction as the heart squeezes.

Diagnostic Evaluation: Cardiac MRI



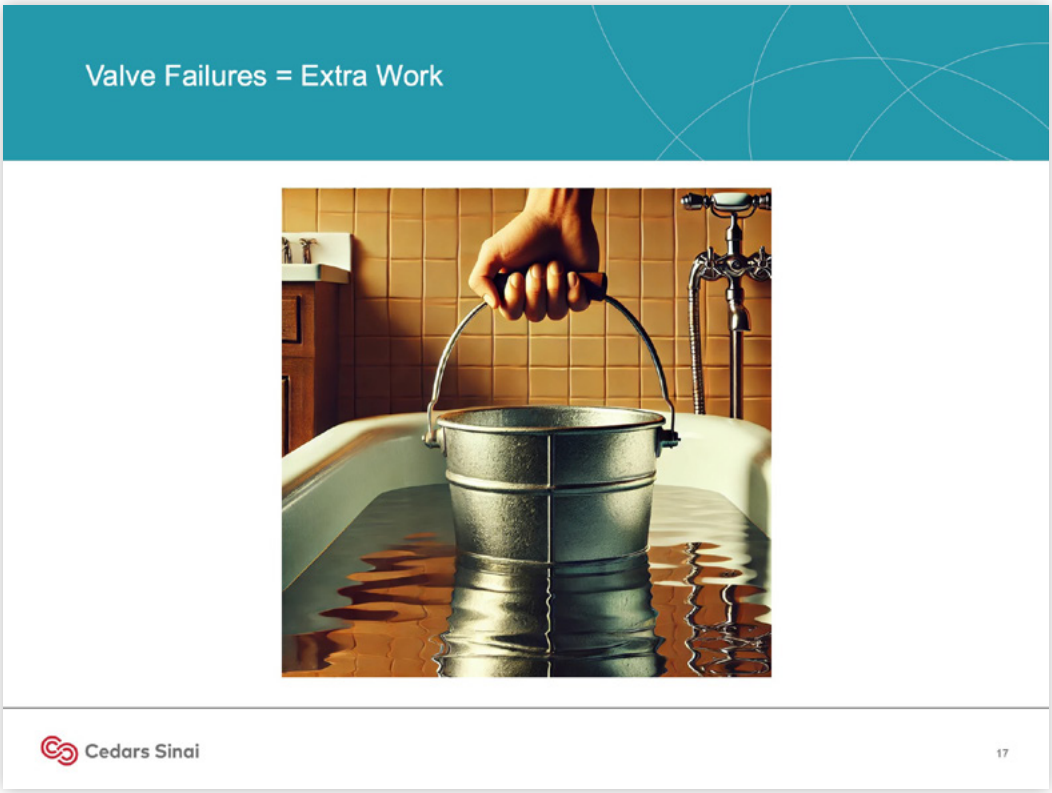
Dr. Dominic Emerson: Because of the beauty of cardiac MRI, we can actually now visualize that really, really well in an actual person. This is a cardiac MRI. It's very similar to that image that I just showed you, which is the cartoon there. You can see that, that in addition to being a nice cool picture, we can really get a sense of what's going on in the individual heart and how the valves are looking.



That is valvular regurgitation, so that's a leaky valve. You can get a sense there that that mitral valve, as the heart squeezes, that turbulent blood going back the wrong direction to the upper chamber, that's what mitral regurgitation or valvular regurgitation looks like in actual person.

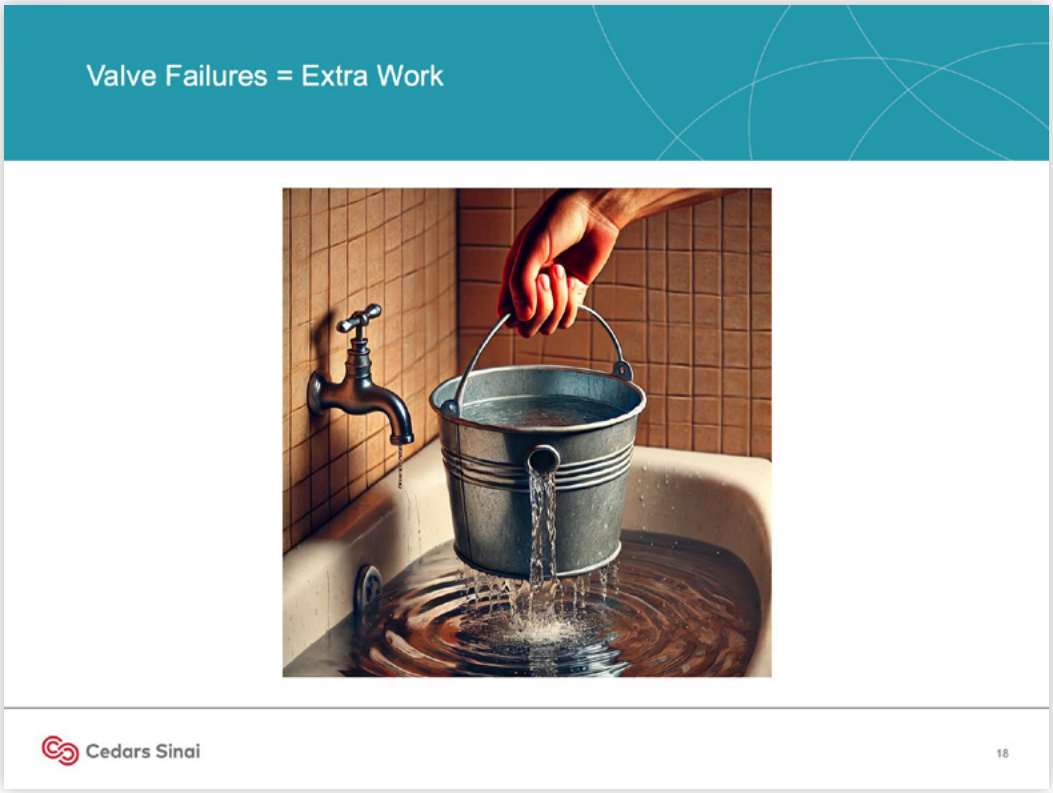
This red circle is just delineating that a little better.

A Bathtub Analogy for Heart Valve Dysfunction

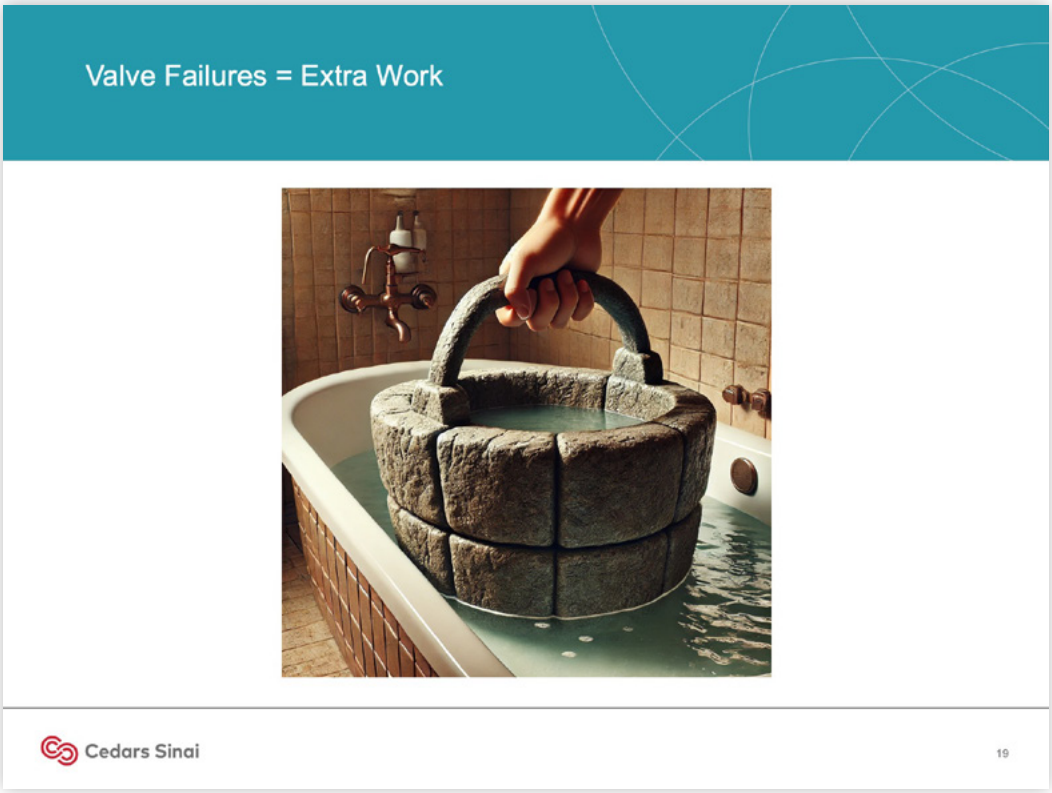


Dr. Dominic Emerson: To give an idea of why leaking is so inefficient, so bad for the heart, I like to use this scenario with patients when I'm describing it.

Imagine that I had a bathtub that was full and I wanted you to empty that bathtub using a bucket. Every time you reach down, you fill that bucket up, it takes work, it takes energy to lift the bucket full of water out of the bathtub and over the lip of the tub.

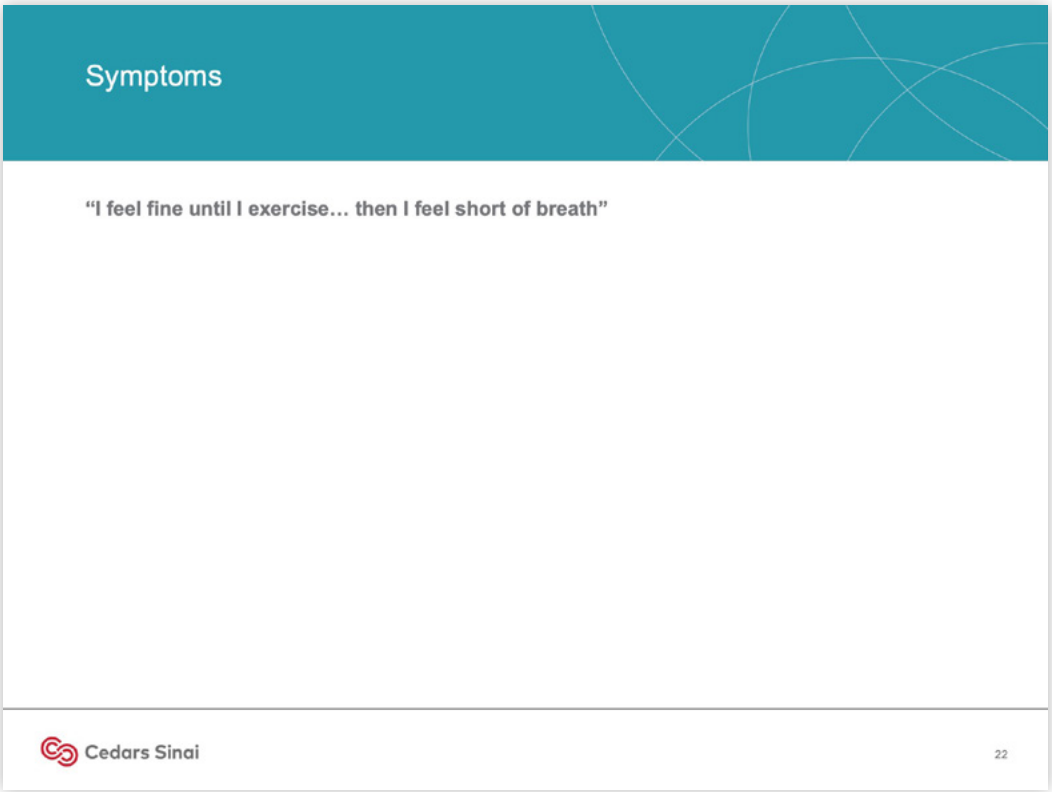


If I had a hole in that bucket, you would still have to do the same amount of work to pull the bucket up, get it out of the water. But, by the time you've gotten it over the edge of the tub there, half the water's gone the wrong direction, gone back into the tub. You're still doing the same amount of work, but you're only getting 30% of the effectiveness of that. That's what your heart does, every time you have a cardiac cycle, every time it's squeezing and your valve is leaking. That's a good way to think of a leaky valve.



Conversely, your valve itself may be too tight. It may be stiff, and because it doesn't open well, the heart has to push much harder to get the same amount of blood out. My analogy for that is it's akin to having same bucket, but instead of being made out of aluminum or whatever. It's very, very heavy, holds the same amount of water. You still look at the same amount of value of blood going forward, but it just takes a lot more effort to get it moving in the right direction.

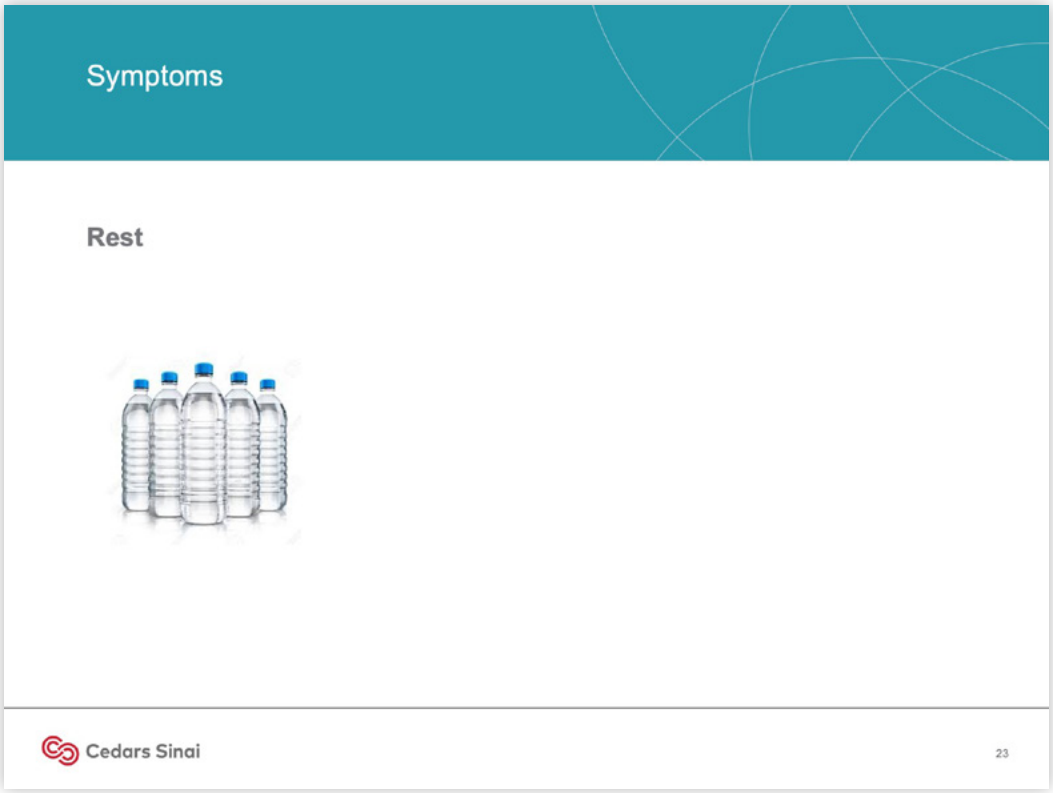
Heart Valve Disease Symptoms



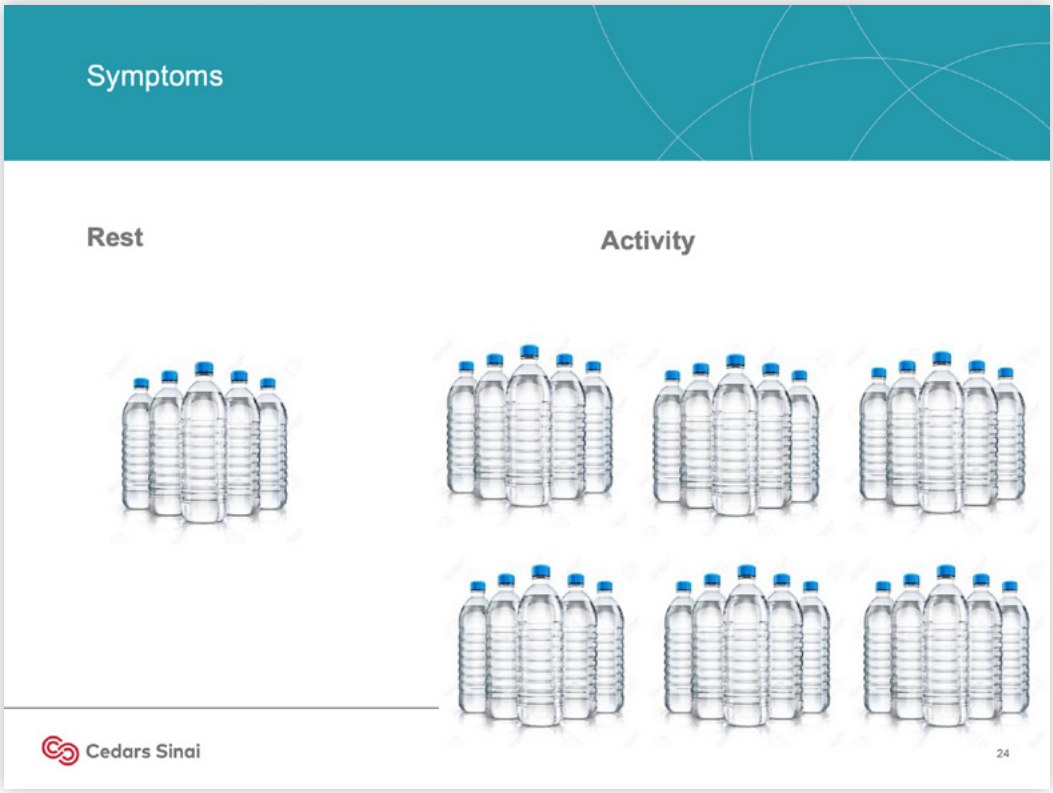
This inefficiency is something that may not initially cause symptoms because the heart is ultimately very amazing and it can deal with added quite well. But, after a while, the heart becomes more and more stressed and more and more inefficient. This leads to symptoms that include usually shortness of breath, fatigue, and can ultimately go down the path of heart failure, which is what we definitely want to avoid.

Since we're talking a little bit about symptoms, I wanted to talk about that and what that looks like because it's a common question I get from patients.

One of the most common ways that I hear about symptoms is somebody will tell me that they feel just fine until they exercise, until they go up a flight of stairs, something like that. They notice that they're short of breath or they fatigue much quicker than they used to. That's a really common way that this thing presents, that valvular disease presents. People often ask me why is it that this is the way that I'm feeling and I'm fine one minute and not the next.

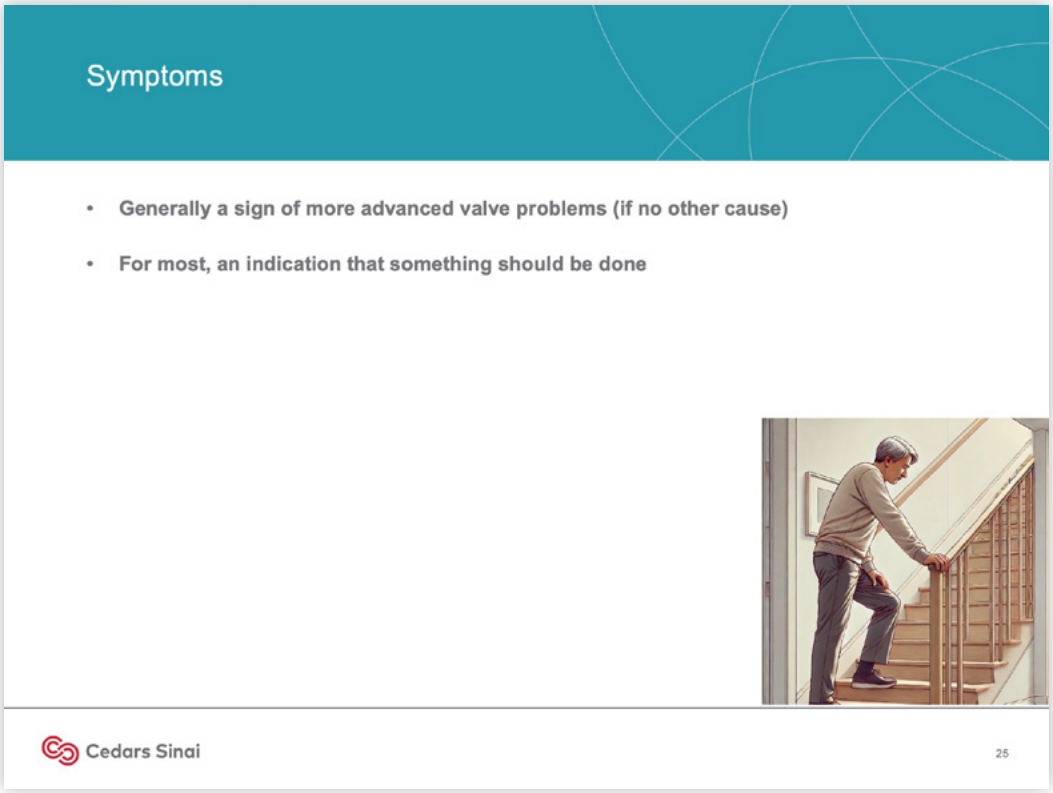


This occurs because the tremendous amount of variable work that the heart can do. At rest, when you're sitting here listening to me talk, most of us out there, our hearts are pumping, doing okay, and they're moving around five-ish per minute. So, that's those five water bottles there. That's a good amount of oxygen to supply everything and blood to supply everything from your brain functioning listening to me, to your gut digesting your lunch, everything. Once you start up with some activity, this amount can go up tremendously.



