

ADVANCES IN AORTIC VALVE AND ANEURYSM SURGERY



Dr. Eric Roselli, MD
Chief of Adult Cardiac Surgery, Cleveland Clinic

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5 out of 5 stars



Thomas Miers
May 28, 2025

Within the last year, I went through an ascending aorta aneurysm repair and aortic valve replacement. The information that was provided by Adam Pick t...

[Read More](#)



5 out of 5 stars



Susanne Schalles
May 28, 2025

This website is truly amazing for people impacted by heart valve disease, including their family and friends who want more information. Thank you Adam...

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5 out of 5 stars



Kurt Zacharias
May 22, 2025

Frequently referenced this website when preparing for my Ross procedure to treat my stenotic unicuspid aortic valve and aortic dilatation. Information...

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Featured Speakers



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Please Note: A complimentary video playback of this eBook is now available on YouTube at [this link](#).

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CHAPTER 1

Welcome & Speaker Introduction

Adam Pick: Hi, everybody. My name is Adam Pick, and I'd like to welcome you to the webinar titled Advances in Aortic Valve and Aneurysm Surgery. If I have yet to meet you, I'm the patient, the aortic valve patient, that started heartvalvesurgery.com over 20 years ago in 2006. The mission of our website is really simple. We want to educate and empower patients just like you. This webinar, which has had over 1,100 registrations from patients in countries all over the world, was designed to support that mission.

FREE LIVE PATIENT WEBINAR



**ADVANCES IN
AORTIC VALVE &
ANEURYSM SURGERY**

Featuring Dr. Eric Roselli, MD
Chief of Adult Cardiac Surgery | Cleveland Clinic

THURSDAY, OCTOBER 15 • 5:30 PM EASTERN



Now, throughout the webinar, you're going to be in what's known as listen-only mode, and I encourage you to submit your questions in the control panel on your screen. As we look at the agenda, it'll become clear why we want to do that. The agenda for today is very simple. We're going to introduce our featured speaker. We're going to talk about aortic anatomy. We're going to look at risks, symptoms, and diagnosis. What are the treatment options and insights? What are patient outcomes and what does the future look like for the treatment of these associated diseases? Then we're going to get into a rapid-fire Q&A where we are going to answer your questions in real time. As the webinar concludes, I'm going to ask you to complete a very quick five-question survey.

Meet Dr. Eric Roselli

As for our featured speaker today, who is he? Well, I'm humbled and I'm honored that he's taking time away from his very, very busy practice at the Cleveland Clinic.



- Chief, Adult Cardiac Surgery
- Surgical Director, Aorta Center
- Specialties: aortic valve surgery, bicuspid valve repair, complex aorta surgery, Marfan syndrome, modified David's reimplantation procedure, and minimally-invasive techniques
- Over 5,000 cardiac surgeries including 3,000 heart valve operations
- Featured on over 300 peer-reviewed book chapters and journals

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[Dr. Eric Roselli](#) is the chief of adult cardiac surgery at the Cleveland Clinic. He's also the surgical director of the Aorta Center. When it comes to his specialties, they are aortic valve surgery, bicuspid aortic valve repair – and let's remember that because repair is going to come up in this conversation – complex aortic surgery, Marfan syndrome, modified David's re-implantation procedure and minimally invasive techniques. During his extraordinary career, which goes out now 25, 30 years, Dr. Roselli hasn't performed 1,000 or 2,000 cardiac procedures. He's performed over 5,000 cardiac surgeries, of which 3,000 have involved some form of heart valve repair or heart valve replacement.

Research is very important to Dr. Roselli, and he's been featured on over 300 peer-reviewed book chapters and journal articles. I could go on-and-on about Dr. Roselli and all of his achievements and his accolades, but we have such a packed agenda. What I want to do is just show you this.



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These are the names of a select group of patients who are in the heartvalvesurgery.com community who went to Dr. Eric Roselli and got excellent outcomes. Behind all of these great names are just some wonderful, smiling pictures of his patients, whether it's Ari, whether it's Mark, whether it's John, Denise, or whether it's a Hall of Fame NHL goalie, Henrik Lundqvist right there, or my neighbor, Julie, who just went to Cleveland last month to see Dr. Roselli. So cannot thank him enough for creating all these smiles in his patients.

One thing I'll tell you is it's just not the smiles, it's the extraordinary support that Dr. Roselli has provided to our community. Right from the get-go, Eric has been a true source of education and empowerment for our patients. If you go on YouTube, for example, he has over 165,000 views of his videos about aortic disease, about aneurysms.

Welcome Dr. Eric Roselli!



I call it the ‘cherry on the top’ of this whole thing, is that Dr. Roselli and I have known each other for over 30 years. We went to school together at the University of Michigan in Ann Arbor. As serendipitous as this may sound, we are not only in the same fraternity, but he was my big brother in that fraternity. This is a really special moment for me to have you here with us. On that note. I just need to say welcome, Dr. Eric Roselli.

Dr. Eric Roselli: Thanks, Adam. Thanks for the kind introduction. I just got to say that the world is small for good people. So, it's no surprise that we've come full circle with all these things. Thank you so much for what you do. What a wonderful community you've brought together and created. Thanks for doing this. Thanks for everybody that's spending your evening with me. I hope to teach you something and then the Q&A, learn something too. We're going to focus on aortic valve and aneurysm therapy. Adam provided a nice prompt of questions for me to run through to organize this talk. And so I'm going to get going with it.

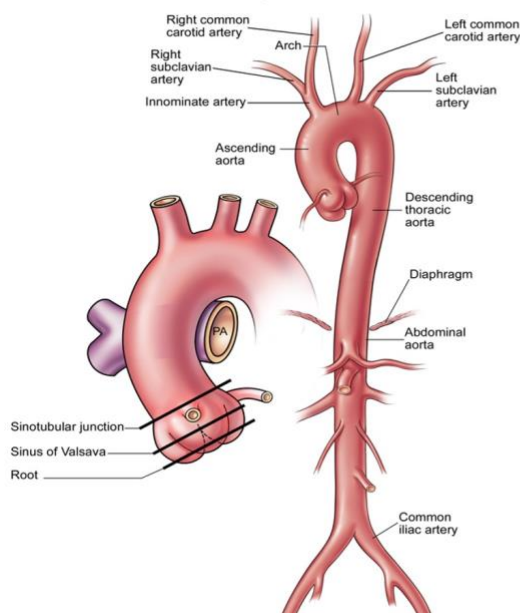
CHAPTER 2

Understanding the Aorta & Aortic Valve

Dr. Eric Roselli: One of the first questions you provided was what is the aortic valve in the aorta and what is their function? I know a lot of you folks on this call are very educated and kudos to you. I think the more knowledge you have, the less fear you should have. Hopefully, we can even strengthen that knowledge base for you. The aorta, it's this organ. It really begins inside the heart, and it's the conduit in simplest terms that runs through your entire torso. We talk about it having segmental anatomy, but it is all one organ. The segments we talk about, which really, again, the root begins inside the heart. It's wrapped in muscle. It's the shortest but most complex portion of the aorta because within the aortic root lives the aortic valve. Within the aortic root originates the coronary arteries. That's how the heart brings blood flow back to itself, and that's what it does. It takes care of itself first before it even sends blood flow to the brain.

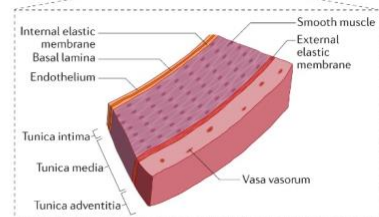
Segmental Anatomy

Aorta Review



Histology

Adventitia Media Intima



Then the next segments of the aorta are the ascending aorta, which runs up in the front of your chest. The arch of the aorta where it swings from the front to the back underneath the base of your neck and gives off these blood vessels that supply your brain and your arms. Then the aorta runs through the back of your chest along your spine, passes through your diaphragm or on the level of your ribs where it goes into the abdomen and gives off branch vessels that supply all the other organs in your belly before it ends around your belly button and branches out to

your legs. It's so many things that we take for granted that are going on in our body. One of them is how the aorta handles this incredible load from the heart and it does it because it is not just a tube; it's not just a hose. It's a really complex organ and there is this microstructure. We talk about histology; it's looking under a microscope at the microstructure of things. It's a three-ply hose and each of these layers in the aorta, they work a very complex function to maintain their integrity throughout a lifetime.