Elite athletes can actually get their hearts to pump up to like 35 or 40 liters or more of blood per minute. That's not most of us, certainly not me, but going up a flight of stairs is all of us would normally do. That itself can even dramatically increase the amount of work and blood flow that your heart is doing. You can easily go from that five liters at baseline to 10 liters with just going up a flight of stairs. If the heart is not operating efficiently, that increased demand may be difficult for it to achieve, and as a consequence, you suddenly feel these symptoms, you suddenly feel short of breath.

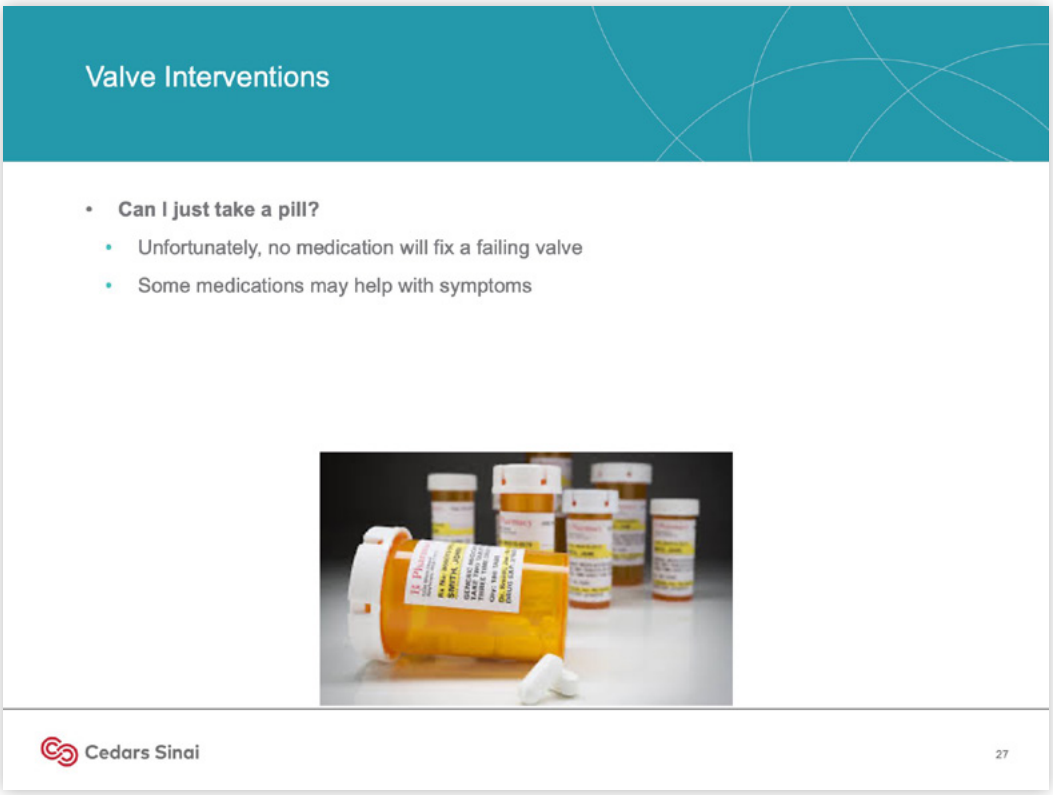
Once you do have symptoms, we as physicians that deal with the heart, begin to get a lot more worried, and that's your cardiologist or your surgeon. If your symptoms in general are from a valve issue, it means that the valve is starting to really stress the heart out and indicates that something should be done.



I should note that this is a bit of a generalization, as are many of the things I'm talking about. Obviously, there's a lot of nuance within heart disease.

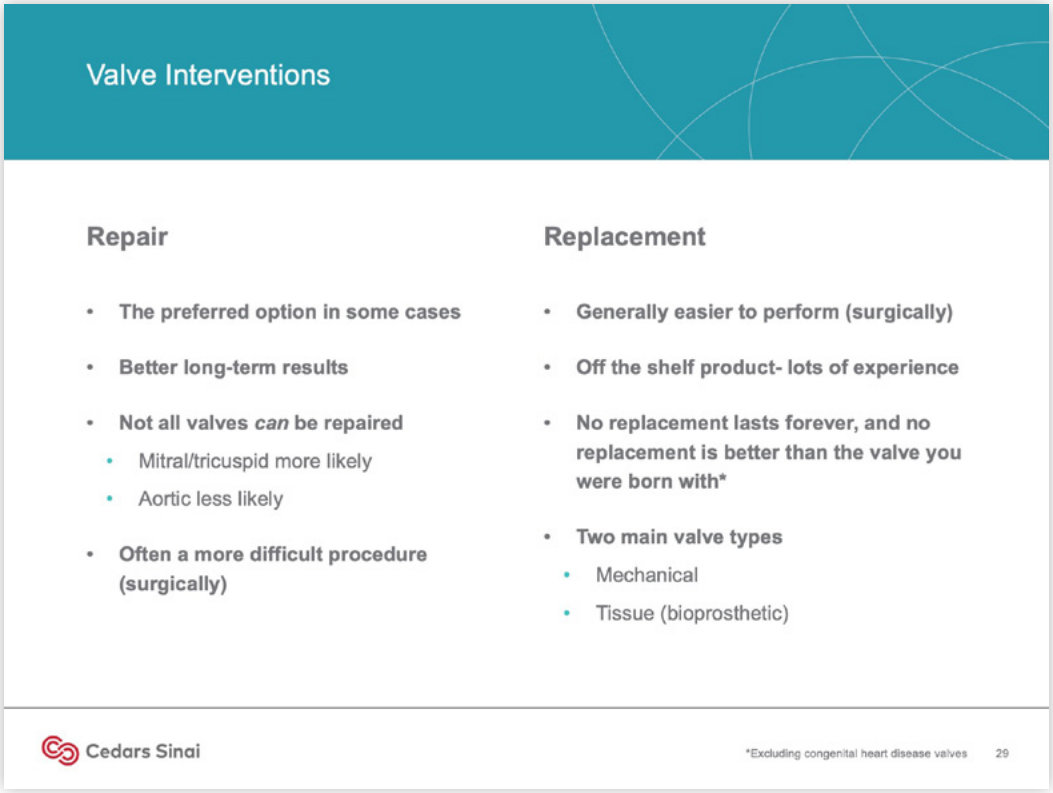
There's a lot of specific things that can change some of this, but in broad strokes is most of what I'm talking about certainly because other things can cause damage, other things can cause disease, these sorts of things. If there's no other cause for your symptoms other than the valve, this is generally an indication that something needs to be done.

Medications



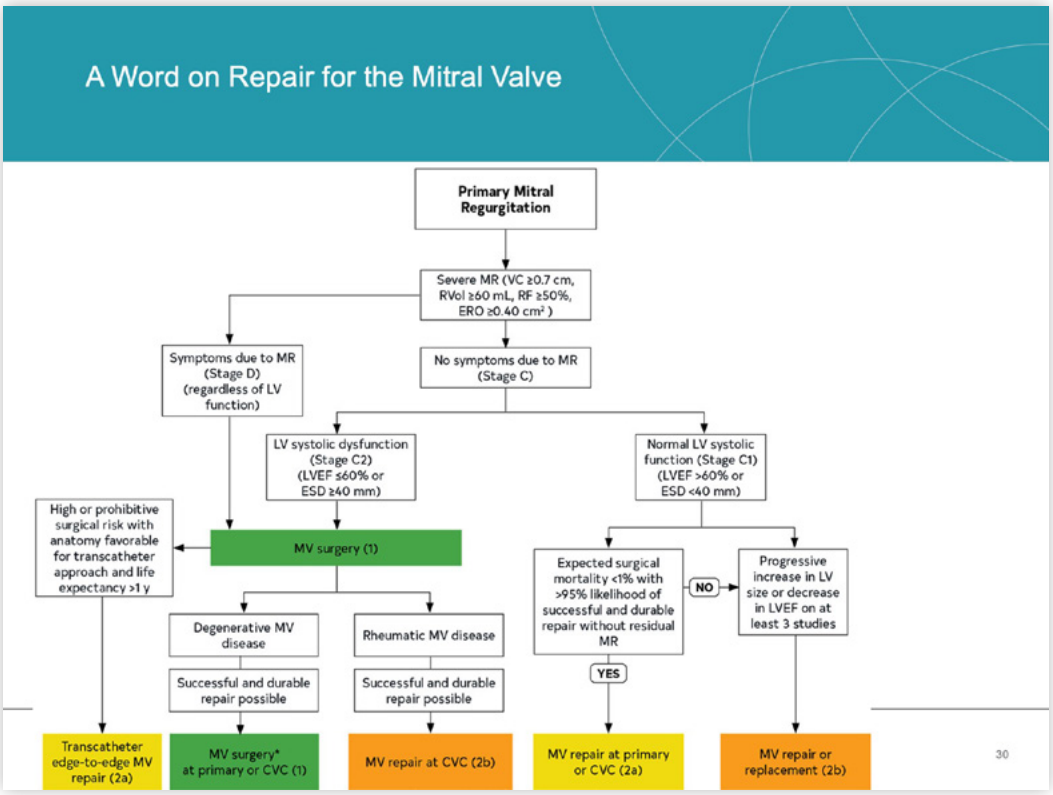
Dr. Dominic Emerson: If you or your loved one meets criteria to have something done, what can we do about it? One of the other questions that I get on asked quite frequently is, “Is there a medical therapy for the valve? “People want to know if I can just take a pill, is there something that I can do? Unfortunately at this point, there's no medication that will fix a failing valve. Valves themselves are very mechanical and they require as a consequence a very mechanical fix. This is both good and bad in that it requires intervention of some sort, yes, but generally are very, very good. Once the valve is repaired or replaced, the problem is generally very fixed and the replacement is generally very durable, which is good news.

Heart Valve Repair & Replacement



Dr. Dominic Emerson: While there's no medications that can fix the valve, there are good options. This goes into a couple different buckets, which are either transcatheter or surgical interventions. There are a bunch of different ways to do this, but in general, you can think of all of these interventions as falling to one of the two groups, either or replacement.

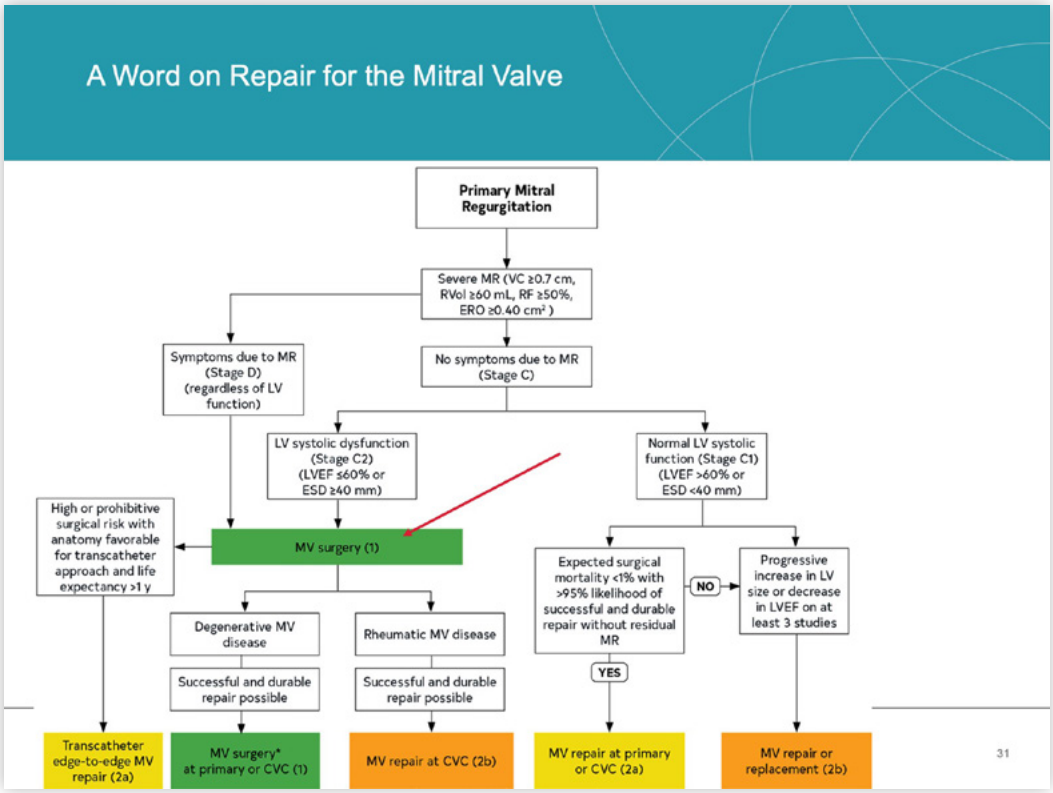
The Guidelines for Mitral Regurgitation



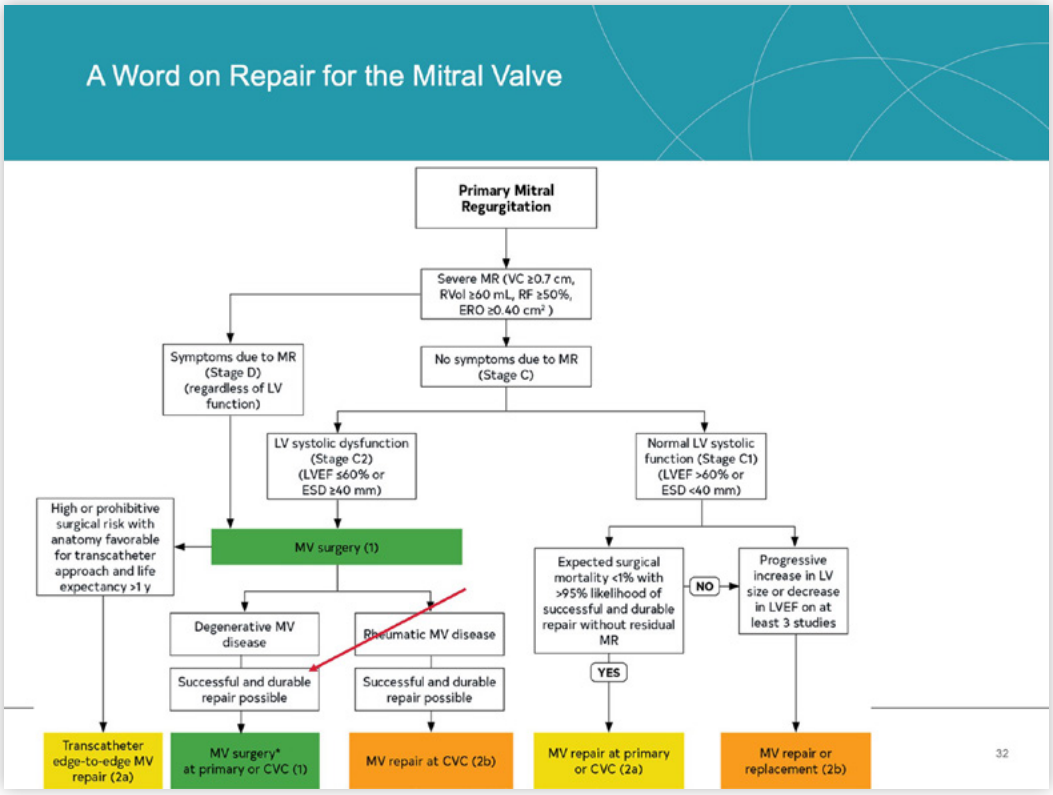
Dr. Dominic Emerson: This is just as it sounds, repair is fixing a broken valve and leaving the patient, I should say, with the valve that they have; while replacement is complete removal of the valve and replacing it with just an off the shelf product that does the same thing as your normal valve would do. In general, I like to tell patients that it's better to leave the hospital with as much of what you came in with as possible

So, whenever we can repair that is the goal. Long-term results for repair, especially in the case of mitral valves, tends to be better, meaning that the durability of the valve is generally better than an artificial valve. It's not quite as simple as that. It's a much more nuanced thing.

When a valve is replaced, you may have heard that there are really two groups of valves, that is the mechanical side and the bioprosthetic side of valves. I'll talk about them a little bit more, but each of them have their own pros and cons.

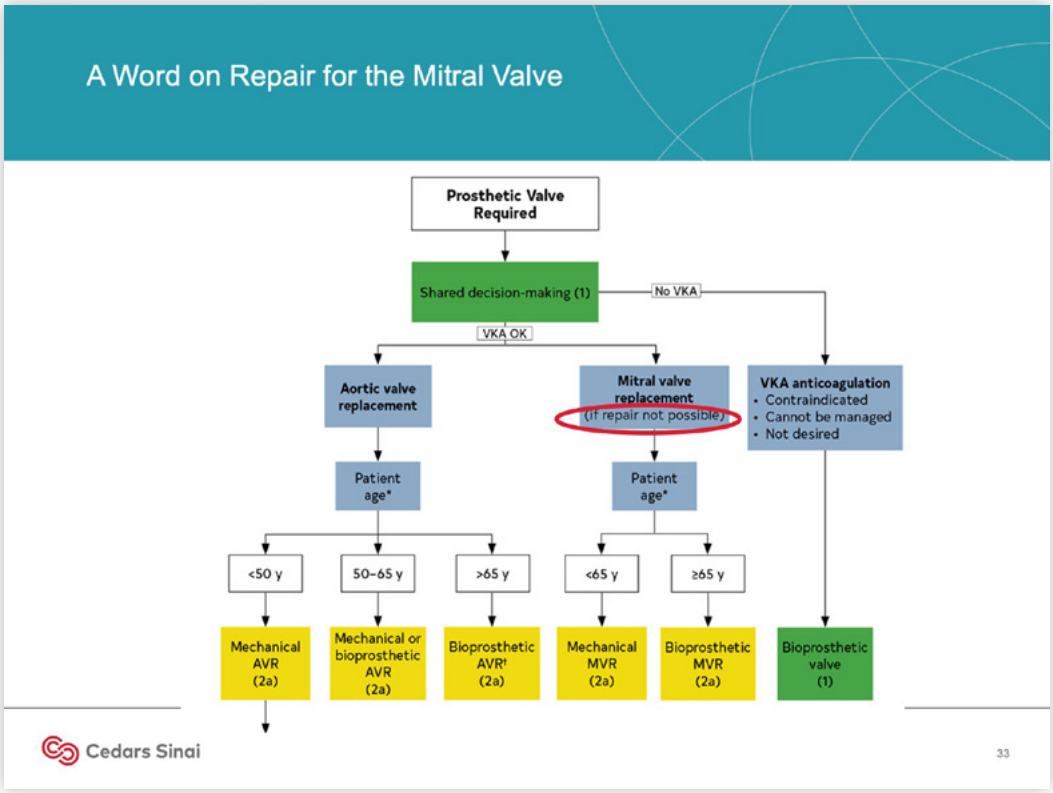


Just a specific word on the mitral valve because I think that there is a little bit more delineation between the benefit of repair versus replacement for that valve specifically. The guidelines currently indicate that the valve should be repaired wherever possible. Multiple studies show that a good repair is better than a replacement for this valve. When you're seeing your individual heart team, wherever that may be, for a mitral problem, you should be asking them, "Can this valve be repaired?" and "What are the repair rates specifically at that institution?"



This is just to show what the current recommendations are. This is how the cardiologists and the surgeons that build the guidelines that we all follow look at it. Mitral valve surgery, if you follow the algorithm, first thing to note is that surgery not a transcatheter is generally the first recommendation for individuals undergoing mitral valve repair.

Secondly, not only is surgery the preferred approach, but that when you go through surgery that the primary goal should be repair, if at all possible in any age group.



Whenever possible, repair the mitral valve is a good rule of thumb for anybody who's undergoing mitral valve interventions.


A Word on Repair for the Mitral Valve
Wherever possible, REPAIR the mitral valve
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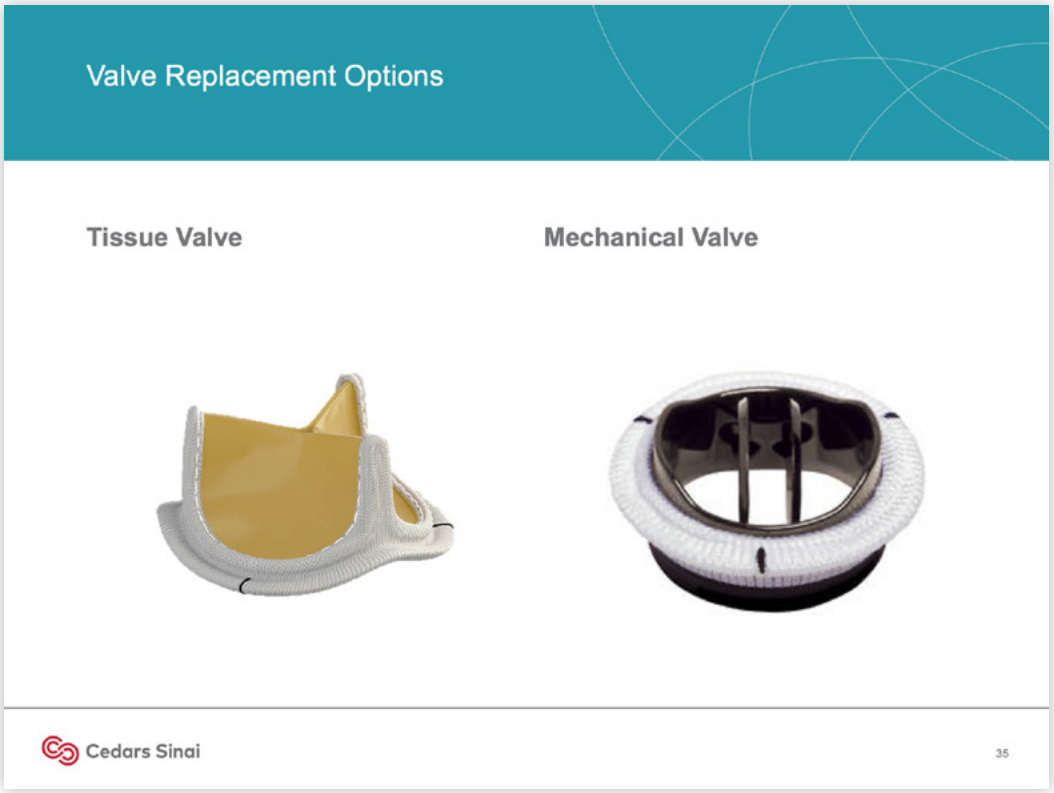
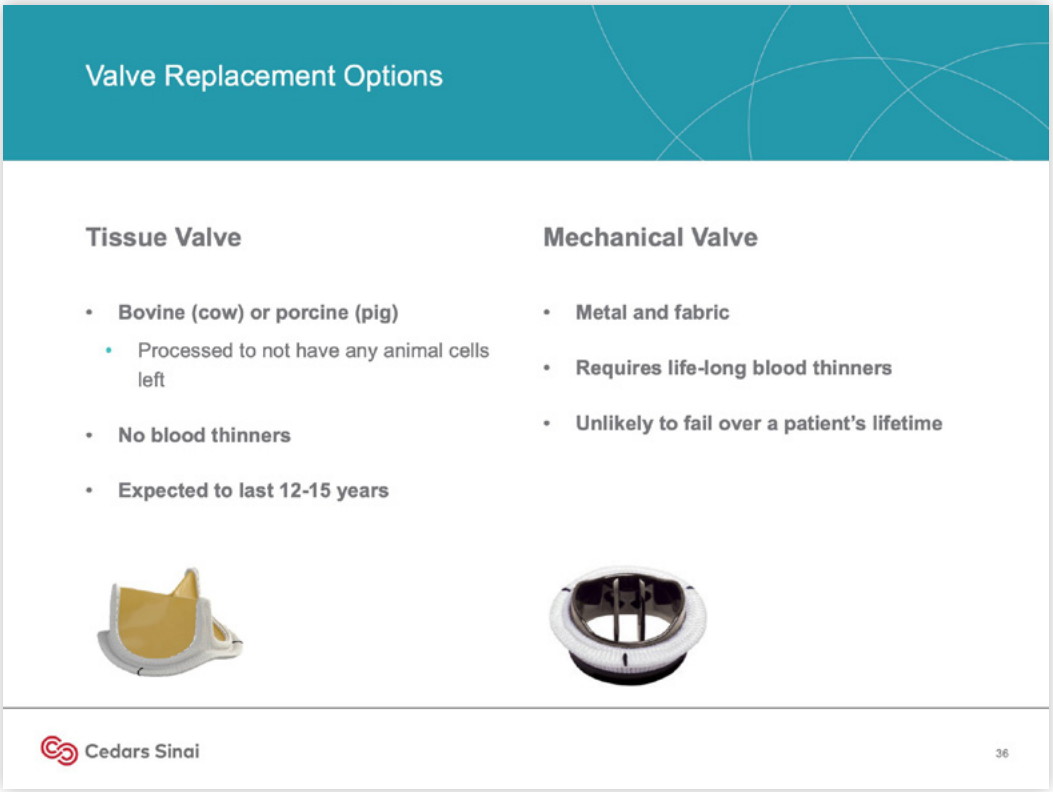
Heart Valve Replacement Options



Dr. Dominic Emerson: Going back to valve replacement options; so if we are replacing the valve, like I said, there's two groups, and that is the tissue valves or the mechanical valves. These are just two representative images of these two, some of the commonly used valves that we might use in individual patients. You can see that the tissue valve itself is made out of tissue. The tissue that we use comes from either a cow or a pig, and we'll call that bovine for cow or porcine for pig. It's important to note that even though they derive from those animals, it's not like actual animal tissue anymore. It's more akin to leather, to be perfectly honest. All the valves go through some special processes that basically remove all the animal cells, and so you're left with tough tissue bits that are there very fibrous, very leather like in its consistency and they last a very long time.

The benefit of the tissue valves that I'm sure anybody who's done any research will have noted already, is that you don't have to be on blood thinners long-term. That is a generalization. Again, it's not a hundred percent. It depends specifically on the patient and the valve that we're going to be using, but in general, most of these patients don't have to be in blood thinners. They do not, however, last forever. A tissue valve lasts for 15 years. Some people it's a little longer. Some people it's a little shorter, depends on which valve and where it's going, but they do not last in general forever. A mechanical valve on the other hand, is just mechanical. It's metal and fabric. As a consequence, those valves don't generally break down at all because they're metal. The downside to this is it does require lifelong blood thinners because the body doesn't react. It notices that, that is a foreign body and doesn't respond to it quite as well as it does to the tissue valves. However, it's unlikely to fail over, the patients that have these done, the idea is that they would never have to have any intervention done again in their life for that valve.

That intervention has changed a lot lately. 25 years ago, reintervention universally meant well we've got to go back in surgically and re-replace that valve. It's not the end of the world. We can absolutely do it. We do it a lot, but it is another operation and it's more challenging the second time. Within the recent years of valvular disease and how we manage it, catheter valves have really become an important adjunct to what we do for these patients. We can now place a valve within the valve and be able to re-replace the valve specifically primarily to the aortic valve, although there are some mitral valves that are now coming to market which makes it much easier to get a second intervention if that's needed.



Because of this, we now recommend that these tissue valves be used in a wider range of individuals including patients that may have to get another intervention in the future will outlive the valve that they're getting, just because re-replacing the valve has become so much easier. It's no longer stating that these valves should only be – the recommendations, excuse me, no longer stating that these tissue valves should only be placed in those 65 years of age or older. It's now a shared decision making model with you as the patient and the surgeon.

Bioprosthetic Valve Failure

- Previously required a second major operation
- Trans-catheter options now exist (TAVR)
- Recommendations no longer state these valves should *only* be placed in those >65 years of age

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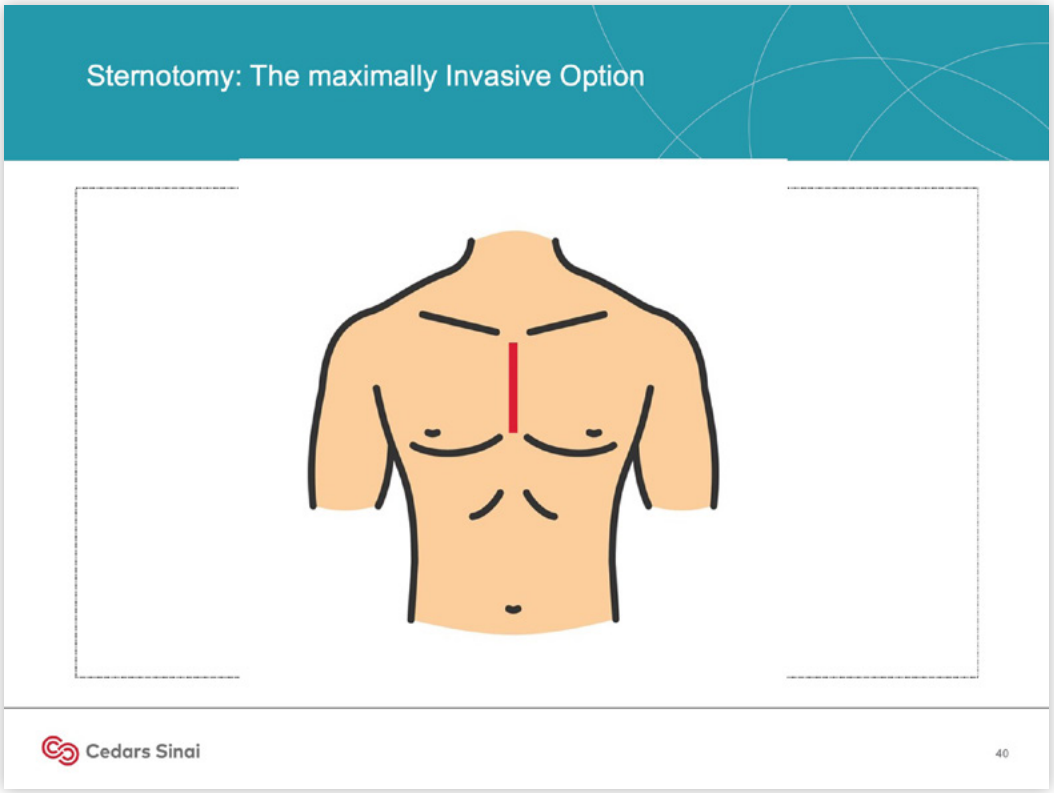
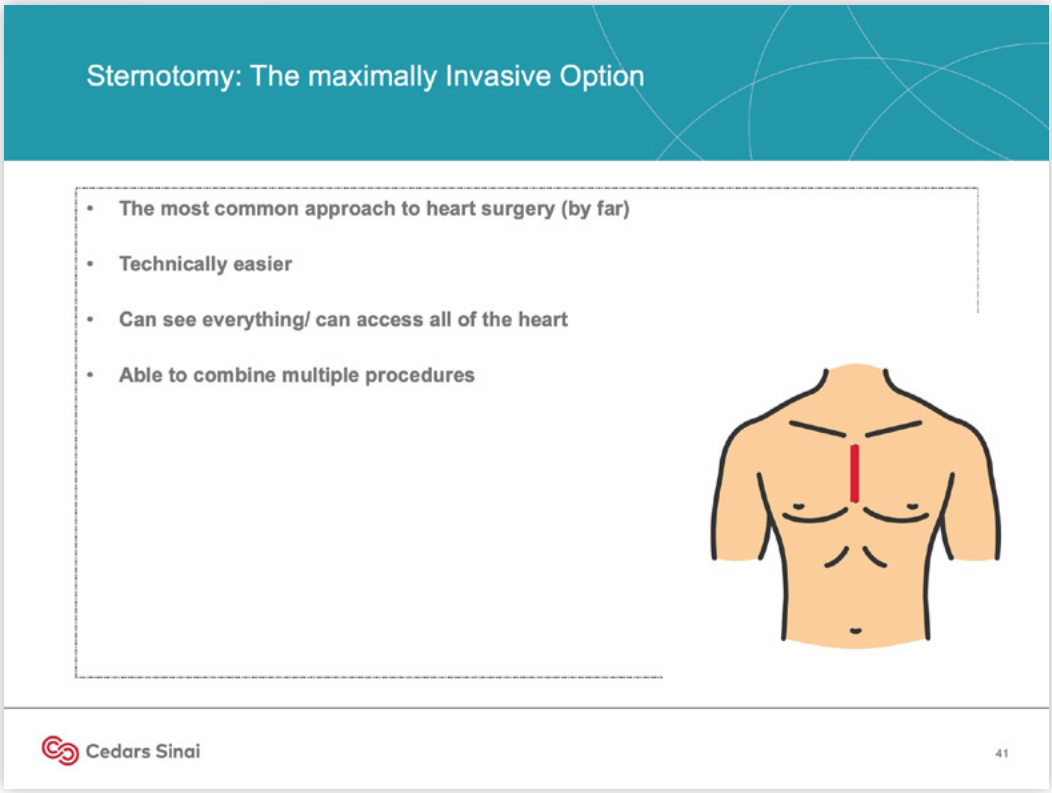
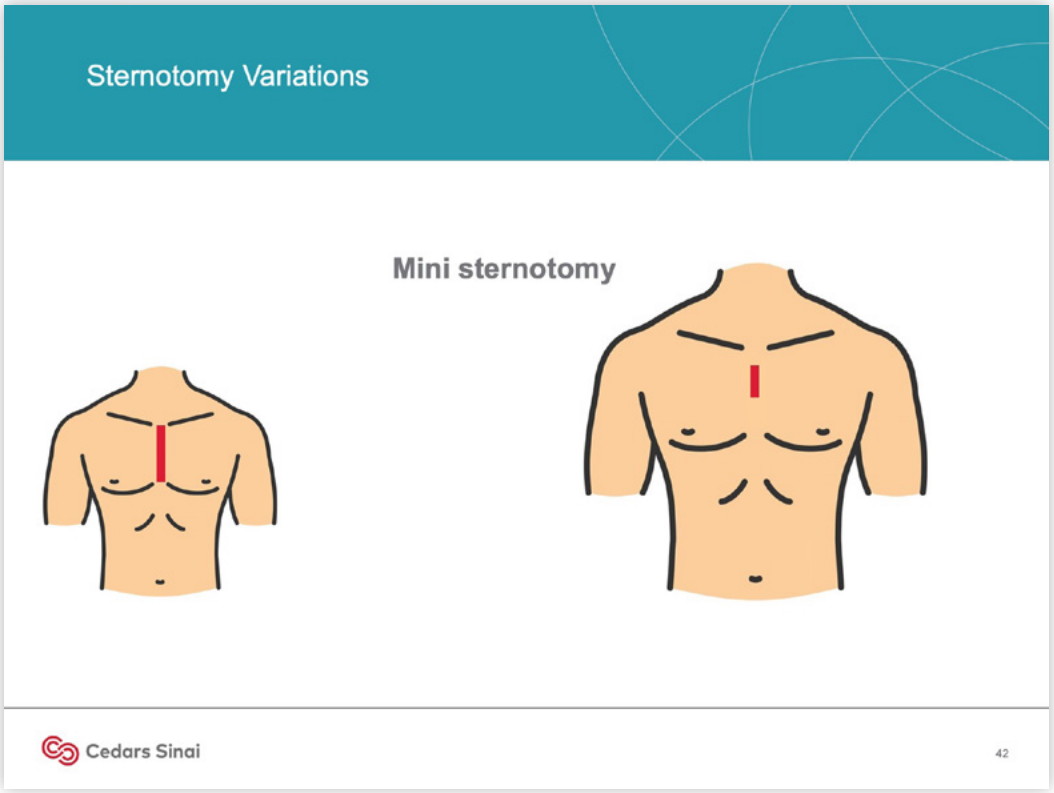
Incision Types



Dr. Dominic Emerson: Moving from the types of valves and why we do it into the interventions themselves, one of the things that people always want to talk about is the incision, what that looks like. I promise this won't be a bunch of gross pictures. They're just cartoons.

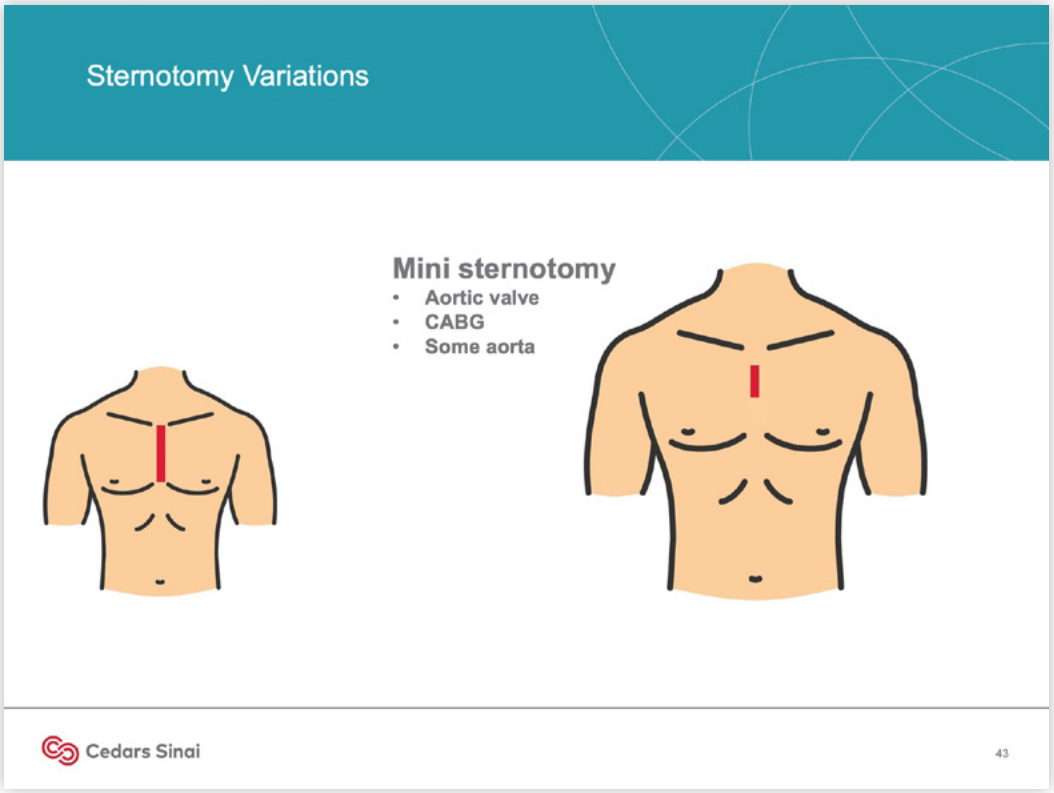


Without delving too much into the weeds, I'm going to group them into a few different simple diagrams of what the incisions look like. The first is a sternotomy. I should note that this is a totally fine way to do it. A sternotomy is a great option. It is the most common type of incision that people say coming through the front here, commonly say your people splitting their chest open. It's not nearly as horrific as that, but it is a bigger incision.



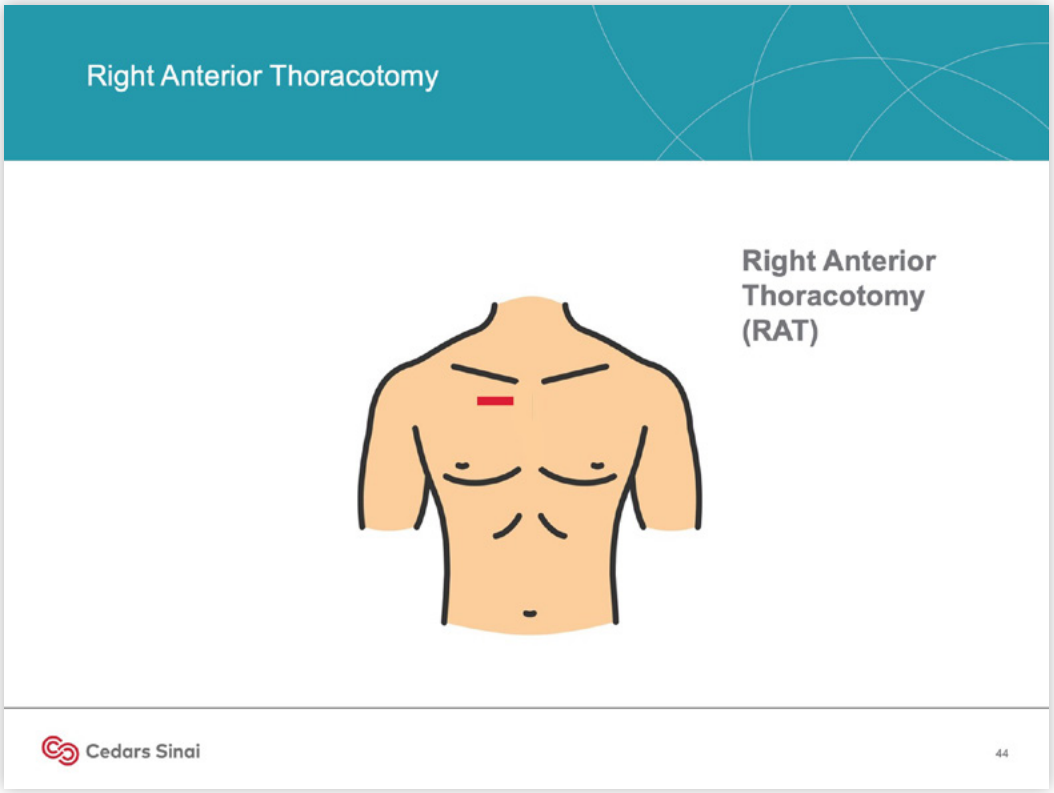
As I mentioned, it's the most common approach to the heart by far worldwide. It is technically an easier approach. There are certainly some benefits to doing it this way. It allows you a better feel of view. You can see the entire chest cavity. In some patients in some procedures, this is definitely the only approach that you can do. That's because if you're having to reach very different areas, you simply can't do it through a small hole in most cases.

I know this talk is really focusing on minimally-invasive approaches, but because not everybody is ultimately going to be a candidate for that, and some people have this as their only option, I just want to emphasize that it's a totally fine way to do it. Most surgeries are done this way and ultimately the right surgery for you as a patient, the right operation for you as a patient is the one that's going to be done safely and it's going to give you a good result.

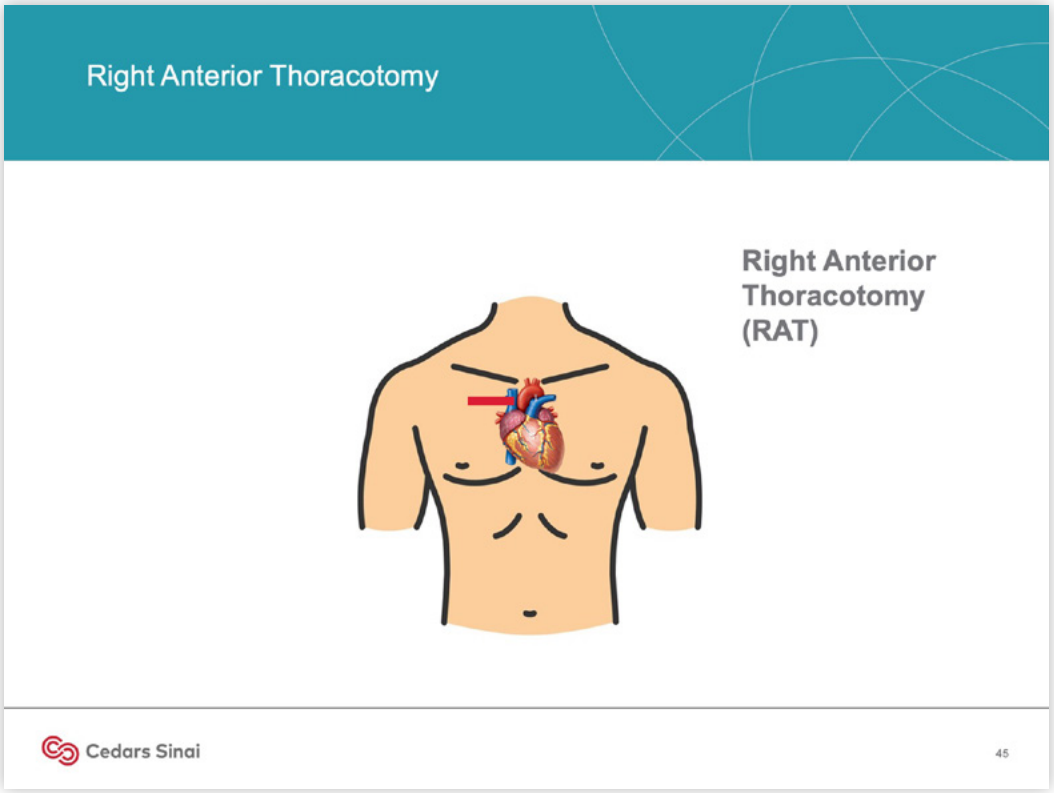


There are less invasive approaches to sternotomy, and some of them are very good access to the chest through smaller incisions. One of these is the so-called mini-sternotomy. Comparing that to the picture on the left, which is the full sternotomy, this allows the surgeon to make smaller incisions. It has a somewhat limited scope of access, but it's not too limited, you can still get to a lot of the chest this way. In some cases, part of the breast bone, the upper part is still split, and that's been wired, shut and brought together at the end, and in some cases, it's basic than that. Again, this is a good approach in some cases, not all, and it's a commonly applied option.