How the Aortic Valve Works

The aortic valve is a structure that sits in that junction between the left ventricle, the main pumping chamber of your heart, and the aorta. All the valves in your heart, they're check valves. Basically, it's a one-way gate. The really cool thing about the aortic valve is this complex three-dimensional structure, not like the swinging doors analogy or a man-made valve. You might think in a plumbing structure where it's just a flap on a hinge. It's a very complex structure where the leaflets of the valve are suspended inside the walls of the aorta.

Aortic Valve



 Cleveland Clinic

Cool piece of trivia, the first person known to really study it and describe it is Leonardo da Vinci. These are his drawings that you see on the left. Back in the Renaissance time, he was illegally taking bodies and studying anatomy, and he spent a lot of time focusing on appreciating the complex structure of the aorta and the guy was so brilliant that he drew these images of why he thought it was shaped – how the function – how the shape described the function and he drew these spherical drawings of how he imagined blood flowing through these cadaveric aortas he

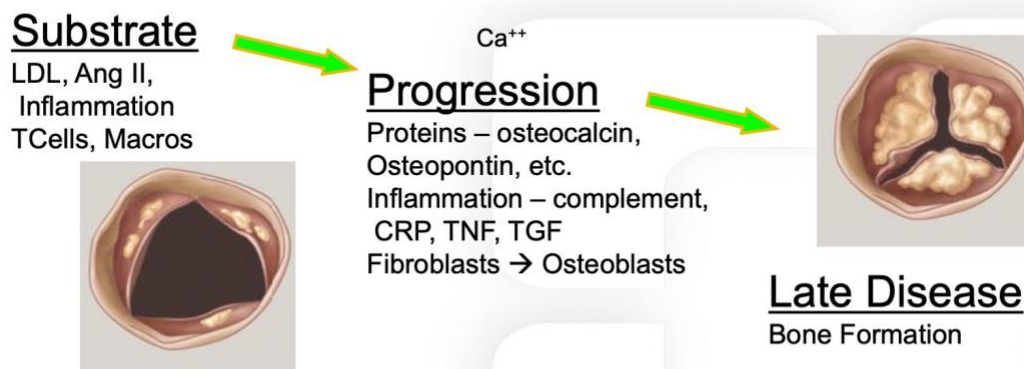
was studying. He was right because you see this modern day image from a 4D MRI demonstrates exactly these little eddies of flow. When the valve closes, the blood swirls and goes into the coronary arteries and sends blood flow back to the heart. It's amazing. It's just amazing how brilliant that man was and how we've now come to appreciate how the aortic valve works. Adam, did I lose my control of the – there we go. So that's it - quick and dirty about what's the aortic valve, what's the aorta, a little history there. I got to throw a bone out to my man, Leonardo, being an Italian guy.

CHAPTER 3

Aortic Valve Disease & Bicuspid Aortic Valves

Dr. Eric Roselli: What are the common forms of aortic valve disease? Well, again, we take it for granted that the valve and the aorta are functioning throughout our lifetime. But because they have to take on this work, they sometimes become diseased.

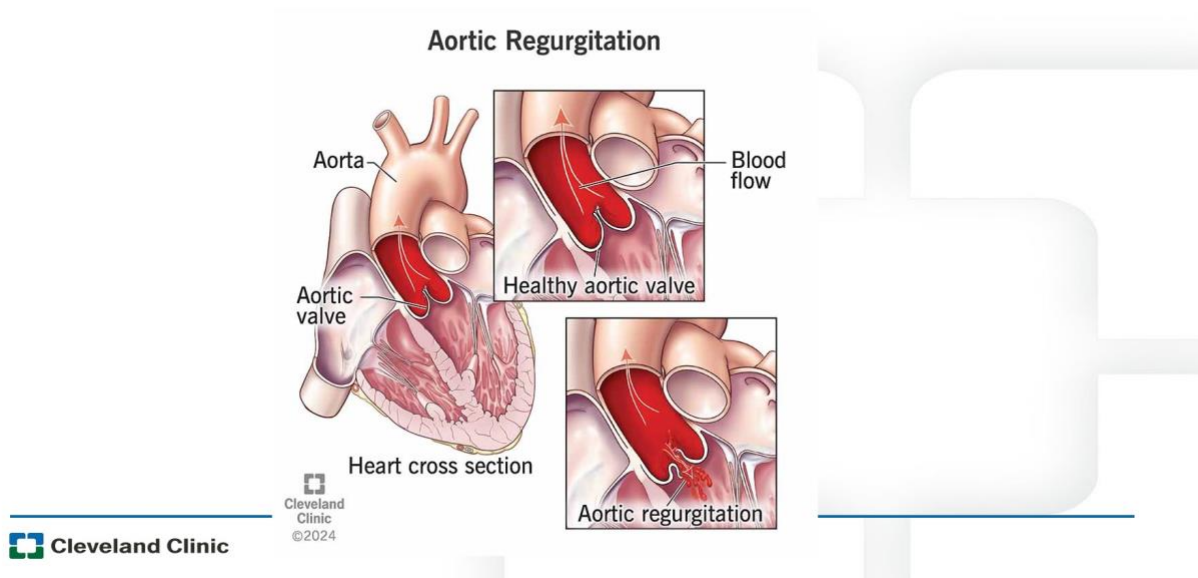
Aortic Stenosis (narrowing)



Cleveland Clinic

The most common disease to affect the aortic valve is aortic stenosis. It is a progressive process where you get a buildup of plaque on the leaflets of the valve. Eventually over time, this plaque goes through this process where it eventually creates literally bone formation. So, what's supposed to be this nice, supple, pliable leaflet that opens and closes every time the heart beats, eventually becomes stiff and the heart has to fight against an increasingly narrow opening. That's aortic stenosis.

Aortic Valve Regurgitation (leaking)

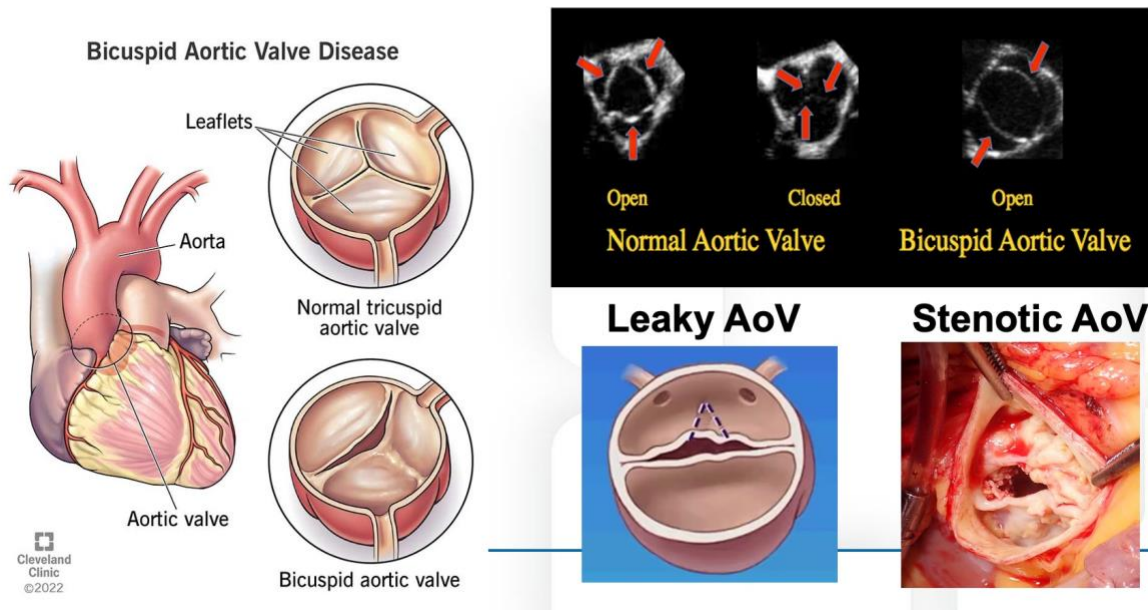


The other thing that can happen to the valve is it can become regurgitant or leaky. It's either narrowed or leaky when it's not working perfectly. A leaky valve, it's supposed to open when the heart beats, let blood flow through the aorta and then close when the heart fills. A leaking valve, when it closes, it doesn't seal. The blood falls back into the heart. Then the left ventricle has to do extra work to handle that extra load of blood volume.