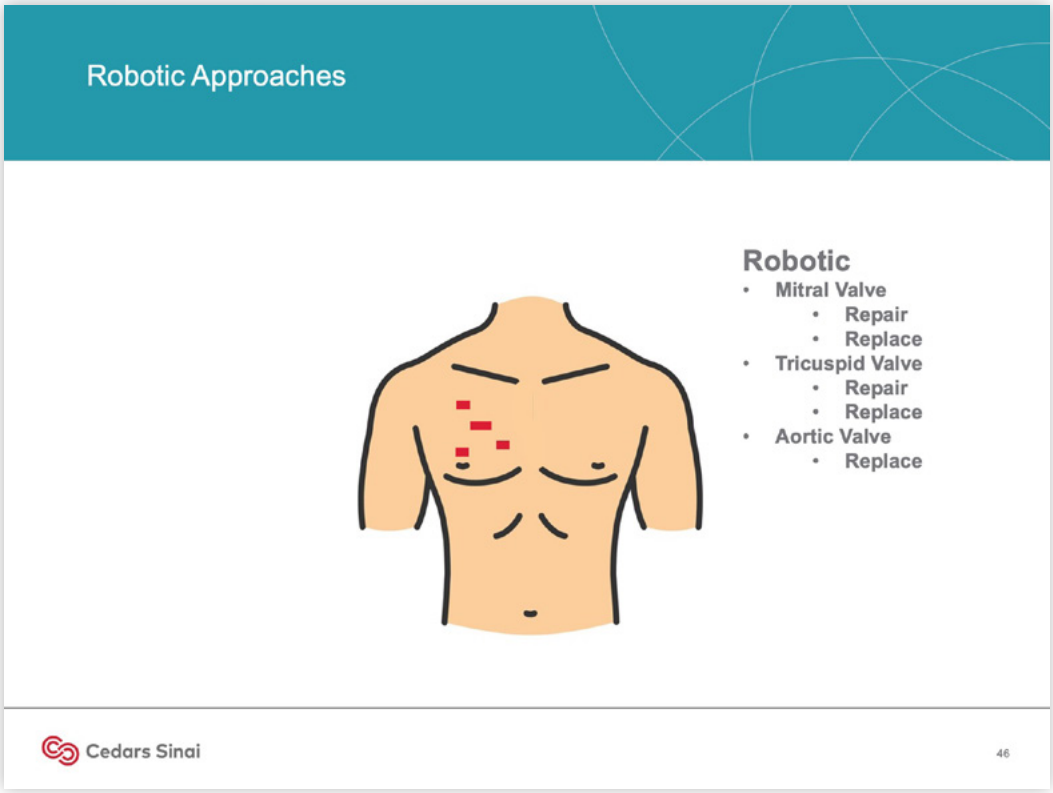
The most commonly areas this is utilized is the aortic valve, some aortic work and some bypasses or coronary artery bypass, grafting or cabbage that you may hear.



The next approach is going in the most invasive to the least invasive is the right interior thoracotomy, or unfortunately everybody just says “RAT”, which if I'm being honest, this approach is a significant step towards being less invasive as it doesn't involve splitting the sternum in any way. It comes between the ribs on the right side of the patient's chest. It allows good access to primarily the aorta and the aortic valve.



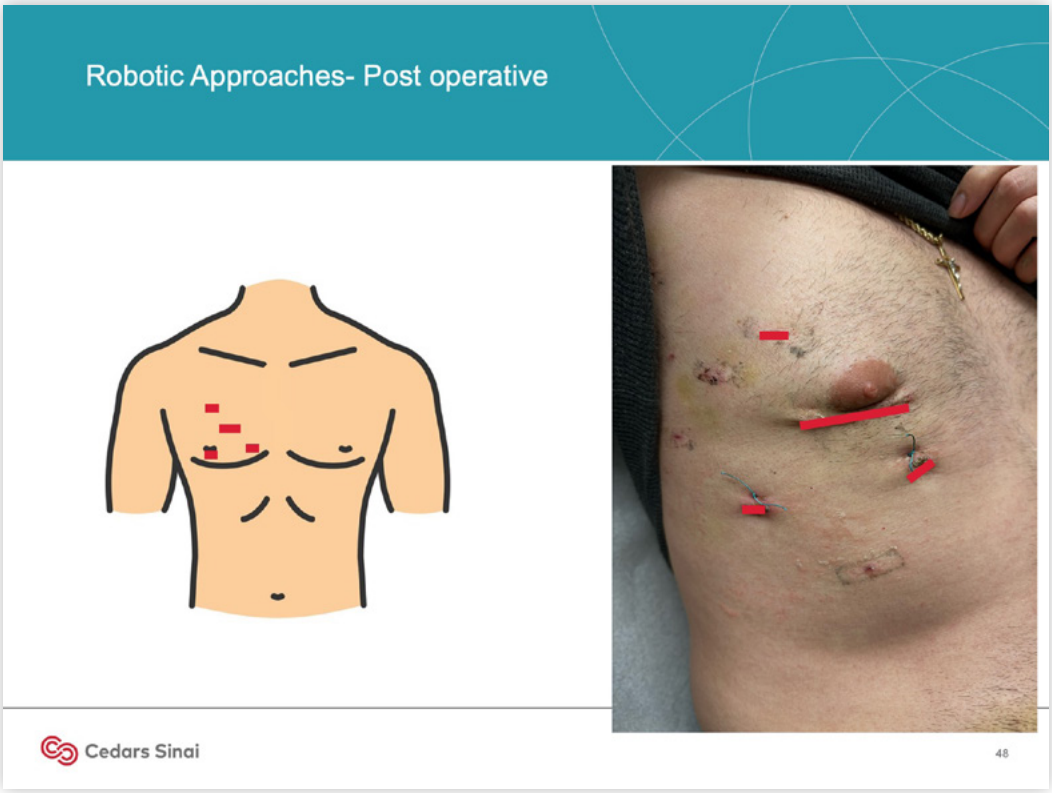
If I overlay the heart here, you can see why that is. It gives access to structures that are just near the incision, and you can see that, that red tube coming out of the top of the heart, that's the aorta, the aortic center of the heart, basically. You can leverage it to get different areas of access, but primarily it's going to be structures that are right overlying that place. It also can be leveraged to not only give decision direct access, but for minimally-invasive access approaches including robotic valve repair.



When you move the incision down a bit, that's what I intended to show there, that's where we will make the incision for robotic repair of the mitral valve. As you can see down, this is still coming between the ribs. It's not coming through the sternum but it's overlying a different part of the heart, and as a consequence, we can see and access a different area robotic.

Robotic incision utilizes that lower primary incision, shrinks it, so it makes it much smaller, and also uses a couple additional ports for the arms. Because I'm a robotic surgeon, this is the way that I access the majority of the valves, I think that this is personally my favorite way to do it. I think it's the best way, but obviously I'm a little biased, because you're not looking at it with your eyes through that incision. You can make the cuts a lot smaller. The robotic arms themselves, they go through – this is not completely the scale. They go through holes that are about the size of your index finger or smaller, and that allows the surgeon an excellent view with much smaller incisions.

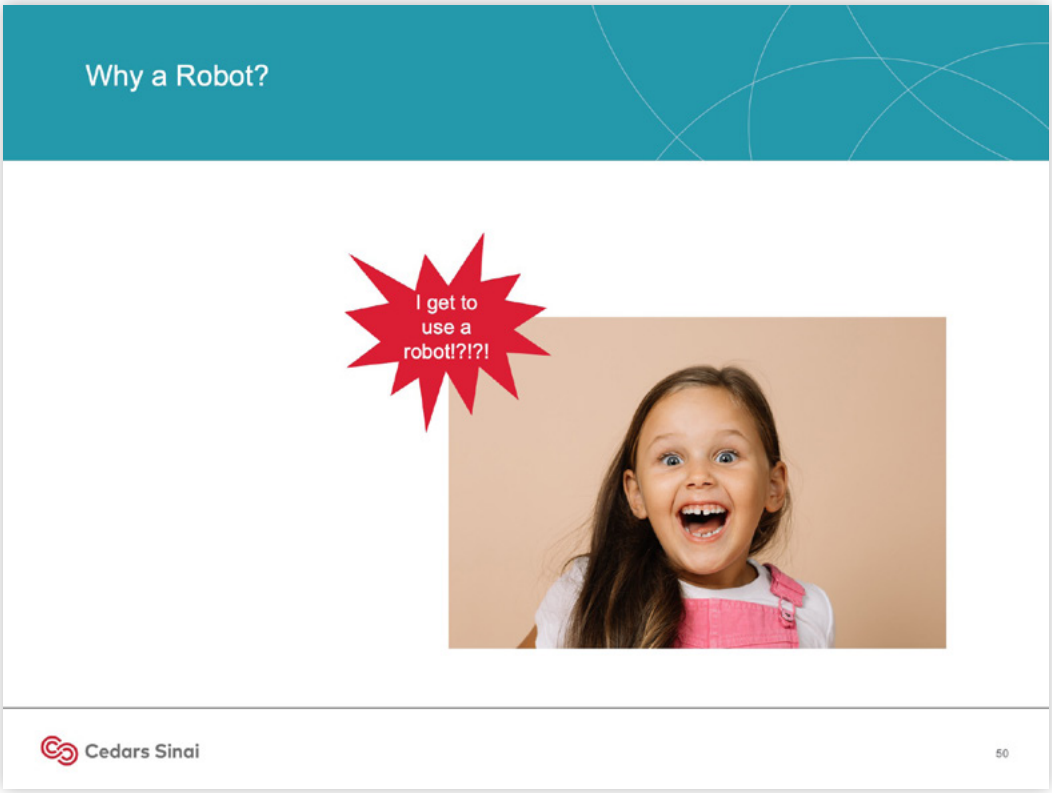
This is what after surgery, the cosmetic result looks like outside the patient. This is a patient of mine who came back to me about a week ago in clinic, and this is about a week out from surgery. You can see that a number of very small cuts. Some of them have some stitches still left on them, which we were going to take out at that visit. Because the cuts are smaller, I think the healing times faster, I think these patients feel better quicker.



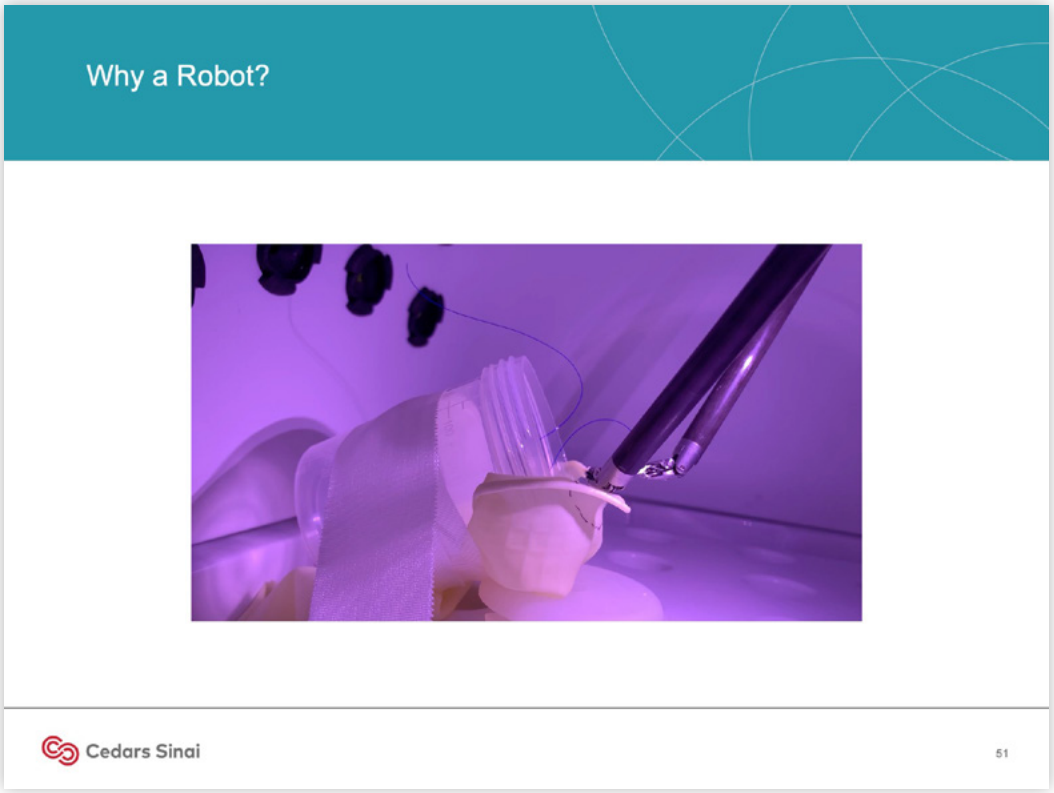
If you overly the picture that I just showed you, this is how they correlate compared to the pictures that I just showed. In women, we will move that incision down below the breast fold in the braw line, and that keeps the breast intact and hides the incision really, really well for those patients.

Robotic-Assisted Approach

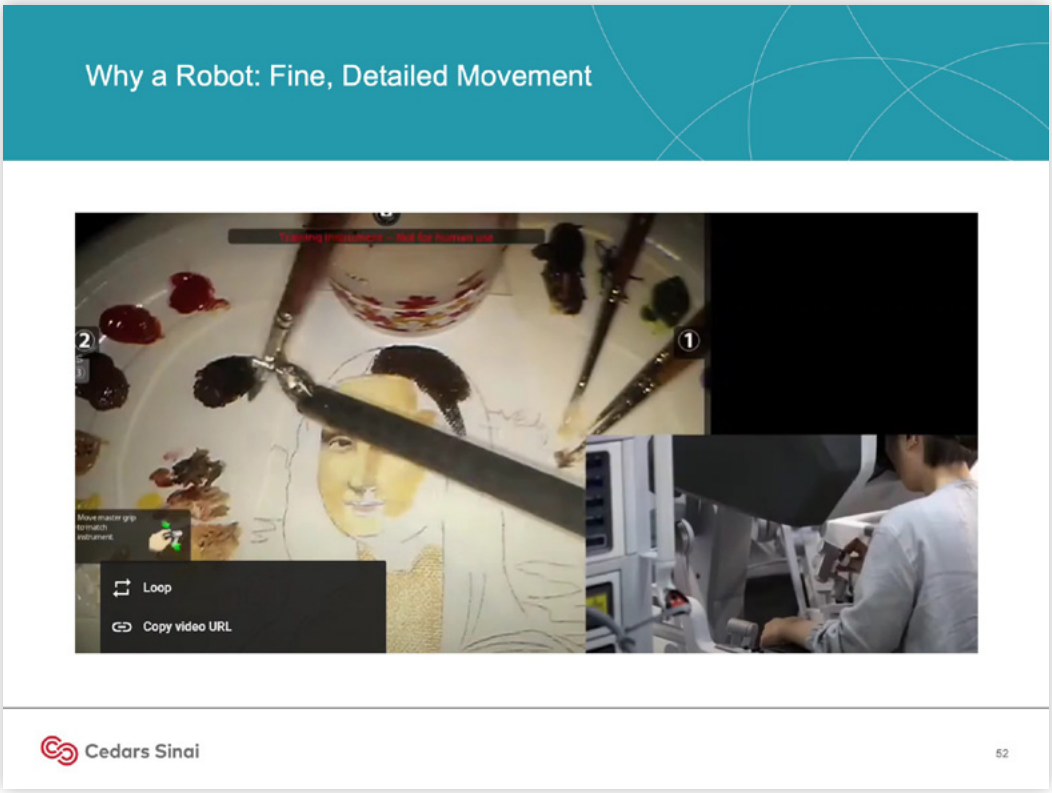
Dr. Dominic Emerson: The robotic platform that we use in all of cardiac surgery is called the Da Vinci Robot. It's built by a company called Intuitive. There have been several iterations of the device over the years, but in principle, this is just a tool that the surgeons use to make tiny movements in the chest with these instruments that are basically like little hands on a stick.



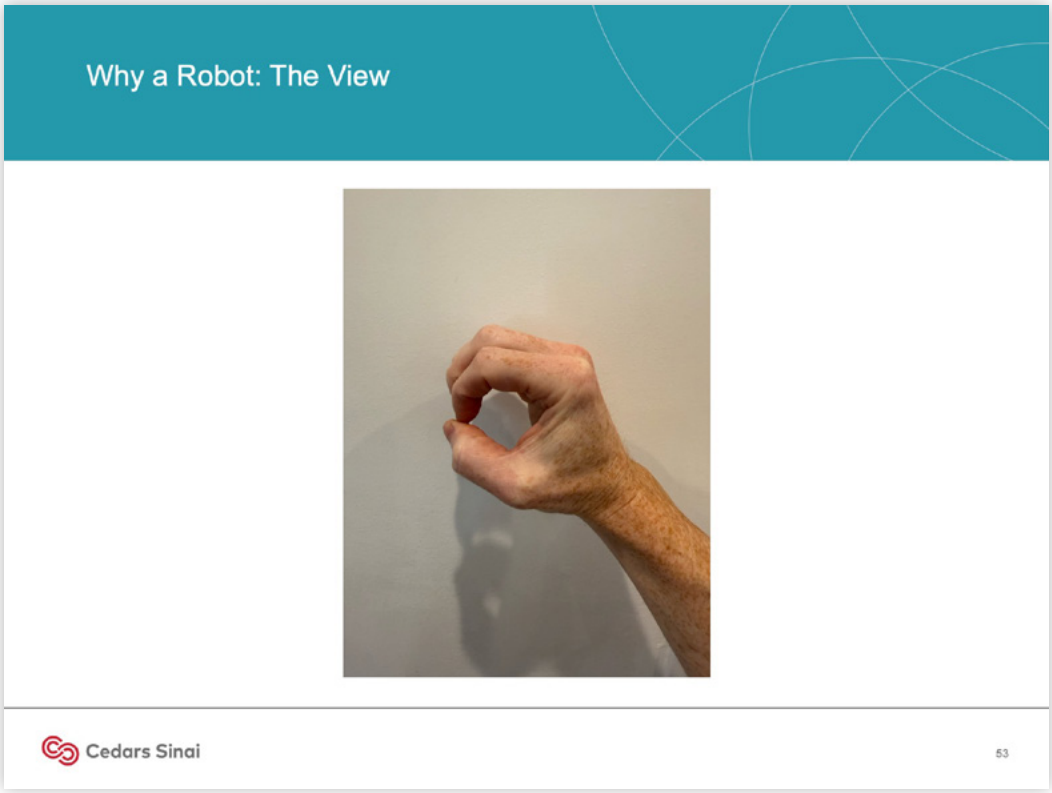
Why use a robot? It is just because we surgeons get excited, the prospect of using this cool tool and the surgeons.



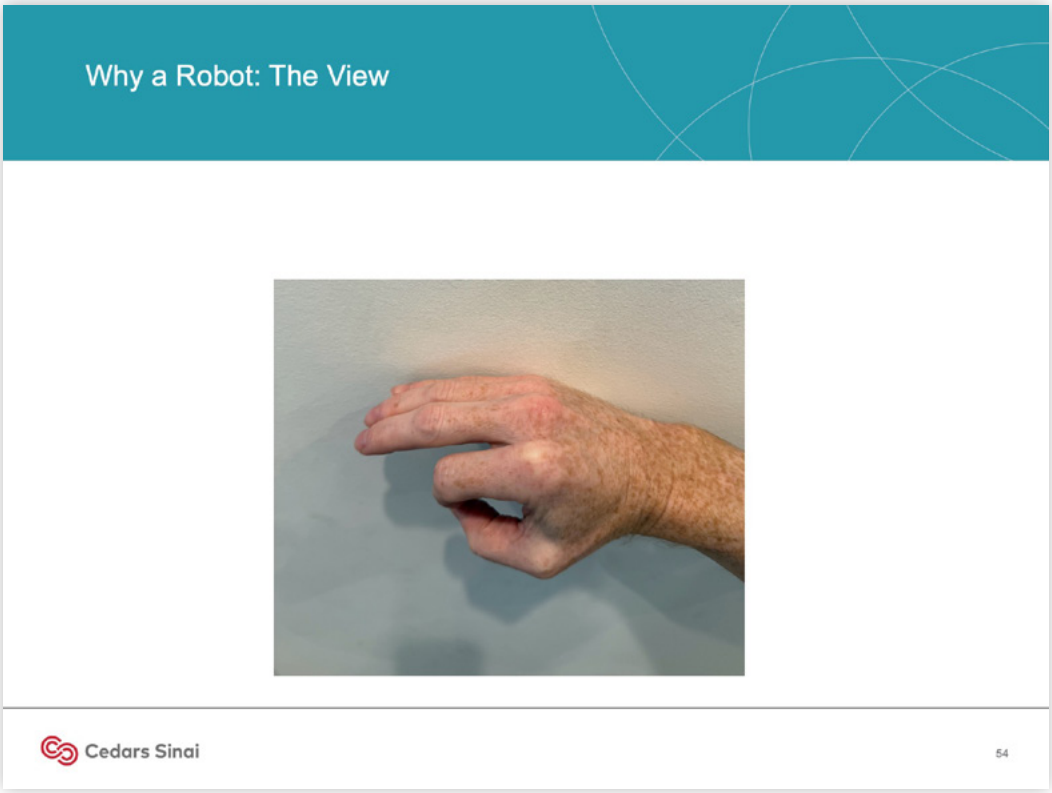
A little bit more than that, the truth of the matter is that the robot not only allows us to keep incision small, but allows us to do some really amazing things that are just simply not possible without robotic assistance. This is one of the training modules that we developed. It looks extremely low fidelity because it is, but it's just to help some of the residents get to learn how the robot works and we do some teaching with it. You can see that those tiny hands, those hands for reference are smaller than a dime. They're about the size of your pinky or your pinky nail, I should say, and we're able to do a lot of very fine work with them.