Bicuspid Aortic Valves and the Risk of Aneurysms

We see this quite commonly in patients with a bicuspid aortic valve. We talk about it like you either get two leaflets or three leaflets, but that's not really how it forms. The structure is super complicated, just like da Vinci described. And the way it forms embryologically in the first trimester of our development has to line up just right for the valve to be able to handle a lifetime of opening and closing.

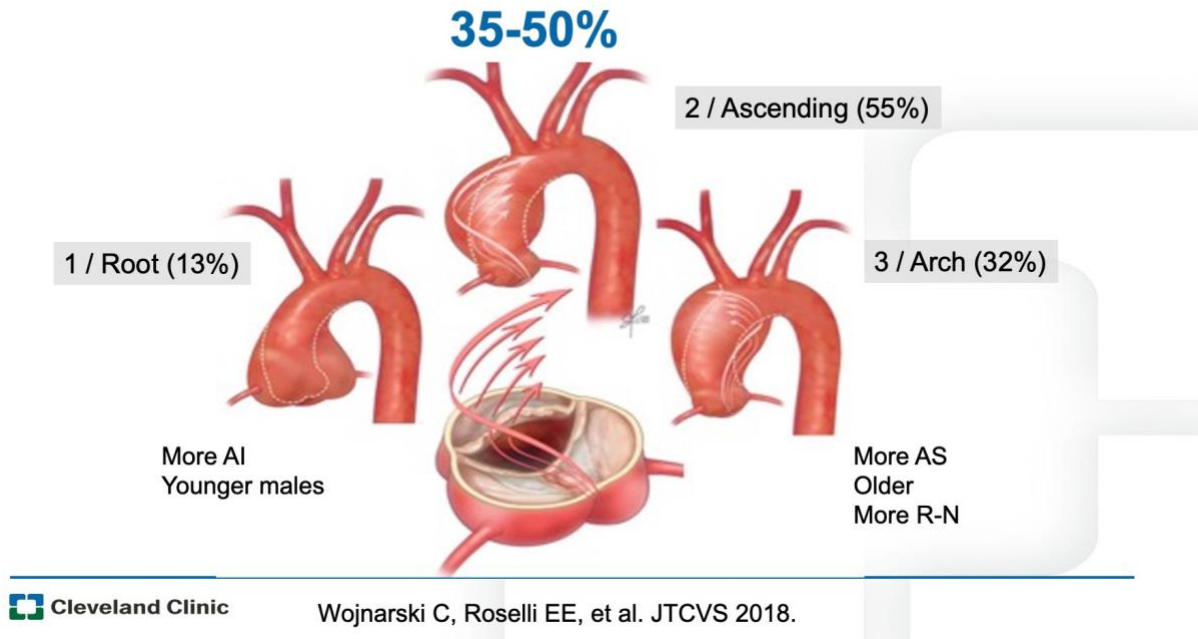
Bicuspid Aortic Valve



In about 2% of the population that valve doesn't form perfectly right and you're left with two leaflets instead of three. Most commonly, it's because they didn't mature up the wall and two of the leaflets are fused together. You see the cartoon on the bottom left where there's like a little ridge between them. You see an echo image on the right where it shows how a bicuspid valve opens differently than a tricuspid valve. All of the mechanics around this put different kinds of wear on the valve, and so we see bicuspid valves fail in both ways. Sometimes they become really stenotic, like this ugly-looking thing over here on the bottom right. This is a stenotic bicuspid aortic valve, which has built up all this calcium and debris because it's just been so much wear and tear on that leaflet, those leaflets over many years that it's become stiff.

And sometimes it stretches out and they don't line up right. And if they don't come together just right – they're supposed to come together like the praying hands emoji thing – then that elongated leaflet, it flops and blood falls backwards. We see a lot of dysfunction in bicuspid aortic valves, especially in younger people.

Bicuspid Aortic Valve + Aneurysm Common



And 2% of the population is a lot of people. Interestingly, when that valve doesn't form quite right in someone with a bicuspid valve, they're also prone to not have the aorta form just quite right, either. Now, we see that somewhere between one-third and one-half of people that have a bicuspid valve, or that condition of a malformed valve, are prone to develop an aneurysm of their aorta. It doesn't mean you're born with an aneurysm. What you're born is something not right in that microstructure. So over time, that aorta stretches and grows into an aneurysm. And we see three patterns where it's mostly the root that's dilated, this root aneurysm.

The most common phenotype or pattern is this ascending aneurysm where it's the mid-portion of the ascending aorta is dilated and then this more diffuse where it extends into the arch. And interestingly, it has something to do with the way blood flows through that abnormal valve with the more common pattern of a bicuspid valve. The blood swirls in one direction and puts different forces on the wall. With a less common, where the right and the non are fused together, it spins the other direction. There's this continuous process of stress on the walls of the aorta that contribute to the development of aneurysm.

CHAPTER 4

Symptoms, Diagnosis & Timing of Treatment

Dr. Eric Roselli: When you have aortic valve disease, what do you feel? Well, usually nothing. Usually, you're just cruising along because your heart is awesome and your body can tolerate an unbelievable amount of disease building up before you feel anything, especially if your other valves are okay and your heart otherwise formed all right. So, we don't really see symptoms in people until they reach a very advanced stage of disease. That's true when it's stenotic or regurgitate, although some people have a combination of both. Typically, they both have to get pretty significant before you develop symptoms.

What are the common symptoms of aortic valve disease ?

**No Symptoms until
VERY ADVANCED Stages of Disease**



Recognizing Symptoms

The symptoms progress as the disease worsens. The symptoms that you can get are typically brought on with activity. As the heart has to work harder against an abnormal valve, then that brings on the symptoms like shortness of breath.

Symptoms progress as disease worsens

Typically brought on with activity

- Shortness of Breath
 - Worsening exercise tolerance
- Dizziness, fainting
- Chest pain (angina)

- Palpitations and fatigue less specific



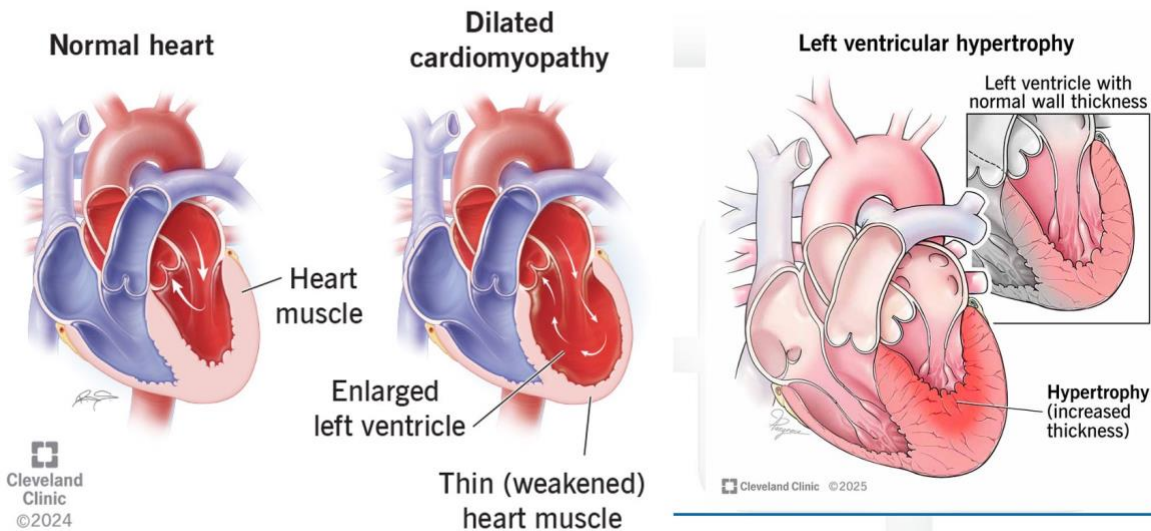
A lot of people don't really know what shortness of breath means until we give them a new valve because it's this process that's gone on your whole life. What I'd like to also ask people about when I ask them about shortness of breath is are you noticing that your tolerance to exercise is changing? If you're 60 and you're noticing you can't do some of the things you should do, you're not old. Sixty isn't old. It may be because your valve is getting worse. So, someone hears a murmur or something like that, you've got to get your valve checked out.

As the disease progresses along, some people can actually have dizziness and fainting, these sudden death episodes. I know that sounds pretty serious, but that's a real symptom, syncope, or eventually chest pain, because if you think about it, the valve is upstream of the coronary artery. If the blood isn't getting through the valve very well, it's also not getting back to the heart very well.

Changes in Heart Structure and Function

Some other less specific symptoms that people may have are palpitations or fatigue, but those can happen for a lot of reasons. Sometimes those are things that are just a trigger for somebody to look at a heart or look at a valve and find the problem.

Left Ventricular Changes Seen on Imaging



More often what we see is that there are changes happening in the heart that you're not developing symptoms from. That means the chamber of the heart can change. If the heart, which is a muscle, is fighting against a stenotic or narrow aortic valve, it's fighting against resistance. You know that muscles against resistance, hypertrophy; they thicken and get bigger. It's fine if it's a skeletal muscle. Do all the resistance exercise you want. Not so great if that muscle that's your heart is getting thickened. Because what happens is the chamber of the heart starts to shrink. The heart itself becomes stiff.

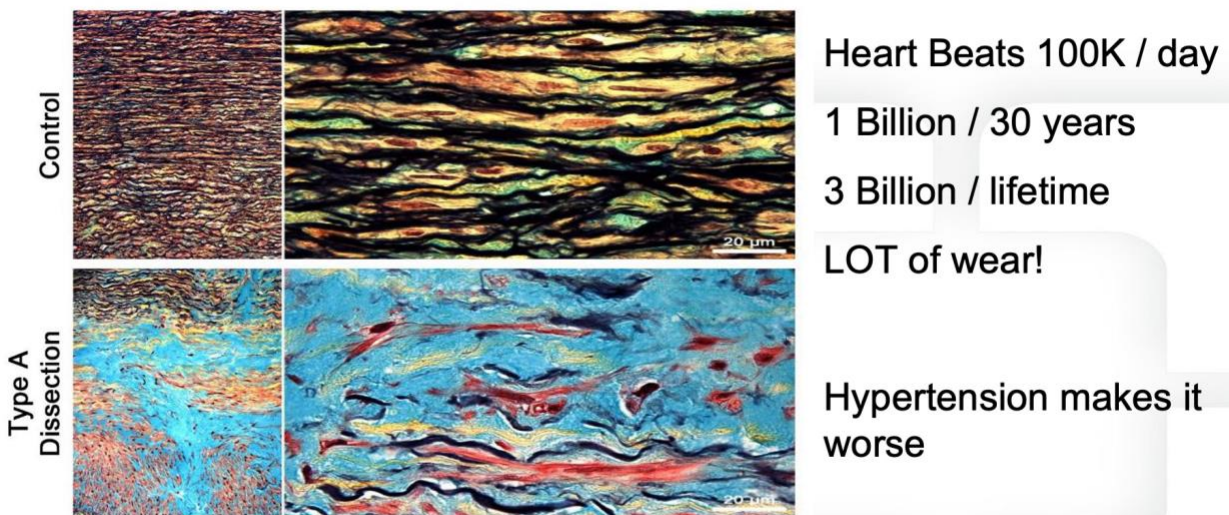
A heart is a pump. For a pump to work well, it has to do two things. It has to relax and fill nice and easily. And then it has to beat. It has to be able to do both of those things 100,000 times a day. Hypertrophy will develop if you have aortic stenosis developing. If you have a leaky valve, now blood is adding extra volume into the heart. It starts to get tired after dealing with that leaky valve for an extended period of time. It doesn't happen overnight. It happens over a period of months to years, really. That chamber of the heart can start to stretch and get dilated. So those are signals that we see on imaging that tell us, okay, this person feels fine. Their valve looks really bad but they feel okay. We're trying to pick the sweet spot of when to do something. We don't necessarily want to wait till symptoms get to that point because I already told you, that it may be really severe, but we start to see some physical changes in the structure of the heart when we're looking at things like an echo or an MRI or even a CAT scan. Well, that might be our signal that we move ahead and take that load off of the heart and get the valve taken care of.

CHAPTER 5

Aortic Aneurysms, Dissection & Risk

Dr. Eric Roselli: Well, let's switch back to aneurysm. What is an aneurysm? I already talked about it a little bit. What it is essentially is an enlarged aorta. I told you what the aorta is in the normal state, how it's got this complex microstructure and its job is insane. Your heart beats 100,000 times a day and it is hammering your aorta right there in your chest 100,000 times a day. That's a billion heartbeats in 30 years, 3 billion over a lifetime.

The Micro Structure Breaks Down First



 Cleveland Clinic

Cikach, Roselli, Apte, et al. JCI Insight, 2018

This little microstructure you see – this is what it looks like under an x-ray. You see all these layers. The black stuff is elastic, elastin. It's like the elastic that you might have in your clothes.

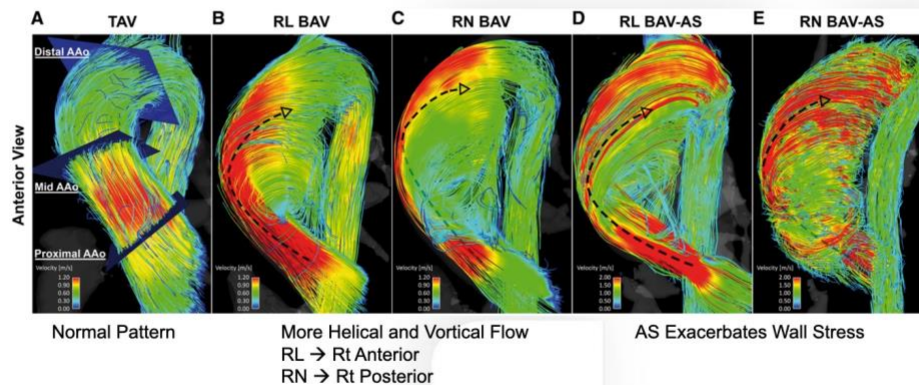
Over time, as we age, our elastin breaks down a little bit. If we have something that's not right in our aorta, that microstructure breaks down even more and it starts to look – this is pretty with all the colors but this is a disorganized a wall of an aorta that can't do its job of being this elastic structure that handles that load. Eventually what happens is these layers can separate; it can come apart. If you have hypertension, high blood pressure, there's more stress on the wall of your aorta, and it can accelerate some underlying process. Your job of the aorta is to maintain its integrity over a lifetime. If there's something that's just not right, and a lot of times we're learning about this, a lot of times it's just one mutation in a single protein that's in that microstructure that's job is to do the janitorial work of maintaining the integrity of the wall. It's just off by a little bit. It switches into breakdown mode. And then over a period of time, as that

aorta weakens, it can break down. And if you have valve disease, the stresses on the wall are even worse.