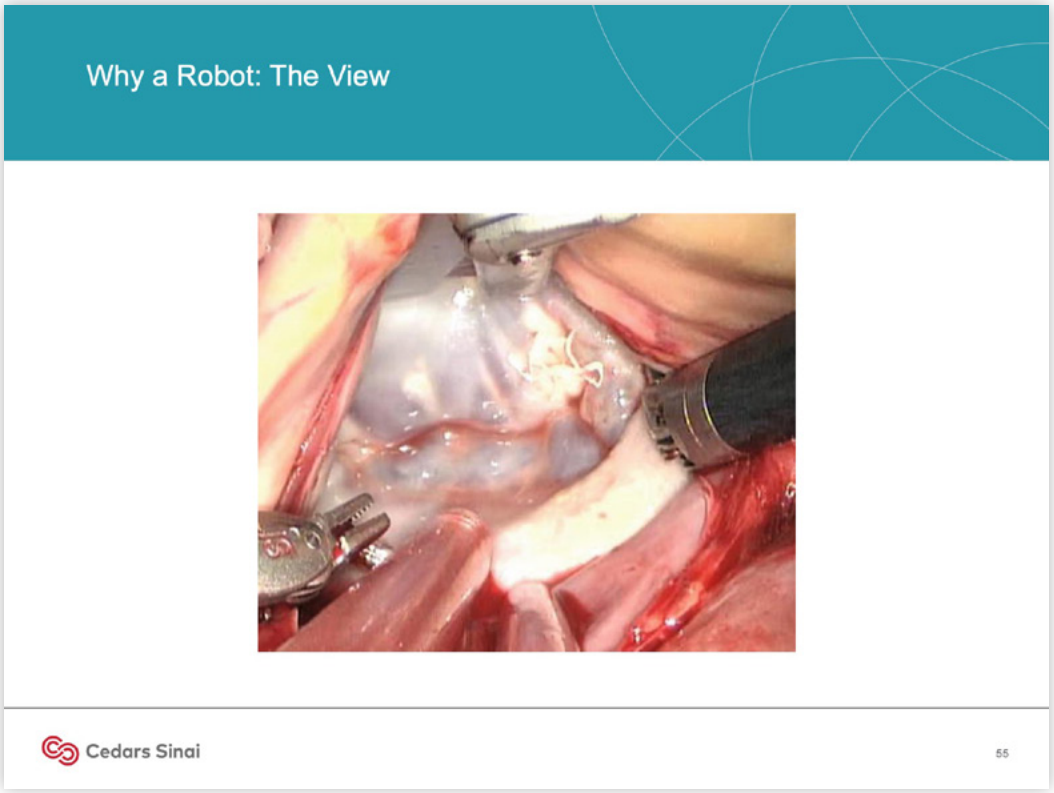
This is just an example of how fine that work can be. Oh, sorry. This should play. Thank you. This is a video of an artist. It's not me, unfortunately. I'm definitely not that good. What's really amazing here is not only the fine detail that this woman's able to do with the robot, but the painting that she's there is the size in total, that total size of the painting is about the size of a credit card. You can imagine how tiny those movements can be to get that amount of detail out of it with the robot, and that's something that we just simply can't do open with our hands.



The other reason I really love the robot is the view that I personally get. Your mitral valve, for example, if everybody puts their hand out and you make like that, that's about the size of your mitral valve, and this happens to be my hand, but that's not the view I get with an open surgery.



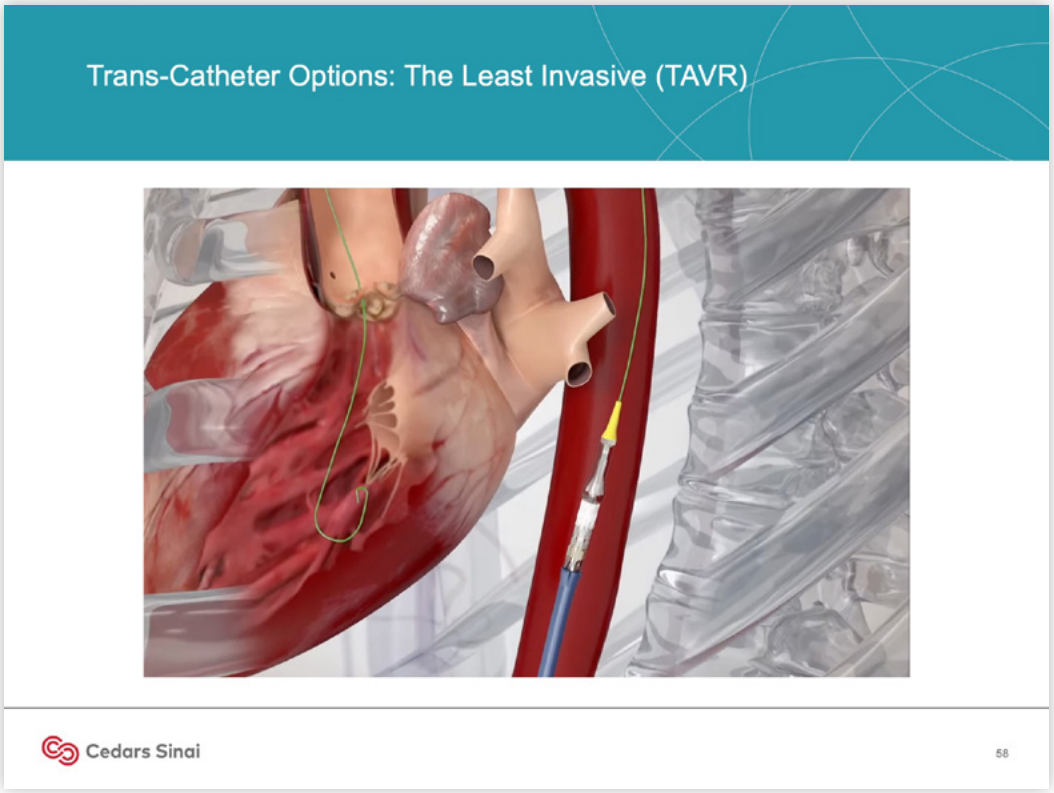
From a sternotomy, I'm looking down on the valve and as I rotate it up, I don't get the perfect angle on it because it's down in the chest. This is more or less the view I get from it. I can still see the valve, I can still work on it, but the exposure is not nearly as good.



This is an image of what we get with the robot. You can see here that I'm seeing the valve face on. It's zoomed in, it's in ultra-high definition in 3D for the person who's on it, and so instead of the valve being this, it looks like it's like this in front of me. As a consequence, I get to be able to do things and see things that I wouldn't be able to do otherwise. I can do a little bit finer work with the robot, and I think the repairs are just a little bit better.

Transcatheter Options

Dr. Emerson: Again, moving to the least-invasive option, this is the transcatheter realm, and that is certainly the least invasive option we have. You can go to the next slide. This option originated with the aortic valve, the so-called TAVR or the trans aortic valve repair, and it replaces the aortic valve that is delivered through a blood vessel in your groin generally, although there are some other access options, and it is by far the least invasive option. There are no incisions.

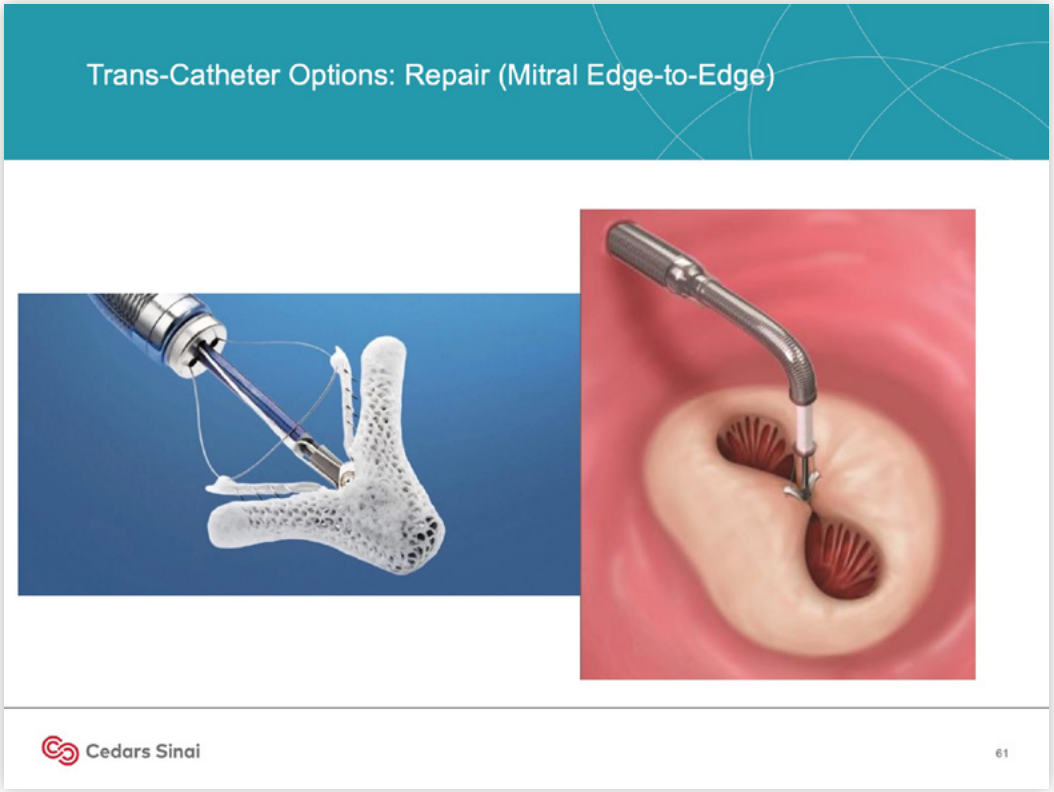


This is a video from Edwards, one of the manufacturers of these valves. This is just one of the different valves in the market, and it shows what this looks like. They are able to gain access through a blood vessel in your groin, and then push the valve, which is on this long across the aortic valve, which you see there; and then they can adjust the valve, they can get really good view of it. This is done with an echo that they're doing real time as well as some fluoroscopy or a live x-ray that they're doing, and then after it gets positioned in the right space, they can inflate the valve, which you'll see here, hopefully in just a second. They inflate the valve and now that new valve has pushed the calcium to the side, pushed the old valve to the side, and now you're left with a good working valve in its place.

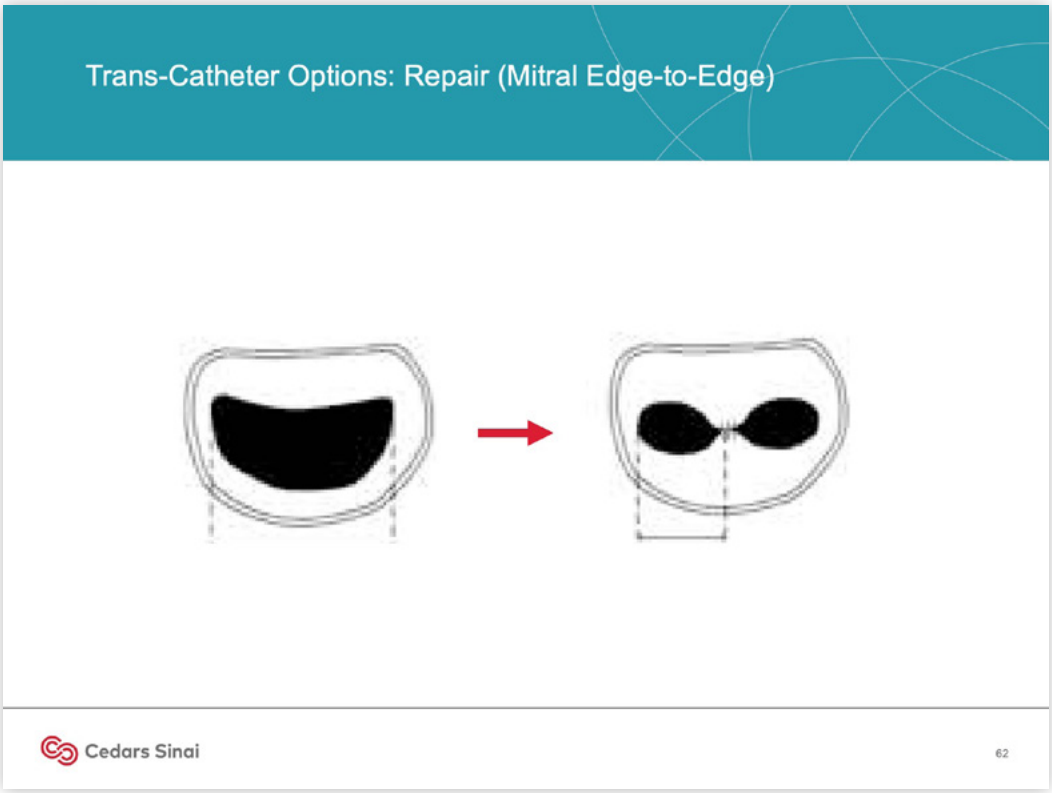
Transcatheter Reoperations

Dr. Dominic Emerson: The valve ultimately at the end looks very similar to surgical valve. It's moving in the same way. It just happens to be done in a much less invasive approach. One other important thing to mention, I touched on it a second ago, is valve and valve options. This is a technology that is much more recent in its application, but it has really changed how we approach valvular repair or replacement, especially in the aortic position. This is a TAVR valve and not all valves are candidate for this, but when it needs to be redone. On the outside here, what you're seeing is a surgical valve that may have been placed and had failed 15 years later. A new valve can be placed inside it using this TAVR technique, and that's what the end result looks like. I think that this is, as I mentioned before, really changing the way we as a surgical society think of tissue valves and who should be getting what, when.

Transcatheter Mitral Valve Clips



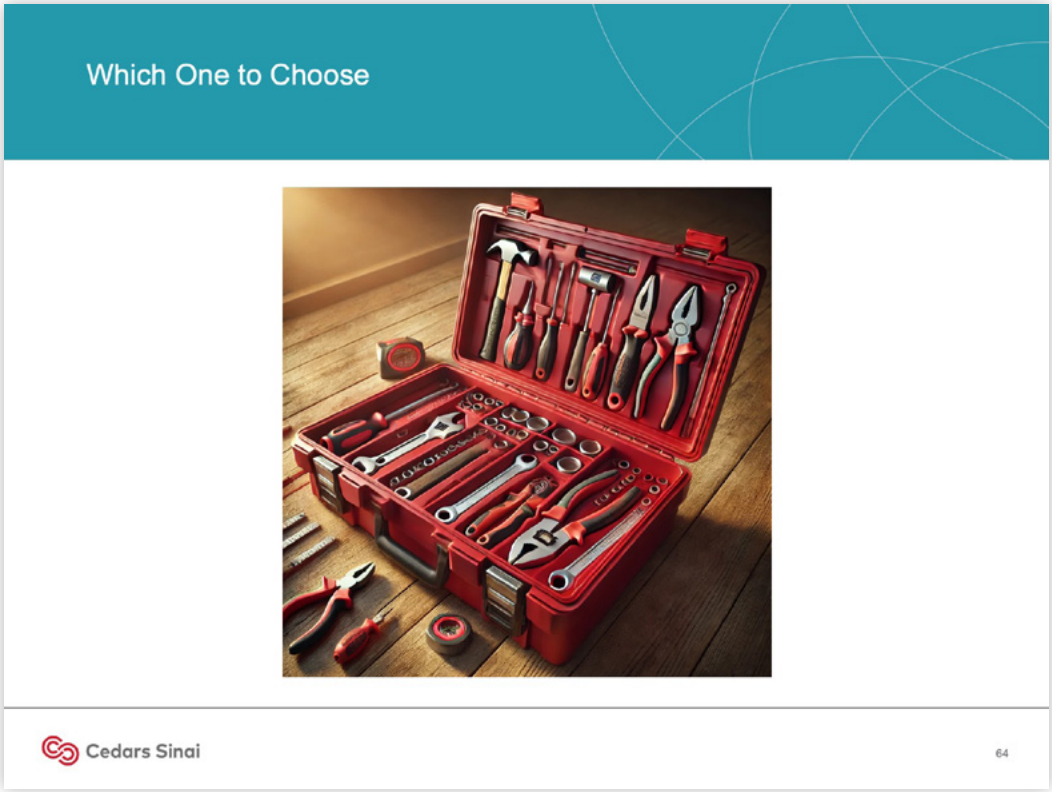
Dr. Dominic Emerson: There are other transcatheter options and more recently a repair from the mitral valve has also come to market. This is mitral valve edge to edge repair, which we'll sometimes hear as the mitral clip or teer T-E-E-R. The mitral clip happened to be just the first one to market, and so that's gotten the name for it, although there are other varieties that are not made by that same company now. What this does, it's again, deployed from a blood vessel in the leg, doesn't require an incision, and it helps to slow down or stop the leakage specifically. It's only for mitral regurgitation.



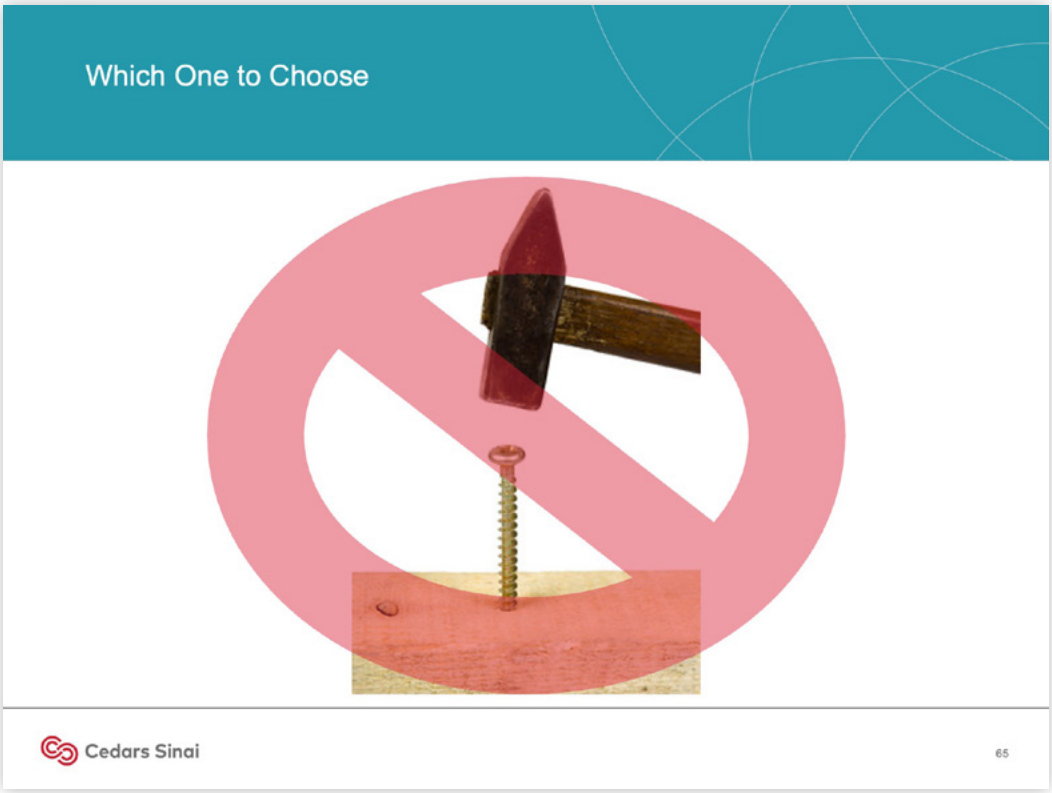
What mitral T-E-E-R does, it effectively pinches the middle of the valve together. Generally what happens is the valve leaflets when they're coming together, if they're not sealing well, one side's coming up too high or they're just not coming together very well, the teer, the clip will pinch those pieces together right in the center as you see on the right side, and help reduce or eliminate that leak. It has changed how we address patients who have mitral valve regurgitation especially in patients who are higher risk.

This is not necessarily mainstream for every patient. As I mentioned before, most patients with mitral valve disease will still be needing to go towards a surgical route, which is what I do, and that may be approached mainly invasively, but teer, this is becoming a larger part of what we do in terms of mitral valve repair for people who have leaky valves. Now it's become an important part of our armamentarium recently.

Which Procedure To Choose?