How Blood Flow Affects the Aortic Wall

So again, here's some really cool 4D flow images.

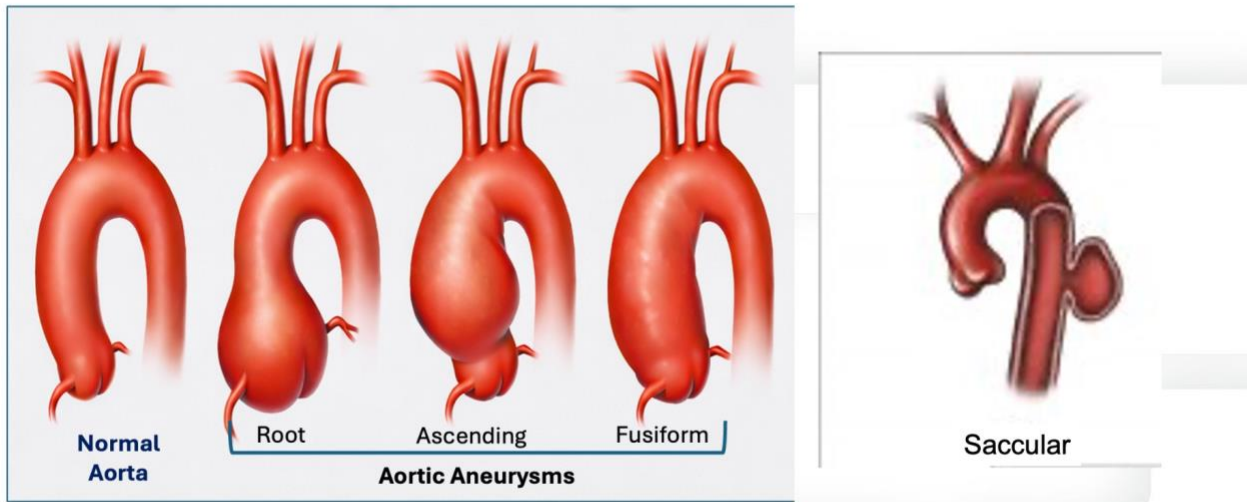
Altered Flow ~ Wall Shear Stress



Shan Y, et al. EJCTS '18

The pattern on the left is normal. Imagine a nice, wide, straight river. The water flows beautifully. You see a turn in the river. The water starts to spin. It starts to churn. You get turbulent flow. You got a narrow spot like a stenotic valve, you get a jet of flow in an area, puts more stress on the wall. We see as their valve disease progresses, it exacerbates these stresses on the wall of the aorta. And that can accelerate an underlying problem with the microstructure.

Weakened Aorta Grows Over Time



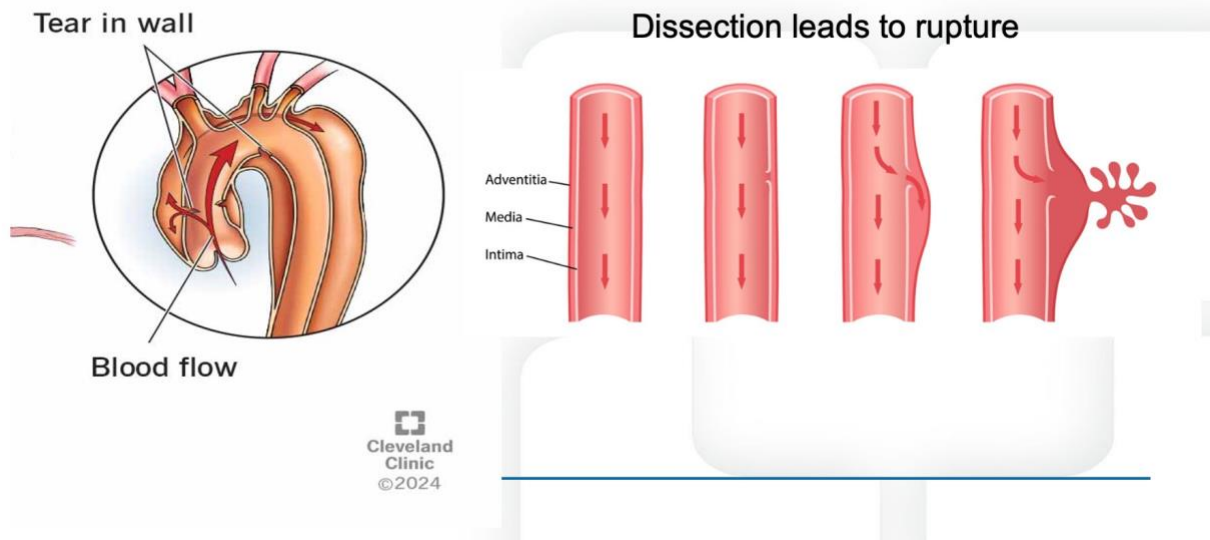
Cleveland Clinic

It will grow over time. You see these cartoons on the left demonstrate again, like I showed you, a little root and ascending and more fusiform aneurysm extending into the arch. These are what we call fusiform; all of these are fusiform aneurysms where the whole wall is stretched. On the right is a saccular aneurysm. I think a lot of people get it in their mind when they're told they have an aneurysm that they have some weak spot that's pooching out the side, like a bubble on a tire or a bubble on a basketball. That's a saccular aneurysm. Intracranial brain aneurysm sometimes are like that. In the aorta, we don't see that very often associated with valve disease. We see it more in smokers where you've got atherosclerosis and plaque, an ulcerated area that breaks down and then it weakens and it pooches out. Those are scary when we find them, they're ugly, but they're usually really isolated, easier to take care of. These are a little more complex, but the nice thing about a more typical fusiform aneurysm is just like a balloon, when a balloon is getting to its maximum stretch point, you get a sense of when it's going to pop. We've got some numbers that tell us when an aorta is getting too big. That's our guideline of when to operate them.

Understanding Aortic Dissection and Rupture

Are these life-threatening problems? Yes, they are. This is what we want to avoid.

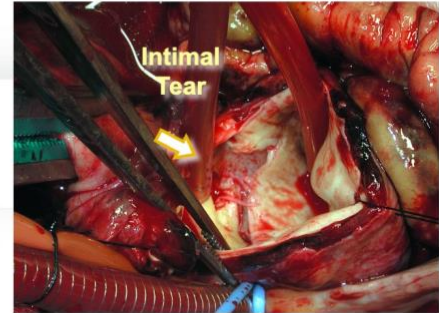
Aortic Dissection or Rupture are Late Events



This is the problem as that aorta aneurysm breaks down, its structure breaks down. The event that leads to death is the dissection or rupture where the wall breaks apart. A dissection is when the inner layer rips and blood gets in there. And if we don't get it fixed relatively soon, if it happens in the first part of the aorta, it can get through that last layer and burst completely. An aortic rupture, and that's what causes people to die.

Aortic Dissection – Quick Stats

- ~ 5000 people / year in the US
- More common in men (2:1)
- Typical age 50 to 70; range ~12 to >100
- At least 80% have HTN
- Dynamic process – intimal tear propagates
- Lethal complications → 1-2% / hour mortality



 Cleveland Clinic

It happens about 5,000 times a year in the U.S. Although a lot of cardiovascular disease is more common in men, it's two to one, so still a third of these are women. It happens to relatively younger people. The average age is late 50s, so 50 to 70s, but I've had 12 -year-olds with a dissection, and I've taken care of 100-year-olds with a dissection. Most of them have some hypertension, so if you have any history of this in your family, make sure you're aggressive about getting your blood pressure under control and getting it screened at a young age and getting it treated. Once it begins, this tear inside the aorta, if you don't get it fixed, most people are dead in a month, if not within hours.

What are the symptoms of aortic disease ?

**Usually none – incidentally found
Unless dissection / rupturing**



What are the symptoms of aortic disease? You don't want to know the symptoms. They're bad. There are usually no symptoms because the aorta doesn't cause you any symptoms until the minute it's killing you and it becomes a dissection or a rupture. Those symptoms are pain. It's pain in your chest. It's pain in your back. It's pain in your belly, usually in your chest because you feel your aorta ripping.

Presentation

• Pain	96%
– Chest	73%
– Back	53%
– Abdominal	38%
• Abrupt onset	85%
• Severe	90%
• Tearing	51%



Hagan PG, et al. JAMA 2000.

The thing that's most characteristic, it's abrupt, comes out of nowhere. You're looking around and you felt this pain like you've never felt before. It doesn't go away. You feel this sense of like you're dying. Again, I told you how people die. It's because the aorta ruptures completely.

Complications Or, How do people die?

- Rupture – exsanguination / bleed out
- Pericardial effusion – tamponade / suffocate the heart
- Aortic regurgitation – acute heart failure / overload from leaky valve
- Branch vessel obstruction – ischemia→infarction – no blood flow to important organs



A couple other things can happen. If it starts to leak into the space around your heart and get tamponade where the heart gets suffocated. We have to get these people to the operating room right away to release that pressure on the heart. If the tear extends into the valve and it rips the valve off the aortic wall, the valve can leak a lot. And if you go from a totally competent valve to a really leaky valve really quickly, you go into heart failure. You can get pretty sick, pretty fast. Some people just die of that. Or as the rip propagates through your aorta, it can shred off some of the branch vessels that are supplying your brain, your belly, and other organs in your body, cut off the blood supply to those and cause those organs to die, which can also lead to death. It's pretty serious stuff.

**“there is no disease more
conducive to clinical humility
than aneurysm of the aorta”**

Sir Wm Osler 1849-1919

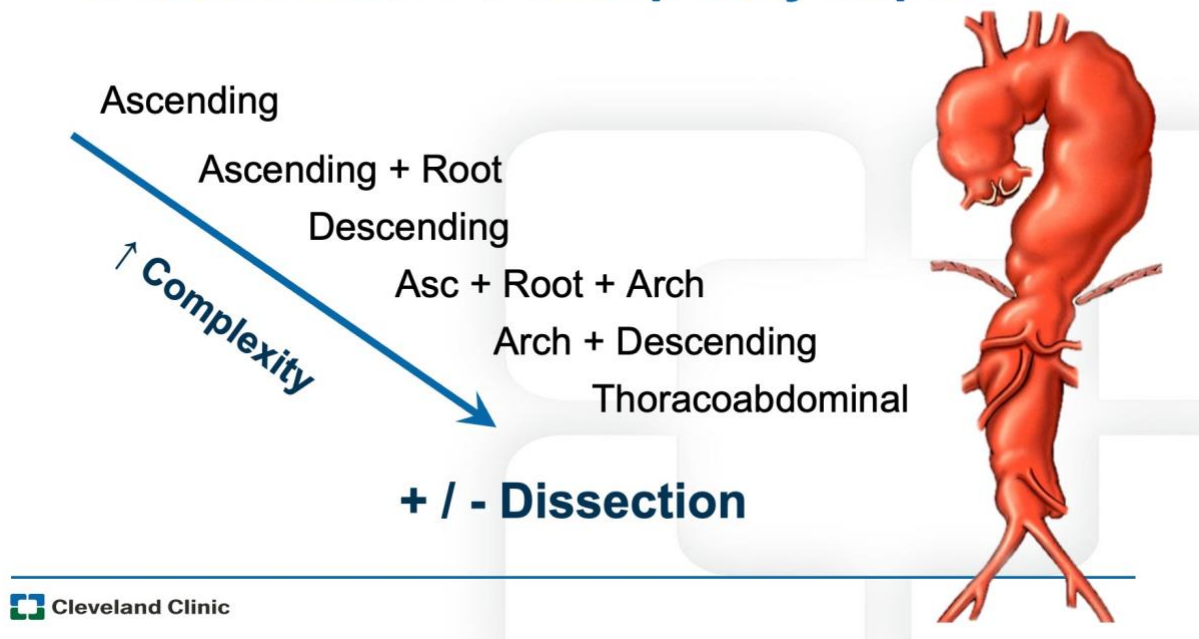
**“no patient should be
considered cured of the disease”**

Stanley Crawford (1922-1992) on dissection



This guy, William Osler, is one of the fathers of modern medicine, said no disease is more conducive to clinical humility than the aneurysm of the aorta. Not true anymore. We know how to fix these. And Stanley Crawford said no, and he was the first guy to really do some of the really complex aortic repairs in the '60s. He said no patient should be considered cure to the disease. So when we operate on these things, we fix the part that's going to kill you now. If you have aortic dissection, it becomes a chronic thing.

Disease Extent → Complexity Repair



We have a lot more to learn about this disease. We need to get it treated sooner. If you have multiple segments of your aorta involved, the repair becomes more complex.

Medical Management and Blood Pressure

Are there medicines that can treat these disorders? Not exactly. There's not really any medicine that can reverse the degeneration of your valve or your stretched aorta, make it shrink.

Can medication treat aortic valve and aorta disorders?

- Not Exactly ...
- Unload the Aorta and the Ventricle
- Optimize the Ventricular Function
- HTN and Heart Failure Meds help but no medicine reverses the aneurysm or the valve disease itself – mechanical problems



But the medicines are important, can offload the blood pressure and the tension on your aorta and your ventricle. We can give you heart failure medicine to optimize your ventricular function if your heart's getting dilated. And we can keep your blood pressure under control to take some of that burden off your aorta. You don't want to do things that give you really bad hypertension like some cocaine, crystal meth. Those are real bad. Those are associated with accelerated bad problems. Power lifting, probably not great, but you shouldn't be afraid to exercise. That's good for you. That's good for your blood vessels.

CHAPTER 6

Choosing Aortic Valve Treatments

Dr. Eric Roselli: So how do we treat these problems? Well, Adam asked these questions about aortic valve treatment. What are the options? What are the different pros and cons of various treatment options for aortic valves? Why do some get replaced and others get repaired? What are the different types of approaches, sternotomy, minimally invasive, TAVR? I'll start with the last question first. I think that's the easiest one.

Aortic Valve Treatment Considerations:

What are the options for the surgical treatment of aortic valve disease? Repair? Replacement? Pros? Cons?

Why do some aortic valves get replaced while others get repaired?

What are the different types of approaches to replace the aortic valve? Sternotomy? Minimally-invasive? TAVR?



Open, Minimally Invasive and Transcatheter Approaches

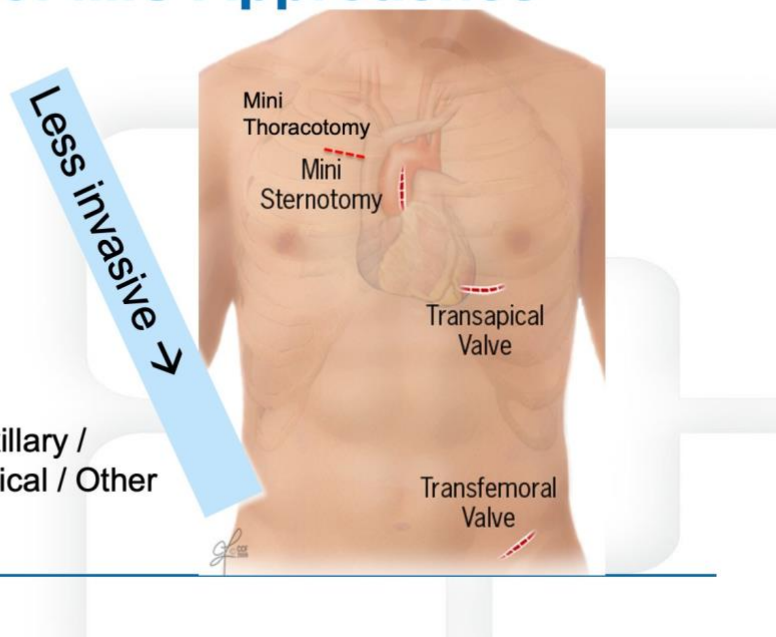
There's a whole bunch of ways for us to get to the valve and get it taken care of. People get really focused on this.