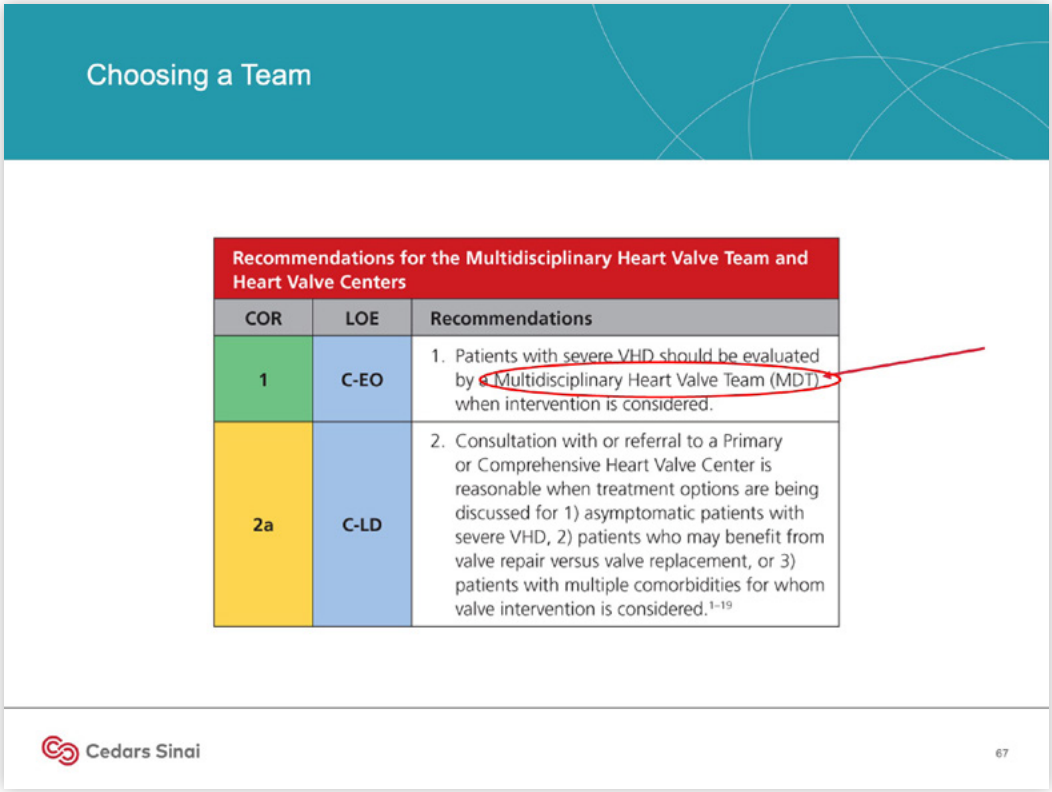


Dr. Dominic Emerson: Which one are you going to choose? Ultimately, it's just a toolbox. There are a million different ways to do it, and it's going to be very patient specific, patient dependent. That means that picking the right tool means having the ability to adjust, and I think that's really, really important.

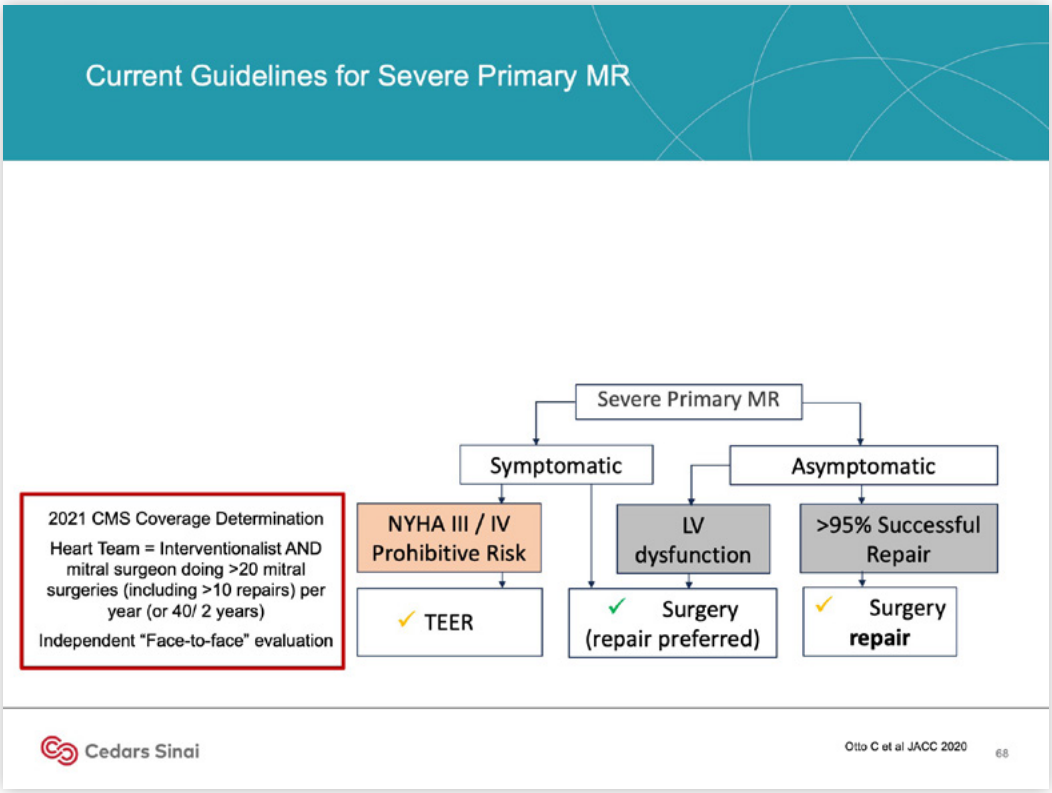


Not every tool is the right tool for every patient. Forcing the tool you like to use the most on every patient is going to be a bad idea. It's the don't use a hammer to drive a screw idea. You've got to be able to adjust and find the right thing for an individual.

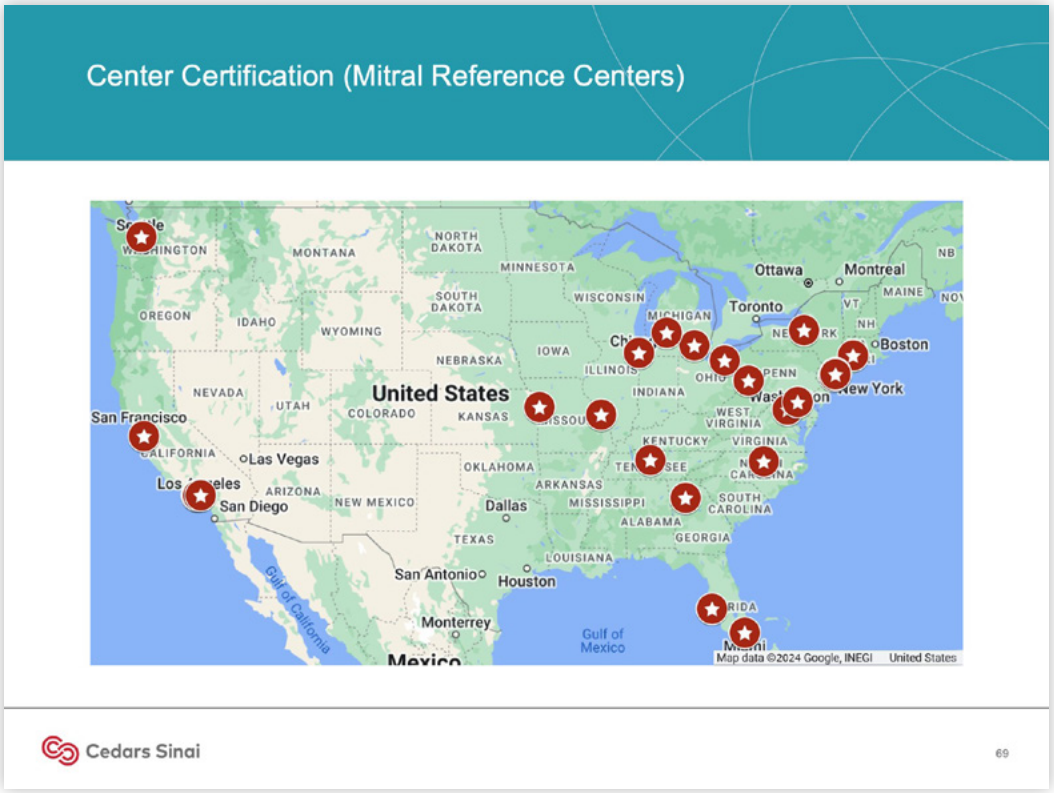
Choosing a Heart Team



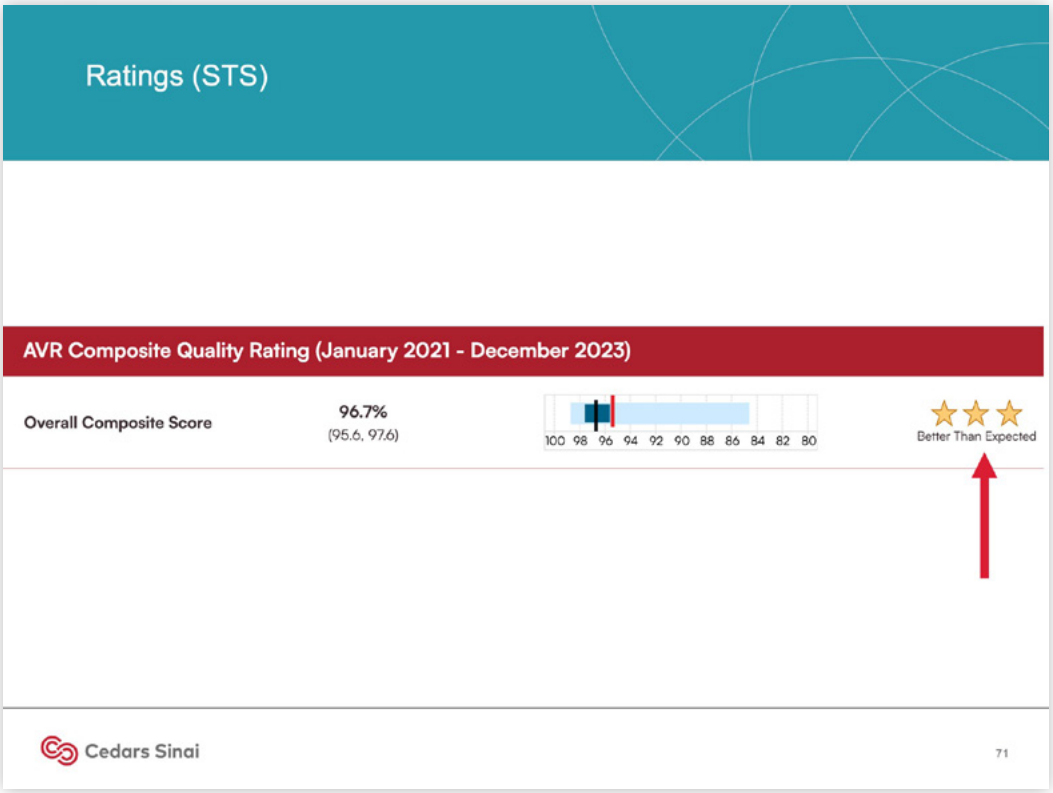
Dr. Dominic Emerson: That gets to the next thing I wanted to talk about, which is choosing a team. One of the most important factors or elements for choosing your team, so choosing the people that are ultimately going to intervene on you and help you get through this valve problem that you have. One of the most important elements for that is making sure that there is actually a team. The guidelines recommend, again this is what the large societies have put out and it's very data-driven, that a real heart team is very, very important. This is a snip from the AHA guidelines, and in time and time again it has been shown that having a multidisciplinary team that involves a surgeon, cardiologists, everybody else, that really improves patient outcomes, improves your outcomes. Making sure that your surgeon or your cardiologists are not making decisions in a vacuum is the best way to get the right care for you as an individual.



This isn't just a good idea, it's effectively the law at this point. Medicare itself actually requires a heart team evaluation for every patient that's going to undergo specifically mitral regurgitation, for example. Mitral valve disease by the algorithm here you can see clearly requires that, and so that all good centers should be involving an entire team. Next slide. In addition, there are certifying bodies and other groups that track outcomes which can help you give a sense of where an individual center is in terms of expertise and outcomes. This is a map of, for example, mitral reference centers.

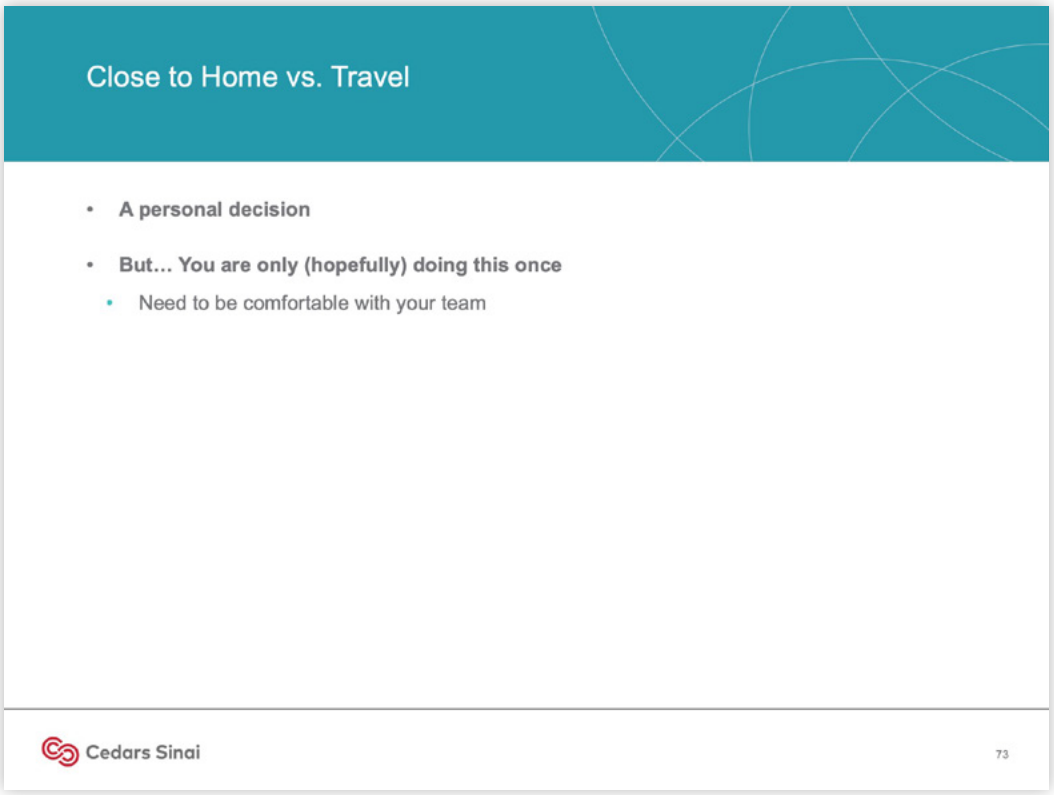


These centers have met additional bar of excellence and some very strict requirements and experience. Being one of these centers indicates both high volume and a high repair rate for the mitral valve. You can see that there's not a ton of these centers across the United States, however.



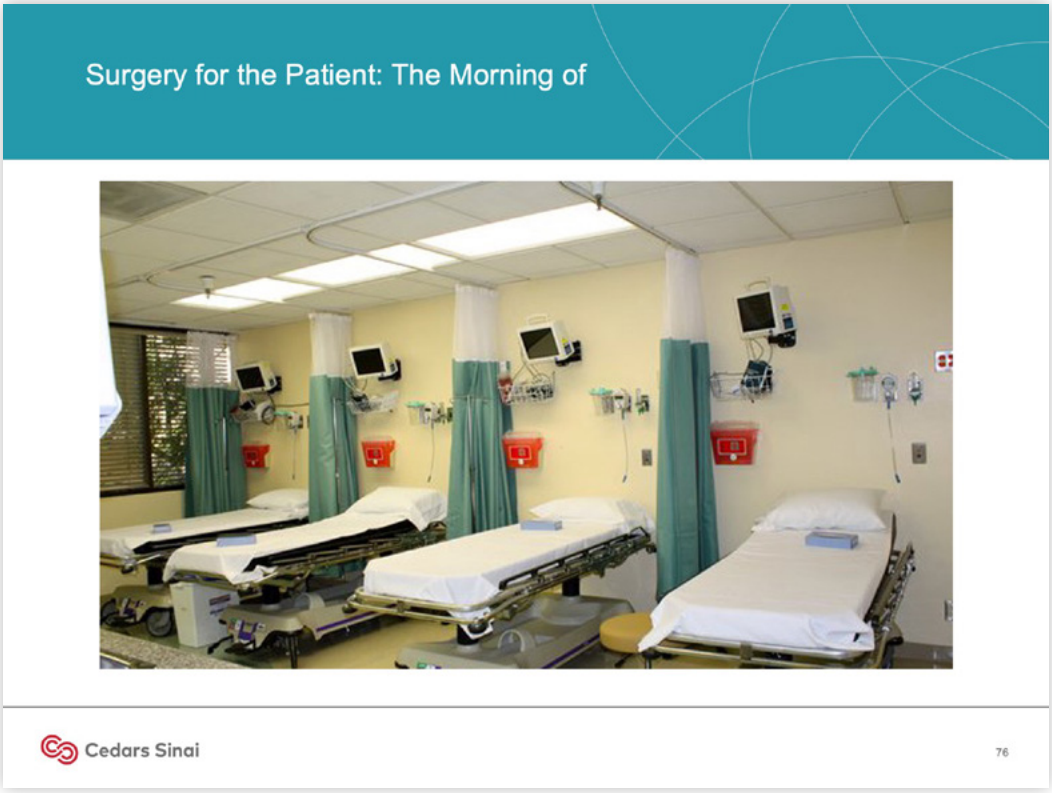
Additionally, the Society of Thoracic Surgeons themselves publish publicly reported documents that indicate the success of individual centers for mitral valve work. One important caveat of this is all publicly available on the STA website, but one important caveat to this is that the score can be highly influenced by the sickness of the patients, and so centers that take on much sicker, much more complicated patients may have lower star ratings, which you see on the right there, than centers that are more community-based and maybe not taking those complex patients. That's an important consideration. In general, if this rating is one star, that means that the outcomes are much worse than expected and that's generally not a good thing to that center. Two stars is as expected, like 80 plus percent of centers will be in that range. That's a very safe range. Three stars is somebody that has well exceeded the expected outcomes.

Traveling for Heart Surgery



One of the other things that patients will ask me is,"Do I go to one of these centers? Do I stay close to home?" I don't necessarily have a right answer for that. Being able to be accessed like here in LA to fantastic centers that are really close to you is wonderful, but traveling for LA if you're coming from north of Bakersfield or something like that is a difficult decision. I don't have it necessarily the right answer for every patient. It's very individualized. You can go to the next slide. One thing I do tell people is that I know you don't necessarily want to travel, and there actually may be fantastic physicians in your community, which is great leverage that if you have it, but you're only going to be doing this once, hopefully, and you want to have the best team that you can to be able to do that. Patients or people will travel to come to Disneyland but they don't want to travel for their surgical care. Again, that's a personal decision, but I would really highly suggest that you pick the center that's going to be right for you and go to a place that has good experience.

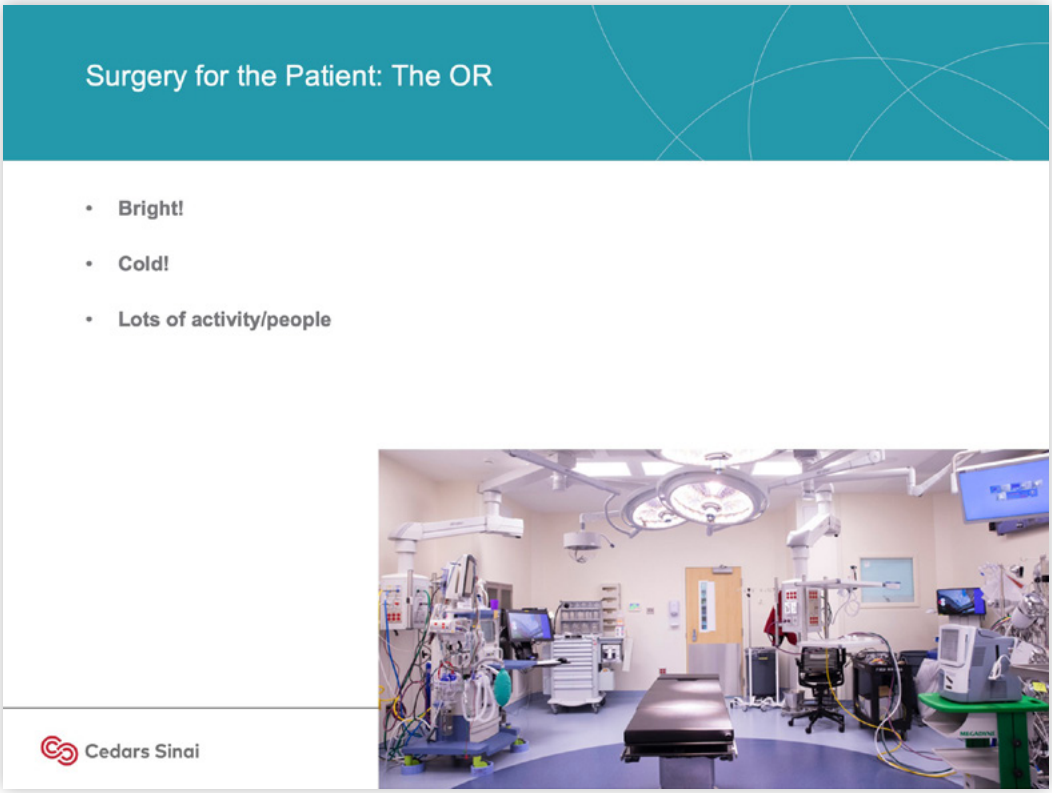
Being In A Hospital



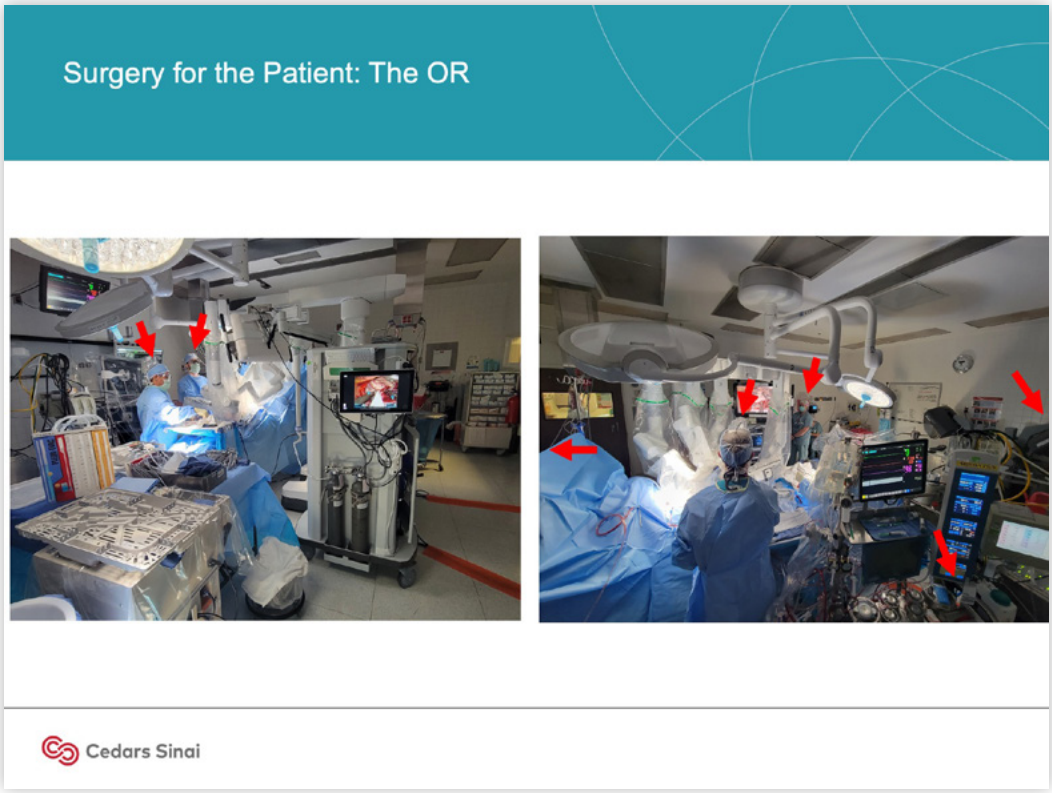
Dr. Dominic Emerson: Finally, I wanted to quickly talk a little bit about what to expect in the hospital. The caveat to this is it's varied, very much depending on the patient. Everybody is going to be different. Please don't email me and say, you said it was going to be four days and it was five days. I want the best for you as every surgeon's going to want that. If five days is the right amount of time for you, that's what's safe. That's what you should get. These are ballpark figures.

That's the first. Patients days will typically start in a room that looks something like this. This is called a pre-op area or sometimes a pacu, which is actually post anesthesia, but it gets used for both things by your nursing team and your anesthesia team.

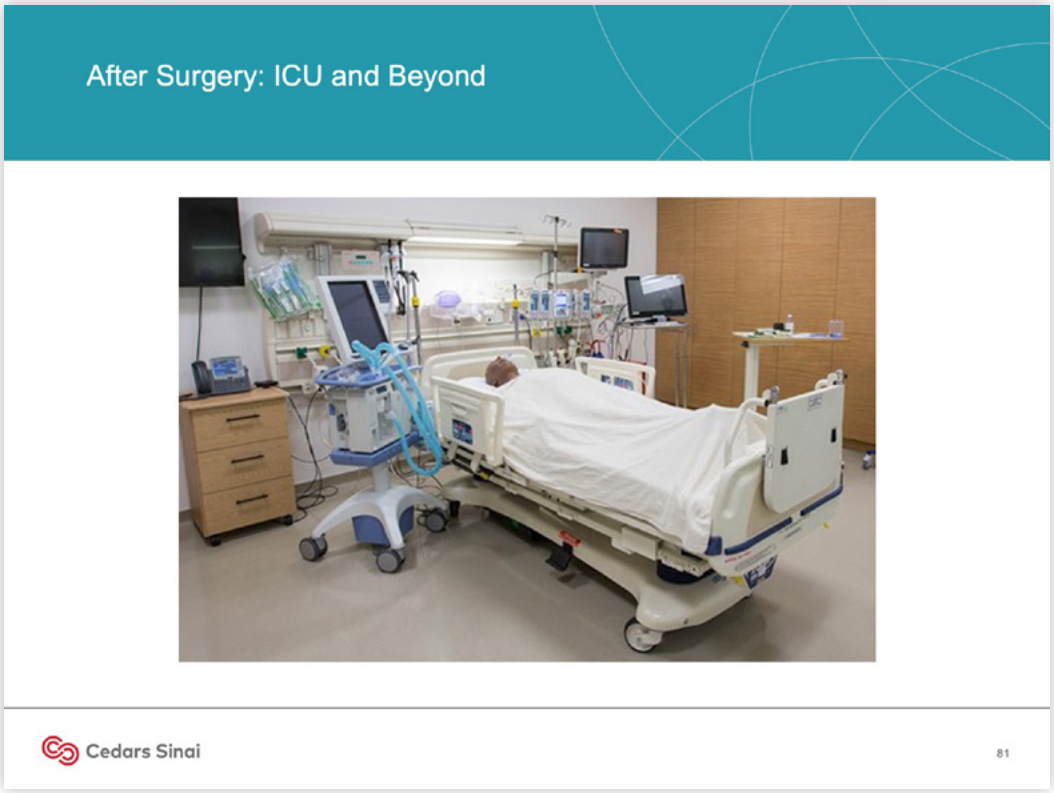
Depending on the individual hospital and what kind of procedure you may need, blood drawn, an IV may be inserted at that point. It takes a variable amount of time, maybe an hour or potentially more. You'll need to change into a gown and take off any jewelry. I would recommend not coming to the hospital with a whole lot of stuff as a consequence because you generally can't take it with you during the procedure. You don't need your watch, you don't need generally your phone, and if you have a family member handing it to them at that point it's great. Family in general is allowed to be with you at this point and for most of this pre-op area.



The next phase was going to the OR or the cath lab itself. The OR is a bright room, which is typically colder than you want it to be, especially now that you're dressed in the hospital's finest cotton gown. Just as a warning, the bed will also be really cold. Patients complain about that all the time. The OR is a busy place. There's a lot of activity going on. Your team will include a lot of people, but they're all there to help you. They want to get the best thing for you. They want to do what's safe. Try your best to relax. Anesthesia will be there. They'll help you with that. They'll help you with some medication to go off to sleep.

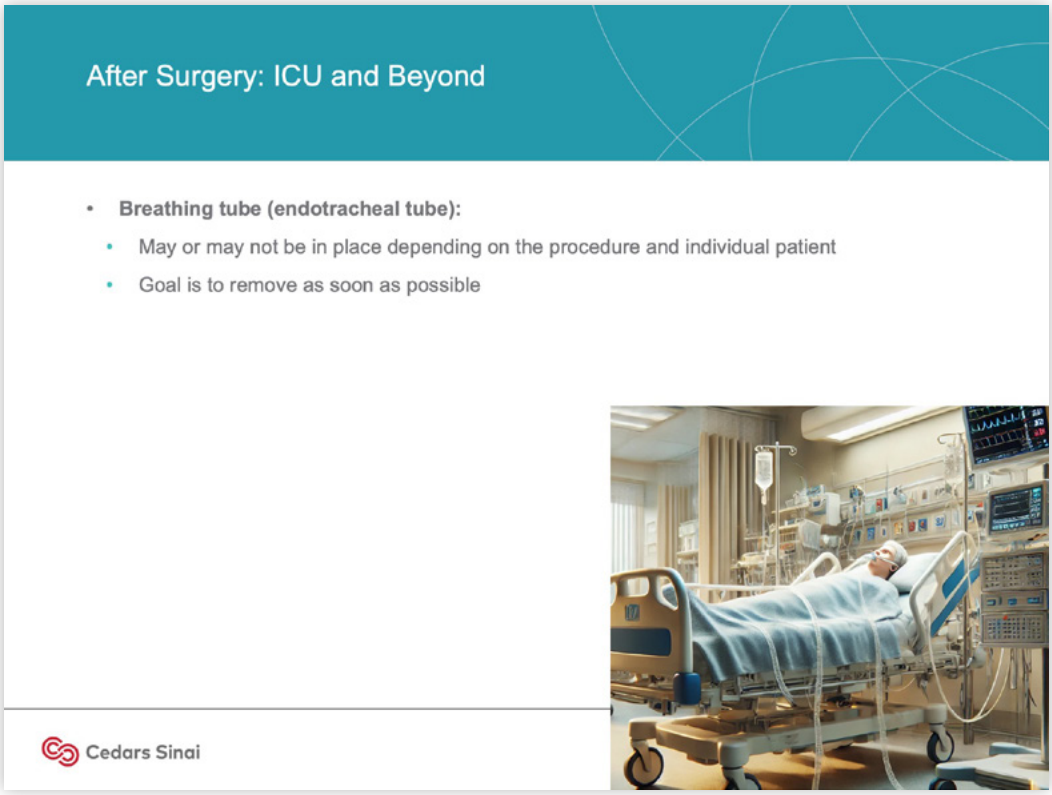


During the case, there is, like I said, a ton of people. You'll be totally asleep for all of this. You're not going to remember any part of it, but just to give you a sense what the room looks like. This is one of ORs. This is a robotic mitral repair that we were doing fairly recently. You can go to the next slide. The personnel here include – Adam, there's a few arrows that are going to pop up. The bedside surgeon right there, a scrub circulating nurse, which will pop up in a second here, perfusionist; a circulating nurse when we're down, perfusionist will pop up. That's there. The anesthesia team, which is one to three people, and the primary surgeon in this case, which for robotic case is off there at the console. It varies a little bit obviously based on what the procedure is.



After the operation is done, you move out to the ICU in general, although again, that changes a little bit based on what you're having done. This is not an actual patient. This is our simulation center downstairs. That's a very, very expensive fancy mannequin that we use for training, but this is generally what that setup looks like. As with the OR, there's a lot of stuff going on here, multiple machines, lots of nurses. Most people are in the ICU about a day. If you're having a TAVR, many of those patients do not go to the ICU, they will go to a pacu. It can be a little different, but for most surgical repairs, you're going to go to the ICU generally, like I said, for about a day. After that, it's off to the regular hospital room.

Ventilator Tube Removal

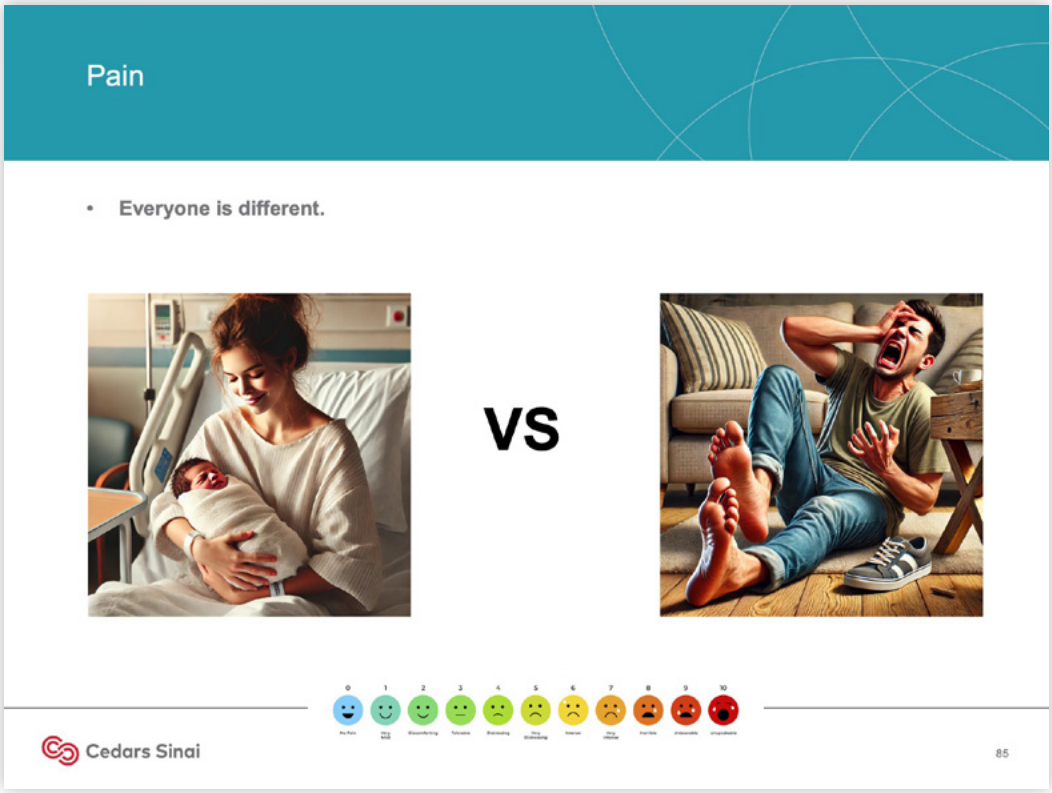


Dr. Dominic Emerson: A couple other things to discuss, the breathing tube specifically. We get a lot of questions about the breathing tube. For most of these procedures, with the exception of some TAVRs, you're going to need a breathing tube during that. You'll be completely asleep when the tube goes in. Most people don't remember the tube being in at all, but it's something that people do worry about. The goal to taking it out is that you have to be awake enough to be able to breathe on your own to get it out. We also don't want you too awake so you're not uncomfortable; finding that balance and the base perfect, to be totally honest, but if you wake up breathing tubes in, that's a good thing. That means the procedure's over. It means that we're going to get it out really soon and you're doing great. Somebody you'll be there talking to through all of that and we'll get it out as soon as we can.

Pain

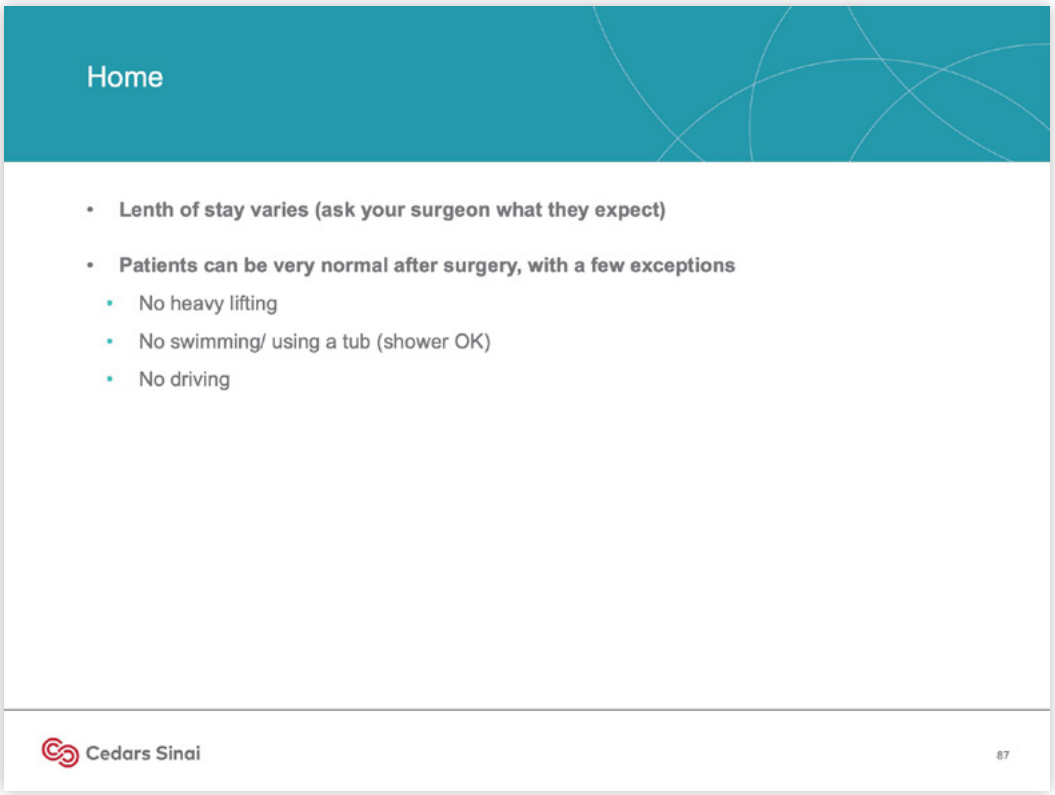
Dr. Dominic Emerson: Pain is something else that everybody wants to discuss, and I think very importantly everybody will have some pain during the course of their procedure. Even getting your blood drawn has some pain with it. We as providers can always do the best job of preparing people for pain. I think the first step is to acknowledge that yes, you're going to have some pain. I can't possibly eliminate pain. All I can do and will do is try to make this better, try to get you through it as best as we can, recognize your pain, but I can't ever make it completely zero.

One of the reasons that it's a little difficult to estimate pain and to talk about it is because everybody's very different. I like to tell people that there are right now behind me in this hospital, women who are giving birth without an epidural.



Then there are people who stub their toe and they're out for the day and I don't know where on that spectrum you as an individual are along and some people just do better with it than others. Some people are just really pain tolerant. We have to tailor the medication to what you need. Everybody's going to be a little different. I can promise you though that we are going to be very actively involved in that. We're going to support you as best we can. We're going to get you through it. Next slide. To do that, we use a multimodal approach that includes things like narcotics, when you need it, something called blocks where we specifically address nerve pain on the side where we've operated. Finding the right balance between all of those things is really important and again, it's an individualized thing.

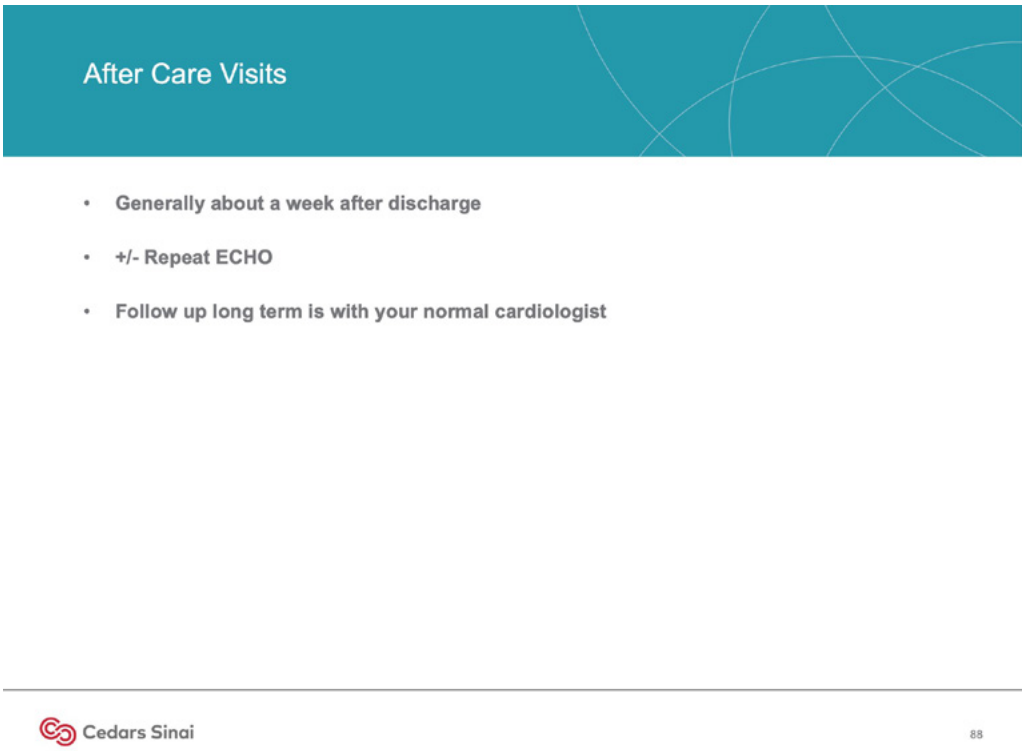
Length of Stay In Hospital



Dr. Dominic Emerson: What about going home? The length of stay, there's procedure. I think it's important to talk to your team about this before you come in. There will be a little variance, even if they tell you X number of days. There's a little bit of variance there just because we want to do what's safe. In general though, you can be very normal after surgery. I have patients who generally walk around the next morning after surgery, we get them out of bed, stretch their legs, move around. After surgery you can do pretty much whatever you need to do. There are some exceptions though. No heavy lifting in general. That goes on for a variable amount of time, but is

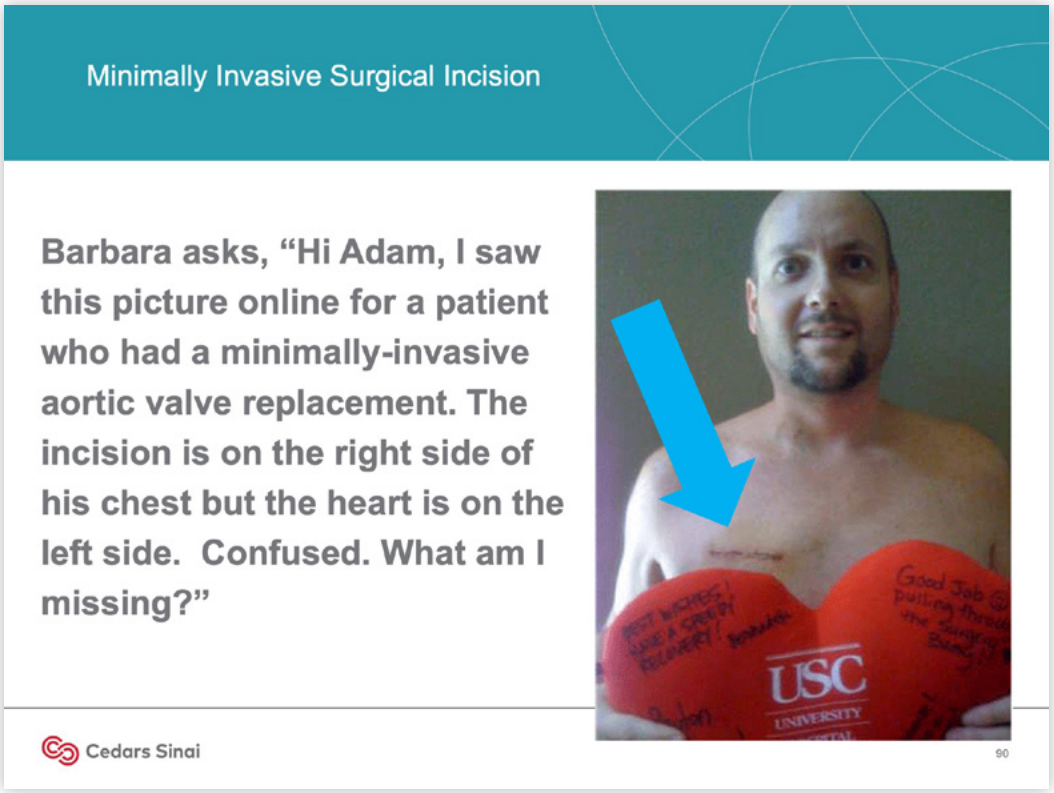
up to six weeks. There's no swimming or using a bathtub. Shower though is okay. You can do that when you get home. Then we don't let you drive for a little while. That's because if you're on a narcotic pain medication, obviously we're not allowed to let you drive. If you're sore, we want to make sure that you're moving this 3000 pound piece of metal around that you're going to do it really, really safely, and that's why we don't let you drive. It's not that you couldn't do it, we just advise you not to do it for a while.