Evolution of MIS Approaches

- Full Sternotomy
- Partial Sternotomy
- Mini Thoracotomy
- Robotic Assisted

TAVR

- Transfemoral / Transaxillary /
TransCarotid / Transapical / Other

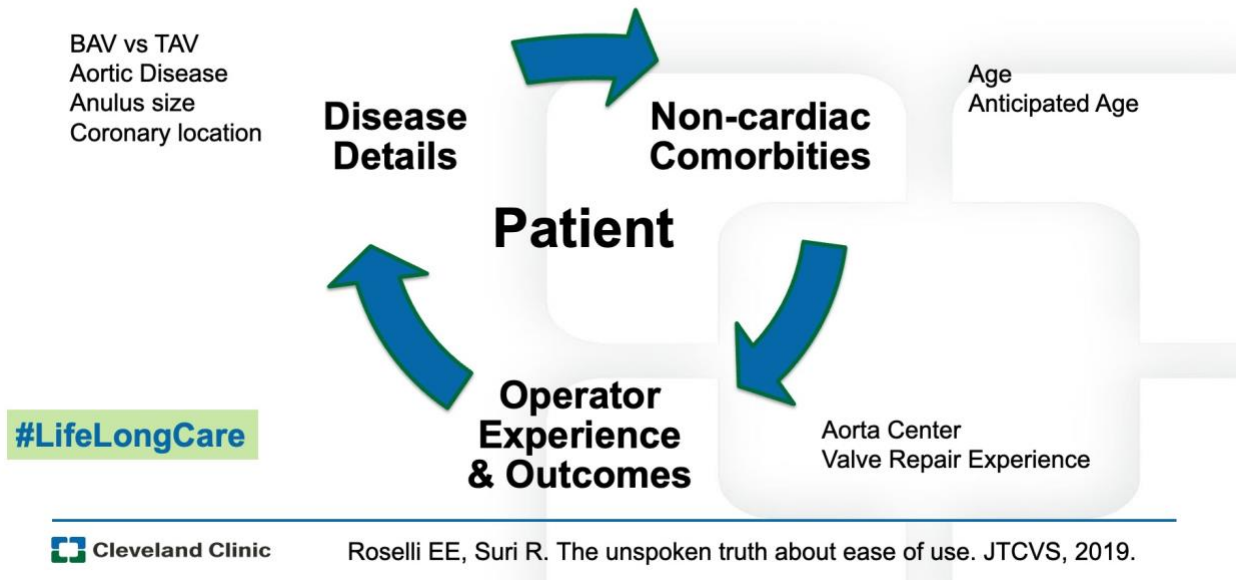


It's okay if you get a full incision because your surgeon thinks that's the best way to take care of it. You will heal just fine. Pain isn't that bad. Get back in action. You can do almost anything you want. It's lovely to have it less invasive. Less invasive maybe accelerates your recovery a little bit. But don't let your operation be compromised because you're focused on the incision that you're getting. We now have a whole bunch of different less invasive ways to do this. The least invasive is a transcatheter valve, but if that device parked inside your old diseased valve isn't going to be a good fit, it doesn't make any sense to do this. It makes way more sense to maybe cut that valve out and sew something new in, and there'll be a lot of decisions in that process that are made. One of the more recent things we've been doing is using the robots to get these less-invasive incisions even smaller with the use of some ports and some robot arms that give us a little more freedom through those smaller incision. That's really cool.

Shared Decision-Making and Lifelong Care

The real decision-making is what's the best choice for your disease? How do we treat your disease the best? This has to be a shared decision between you and your surgeon.

Risks and Benefits Must be Tailored to the Patient



Your cardiologist, if they're good and they know your surgeon as well, they're going to weigh in on it too and that's awesome. We have to look at I think three different competing things. You're always in the middle; that's for sure but we have to look at the disease details, not just is it a bicuspid or tricuspid valve and is it stenotic or regurgitant but what's the aorta like? What's that replacement going to look like? Is it going to fit well inside? There's going to be an efficient valve. Is it big enough? How is the coronary going to line up? Maybe what will happen later on? If you're young and we expect you to outlive the valve that you choose, what might the next surgery look like? Then if there's something like a leaking valve that might be repaired, you've got to ask your surgeon how comfortable they are doing repairs. That sounds arrogant, but I always say I can repair any valve. It's not whether I can; it's whether I should. I have to make this decision at the end of that repair if I think that repair is going to be durable enough that it's better than replacing.

You want your doctors to be in that discussion with you about achieving lifelong care and a lifelong approach to this disease. That's really not just about the valve and the aorta, but what happens to your heart and your whole body. So those are the discussions you have to have and you have to think about. Someone asked earlier, Adam, about operating sooner.

RECOVERY and AVATAR RCTs



Early Surgery or Conservative Care for Asymptomatic Aortic Stenosis

Duk-Hyun Kang, M.D., Ph.D., Sung-Ji Park, M.D., Ph.D., Seung-Ah Lee, M.D., Sahmin Lee, M.D., Ph.D., Dae-Hee Kim, M.D., Ph.D., Hyung-Kwan Kim, M.D., Ph.D., Sung-Cheol Yun, Ph.D., Geu-Ru Hong, M.D., Ph.D.,

- 7% vs 21% mortality with early AVR

Circulation

Volume 145, Issue 9, 1 March 2022; Pages 648-658
<https://doi.org/10.1161/CIRCULATIONAHA.121.057639>



ORIGINAL RESEARCH ARTICLE

Aortic Valve Replacement Versus Conservative Treatment in Asymptomatic Severe Aortic Stenosis: The AVATAR Trial

Marko Banovic, MD, PhD , Svetozar Putnik, MD, PhD, Martin Penicka, MD, PhD, Gheorghe Doros, PhD, Marek A. Deja, MD, PhD , Radka Kockova, MD, PhD , Martin Kotrc, MD, Sioita Glaveckaitė, MD, PhD, Hrvoje Gasparovic, MD, PhD, Nikola Pavlovic.

- HR 0.46 mortality with early AVR



There are all these TAVR studies looking at earlier operations on the aortic valve to offload the heart. Well, look, these are two old studies from 2020 and 2022 where they randomized patients to get surgery earlier, surgical aortic valve replacement in asymptomatic patients with severe – they all had really bad stenosis but they were not symptomatic and they all had stress tests to confirm that there wasn't some symptoms they weren't recognizing and they found in both of these randomized studies in very important journals, New England Journal of Medicine circulation, so peer-reviewed articles, really good studies that the mortality was reduced in both of these series. If once you reach that critical threshold, you just got your valve taken care of. It takes the load off your heart. We've got to take care of your heart.

Mechanical, Tissue and Other Valve Options

Then when you make the decision to move ahead, what do you do? Do you repair or replace? Do you get a mechanical or a biologic valve? Do you get a stented or a stentless valve, big valve, cow valve? How big? What about autologous, meaning your own valve, Ross procedure? All of these are overwhelming discussions and options to have. So again, you have to have this shared decision-making process with your cardiovascular team, the surgeon and your cardiologist.