After Care Visits



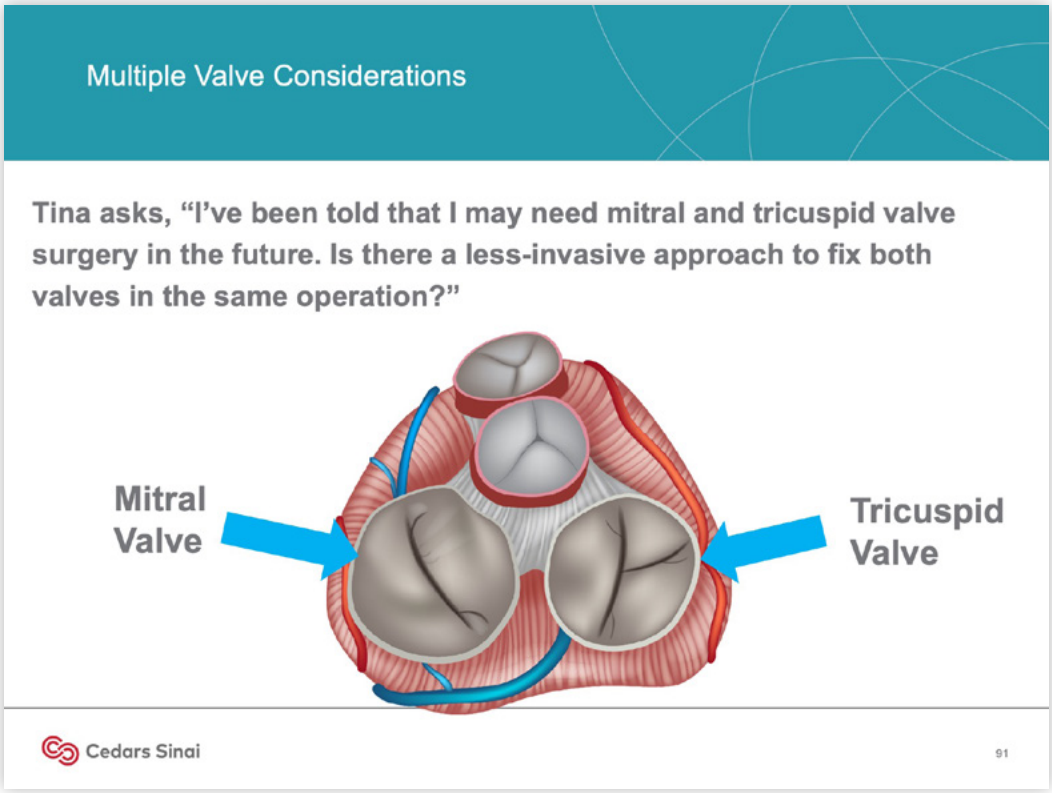
Dr. Dominic Emerson: After you leave the hospital, we generally see about plus or minus a week after your discharge. Often you get a repeat echo at that time, and then you're back to your regular cardiologist and they will follow you. Just because your valve is repaired and looks beautiful doesn't mean you never need to see a cardiologist again. It's important to remember that those people that saw you coming in, the people that referred you to see me or to see whoever else are going to follow you generally for long-term to keep a cosign on your valve to do echoes periodically, they may be also managing blood pressure, that sort of thing.

Questions & Answers



Adam Pick: Dr. Emerson, I cannot thank you enough for the prepared remarks. While you have been talking, we have received over 40 questions online. I've received texts, I've received emails, and so why don't we not waste any time and get right to the questions. The first one comes in from Barbara, and you addressed this earlier, but I just want to make sure all the patients understand this. She says, "Hi Adam, I saw this picture online for a patient who had a minimally invasive aortic valve replacement. The incision is on the right side of his chest, but the heart is on the left side. I'm confused. What am I missing?"

Dr. Dominic Emerson: Yeah, so one of the things that we have to do as part of the pre-op and part of our safety check that we do is I come in and I mark all the patients, so I have to come in and write a little yes on the side that I'll be operating on and I always joke with patients that I'm putting the mark on the right side of your chest. I know where the heart is, don't worry. The reason that we put the right mark on the right side of the chest is because that's the easiest way to access it. We feel the heart on the left side of the chest, that's because that's where the apex of the heart is, the tip of the left ventricle, which is the most moving part and that's why you feel it the strongest there, but your heart's basically right in the center here, and to be able to access the aortic valve, which looks like this gentleman had, you want to come in right above it on the right side of the chest, a little lower down. We would come in for the mitral valve. The mitral valve we get to through a similar incision. Generally if it's robotic, it's going to be a bit smaller than that, and we come out at the back of the heart effectively, which we access from the right side of the chest.



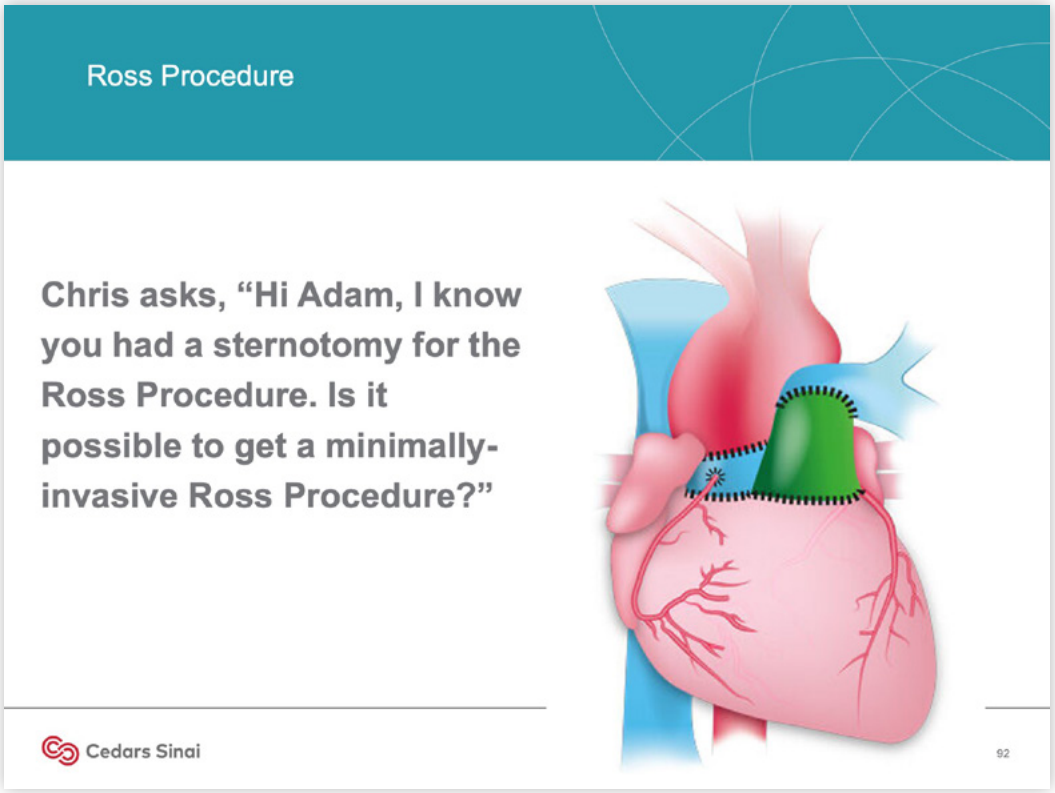
Adam Pick: We're moving on to Tina. We've gotten a couple questions about this about multiple valve operations. Dr. Emerson. Tina asks, "I've been told that I may need mitral and tricuspid valve surgery in the future, is there a less invasive approach to fix both valves in the same operation?"

Dr. Dominic Emerson: Yeah, so that's a great approach. A minimally invasive is a great approach for that, I should say. This is actually what I did this morning. We can address both pathologies and actually a mitral and tricuspid valve is fairly commonly done. We can do that with a minimally invasive approach, small incision looking directly through, we call it like a thoracotomy approach or like I did today, which is with the robot, same robotic repair of the mitral valve that we would normally do, and we can access either repair robotically. In some cases, we use the robotic for part of it but not the whole thing, but it's done through this for the tricuspid, I should say, and it's done through the same

normal incision that we would do with a robotic approach. It's that same very small incision with a couple other little small holes for the robotic arms.

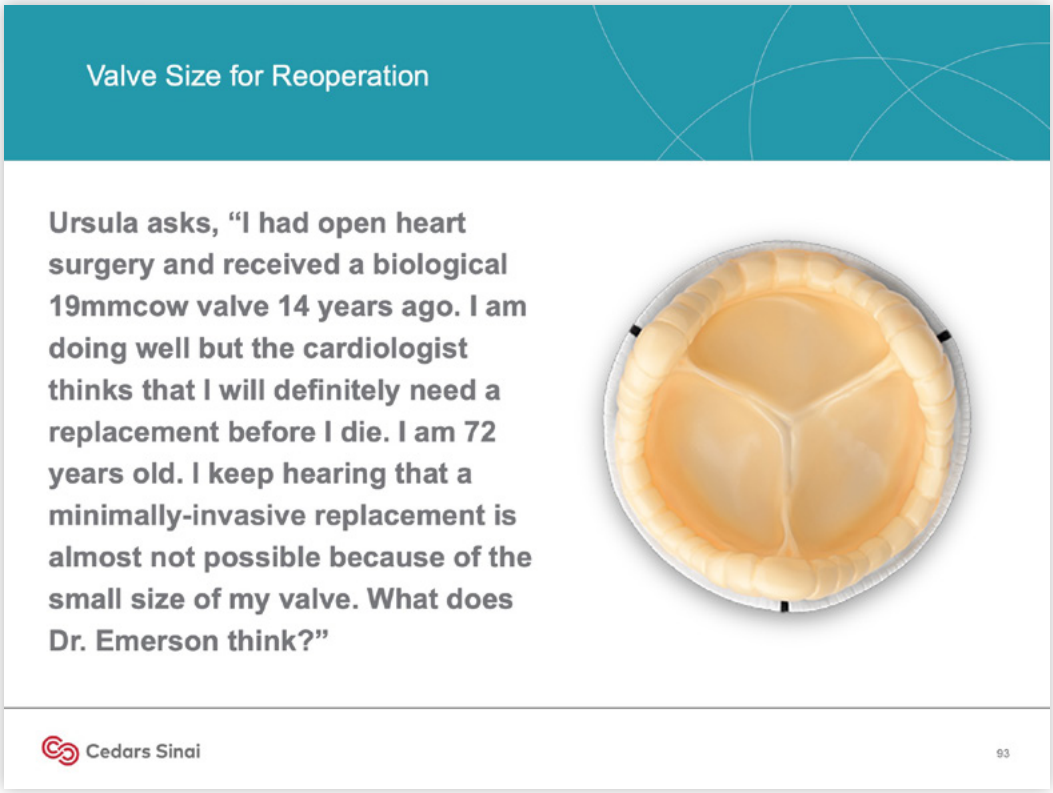
Adam Pick: Dr. Emerson, I know a lot of folks up to 30 some percent can have AFib if they have mitral valve disease. Can you also use the robot a multiple procedure, valve procedure and do a maze procedure all using a minimally invasive approach?

Dr. Dominic Emerson: Absolutely, so it's actually pretty common. As you mentioned having these arrhythmias AFib is very, very common in patients who have mitral valve disease. While we're in there, I'm literally looking at the – because we access it through the atrium, that's how we get to the valve, at the area that we would do the lesions, the special scars that we create with the maze procedure, which is the procedure we use to address AFib. I can do that very easily as an adjunct to a mitral valve repair. Additionally, while I'm in there, I'm also looking at the left atrial appendage. The left atrial appendage is if you imagine the top chamber of your heart, the atrium is like a room, left atrial appendage is like a little closet on the side of the room. The concern is that in AFib, that can get clot in it and that can lead to a stroke, and that's why patients are on blood thinners with AFib and that's the biggest risk for AFib is actually stroke is the thing we worry about the most. While I'm doing a minimally invasive mitral, I'm actually looking at the atrial appendage, and I can close that off. I seal the closet door, if you will completely, and it doesn't open anymore. As a consequence, you don't have to worry about stroke burden from that. It's something that we add on to actually a good number of these cases.



Adam Pick: Great, let's move on to Chris. He says, “Hi Adam, I know you had a sternotomy for the Ross Procedure” which I did, I'm now nearly 20 years out, I have not had a reintervention or reoperation. My heart is doing great, but specific to this conversation, Dr. Emerson, Chris asks, “Is it possible to get a minimally invasive Ross procedure?”

Dr. Dominic Emerson: Unfortunately, because the Ross procedure involves really two valves, we have to access the pulmonic valve and the aortic valve, and then it's not just the valve but we're also redoing the aortic root. It's not something that's generally amenable to a minimally invasive approach. The Ross procedure isn't done nearly as the rest of the valve procedures. I think that going to a center that has that as an option is an excellent thing. I think a Ross, Adam and your testament to this, it is a fantastic procedure that in the right patient can yield extremely, extremely good results, but unfortunately because it's more invasive, it's more work, it's not something that we do minimally invasively.



Adam Pick: Great, let's move on to the question from Ursula, and this is a fantastic question. She says, “I had open heart surgery and received a biological 19 millimeter cow valve 14 years ago. I'm doing well, but the cardiologist thinks that I'll definitely need a replacement before I die. I'm 72 years old. I keep hearing that a minimally invasive replacement is almost not possible because of the original small size of my valve.” What does Dr. Emerson think?

Dr. Dominic Emerson: That's a tough question because these valves can be very different depending on the manufacturer and for the valve itself. This has changed a lot in the last probably five years for a variety of reasons, one of which is now the valves, because the valve manufacturers are thinking, okay, we have to plan for potentially valve and valve procedures, these minimally invasive procedures, they're realizing that the valves have to be able to stretch and that

thing. They're actually designed to valve and valve TAVR at some point. The older valves certainly weren't that way, and that's probably why they told you that. Sometimes they can still do it at more experienced centers, but that depends a little bit on the type of valve you have. It's hard for me to be a hundred percent on that. That being said, we do a lot of redo valve procedures on patients, and though it is often a full sternotomy, it's a bigger incision, we get patients through it. It's a little tougher than the first time you had it 14 years ago, certainly, but we can get you through it and we can do it safely.

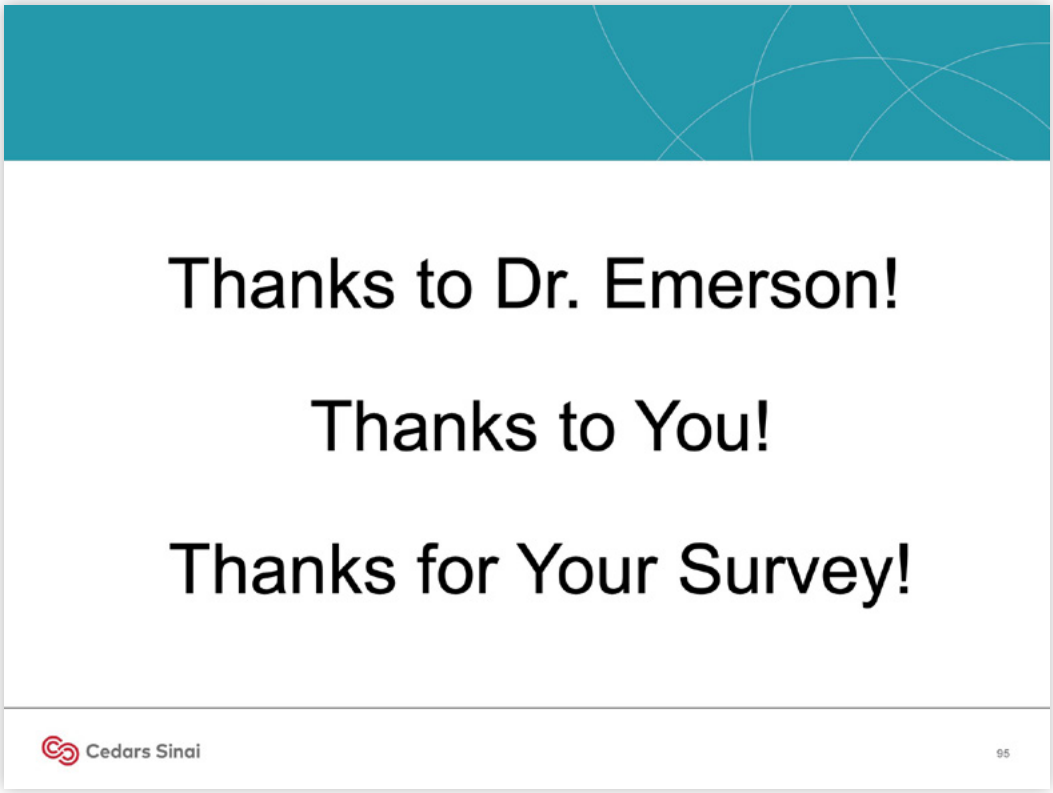
Adam Pick: I love what Ursula brings up here, and you talked about earlier Dr. Emerson, which is planning for the lifetime management of valve disease. If you're a patient on the line, you've not had a procedure yet, I'm guessing Dr. Emerson, you might recommend that when you do get that first replacement, you want it to be as large as possible?

Dr. Dominic Emerson: Yeah, so that's an excellent point and it's very individualized. It's a little nuanced for each patient, but in general, when we're doing a surgical valve, specifically the aortic valve, we clean out all that calcium that's around the valve. We want to get the largest valve that we can get in safely so that ultimately down the line, they can put a new valve in if they need to. Also we know from data from multiple different studies that the larger valves tend to last longer, and that's just because the smaller valves, there's a lot more pressure grading across. It's less more stress on the valve and they don't seem to last quite as long. There are options for patients who are smaller who really need a smaller valve. We have ways to enlarge the area that we would put the valve in now called root enlargements. We can at this point now put larger valves in patients than we used to, and I think we can do that very safely with, again, an eye towards, as you mentioned, the lifetime management of that individual's valve disease.

Adam Pick: Yeah, great points, Dr. Emerson. Kelsey asked, “I'm considering a robotic mitral valve surgery, and I'm curious, is there a difference in complication rates between a sternotomy and a minimally invasive robotic approach?”

Dr. Dominic Emerson: I think that's a fantastic question and what we definitely get a lot is, is there any risk that we're taking? The robot, as I mentioned, is just a tool and the incision is just a way we get there. The things we're doing to the valve, to the heart are really basically the exact same. The end result, like if I was to suddenly go in and look at it and show you a picture of after I did it versus with a robot versus I did it with an open approach, we want them to look the same. We want the same good result because we have great results with the sternotomy, the open approach. That being said, there are still risks with still heart surgery. Those risks are generally pretty low, and by low, I mean we're 1% for most of them or less.

In our, for example, series that we published a few years ago on the first 1400 or so, the mitrals that we did robotically, mortality rate for that was very, very low, like 0.3%, and so it's a very uncommon thing. It's not zero. I tell patients all the time, at the end of the day, it is heart surgery. Many of these patients are pretty sick, but we can in general do it very, very safely. The risks for robotic surgery are similar to the risks for open surgery. There are some slight differences, but in general, there's not additional risk posed by a robotic approach.



Adam Pick: Right, and on that question, I think unfortunately we've got over now 50 questions. We're not going to be able to get to all of them today. What I do want to do as we wrap up the webinar, and please don't hang up going just yet because I want to just thank you, Dr. Emerson, for taking the time to support our community with all this great actionable information. Thanks so much for being with us today.

Dr. Dominic Emerson: Thanks so much and thank you all for joining, and please reach out to Adam or myself if there's any questions or anything I can do.

Adam Pick: Yeah, and thanks to all the members in our community. This is the part where I'd like to ask you to complete a very quick five question survey that is going to be coming onto your screen right now. If you could complete that, we would really appreciate it. Dr. Emerson, again, thank you so much, and as we say here at heartvalvesurgery.com, keep on ticking.

Patient Resources

Since 2006, HeartValveSurgery.com has developed several resources to help you better understand your diagnosis, your treatment options and your recovery.

Listed below, please find resources created exclusively for patients and caregivers. We hope they educate and empower you.

- Adam's Free Patient eBooks - Download 10+ free eBooks about heart valve dis-ease and treatment options for aortic, mitral, pulmonary and tricuspid valves.
- Heart Valve Learning Center - Visit the Heart Valve Learning Center to access over 1,000 pages of educational information about valvular disorders.
- Patient Community - Meet people just like you in our patient community. There's nothing better than connecting and learning from patients who are sharing their stories in our community.
- Surgeon Finder - Find and research patient-recommended heart surgeons that specialize in heart valve repair and heart valve replacement procedures.
- Heart Hospitals - Learn about medical centers that have dedicated teams and resources that specialize in heart valve therapy.
- Adam's Heart Valve Blog - Get the latest medical news and patient updates from our award-winning blog.
- Educational Videos - Watch over 200 educational videos filmed by the HeartValveSurgery.com film crew about heart valve surgery.