Shared Decision Making

Valve Choice = (Informed) Patients' Choice

- Mechanical valves → NOAC loses against Warfarin
 - RE-ALIGN: Dabigatran vs warfarin
 - ↑ bleeding *and* ThEmboli NEJM '13
 - PROACTXa: Apixaban vs warfarin OnX n = 863
 - ↑ ThEmboli 1y 4.2% vs 1.3%; non significant bleeding 3.6% vs 4.5%

- Life-long warfarin anticoagulation vs reoperation:

Patients choose bioprosthesis or Ross

- Full Vs Less Invasive → **Patients choose less invasive**



What we've seen is that even though mechanical valves are great and you don't need any more operations, we tried to see if we could get some easier anticoagulation. It's not going to happen. It has to be Warfarin. It's probably going to be Warfarin forever, Coumadin forever, because I don't see any pharmaceutical company putting in the millions of dollars it takes to develop a new drug. And the folks who make the Onyx valve, they did a really great study in this product study where they looked at over-the-counter Eliquis in patients with and without valves. And even though it wasn't horribly different, it was safer just to take Warfarin, and that's the way to go. A lot of people say, I don't want to be on that stuff. I'll take my chances with the re-operation down the road. They'll choose a bioprosthesis or they'll choose a Ross if they're younger.

Then people always want a less invasive incision if it's available. But remember, don't get too focused on that. That's a later thought. Make sure you're getting the right operation up front that's in the mindset of this lifelong care, thinking about those conflicts in the decision-making process.

When an Aortic Valve Can Be Repaired

Now, what if you're a young patient with isolated aortic regurgitation or aortic insufficiency? You might hear AI or AR. They're the same thing, leaky valve. Think about repair.

Young Patient with Severe Isolated AI ?

Think about Repair



That's what we do as surgeons. So think about repair as being an option. When do we do a repair? Most often, it's people that have an aneurysm, so their valve is stretched. The leaflets are still good and healthy, and we can reconstruct the whole thing and get those valves lined up so they line up nicely and they work again.

Who do we Repair? Regurgitant, not stenotic valves

- Root Aneurysms, especially with heritable disease
- Bicuspid Valves
- Right cusp prolapse with Congenital heart disease (VSD)
- Sinus of Valsalva aneurysm (windsock type)

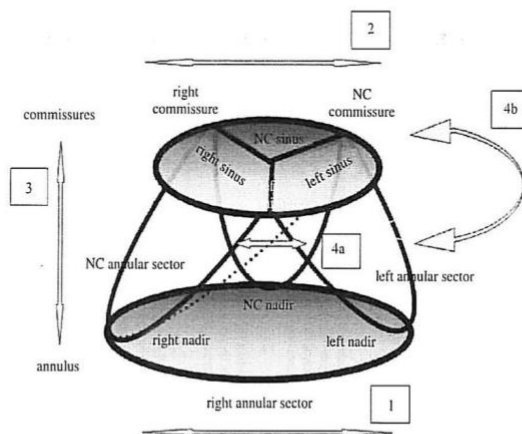


The other category of patients that have a predominantly regurgent or leaking aortic valve, bicuspid valves, we can do the same thing. We can get those two leaflets lined up so they come together nicely. That takes some of the load off of it. It's a living valve. It may last you longer than a biologic valve off the shelf. And then there's a couple other things we see. Some people have a tricuspid valve that leaks because they were born with a little hole in their heart that was fixed when they were a kid. And it shows up later on that that valve is a little abnormal in that area because it's right in the same location in the heart. When things formed, it wasn't just quite right. And it's caught up to them decades later. And then there's these other things, that are unusual. We see sometimes people have an isolated aneurysm of the root.

Valve-Sparing Root Procedures

I've already talked about this a little bit, but the aortic valve isn't just the leaflets that open and close. Their function is dependent upon the entire structure of the aortic root.

Aortic Root Dynamics



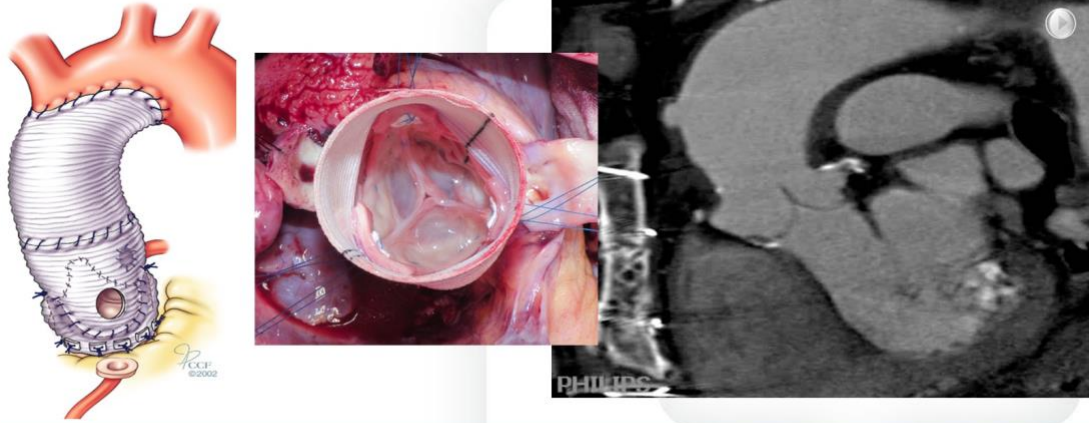
- Four modes of Deformation

- 1 – circumferential at annulus
- 2 – circumferential at commissures
- 3 – longitudinal
- 4 – shear strain and torsional

That's what we think about when we repair valves. You see, this is a 4D CAT scan, and this is the aortic valve opening and closing. This is blood coming out of that outflow tract. You see how dynamic it is. See how the heart stretches as the valve opens and then shrinks when the valve closes and the aorta moves with every heartbeat.

Valve Sparing Root Reimplantation

- Great for root pathology



We have to reconstruct and recapitulate that more normal anatomy when we do something called a valve-sparing root re-implantation procedure, often known as a David's procedure or root remodeling. We take the whole aorta apart, we sew it to the inside of the heart, and then we sew the valve back inside that, reattach these two coronaries on the side, and rebuild that root. And that aorta that's then made out of that fabric, that woven polyester fabric, can be durable forever.

If we get that valve in a nice place – and then there's all these other things. This is supposed to look busy.

Root Repair Strategies

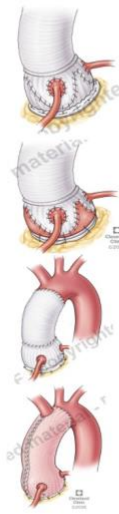
Root + Anulus Support

E – Root Reimplantation (David)

F – Root Remodeling with Annuloplasty (Yacoub +)

G – Ascending Replacement + Root Wrapping (Florida Sleeve)

H – Personalized External Aortic Root Support (PEARS)

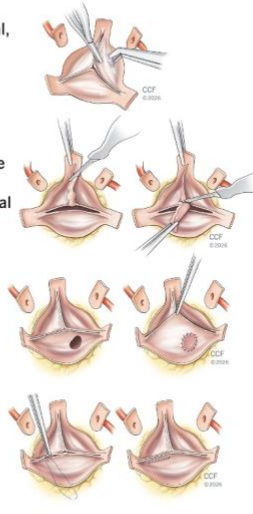


A- Debridement of focal, non-penetrating calcification

B- Bicuspid valve raphe release, shaving +/- resection of focal fibrosis

C- Pericardial patch repair of focal perforation

D- Primary repair of central fenestration



E- Supra-commissural reapproximation (figure of eight)

F- Tricuspid valve repair with limited central cusp plication

G- Bicuspid valve reimplantation with extended plication after raphe resection

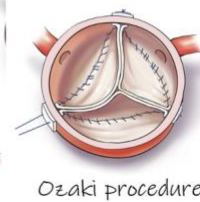
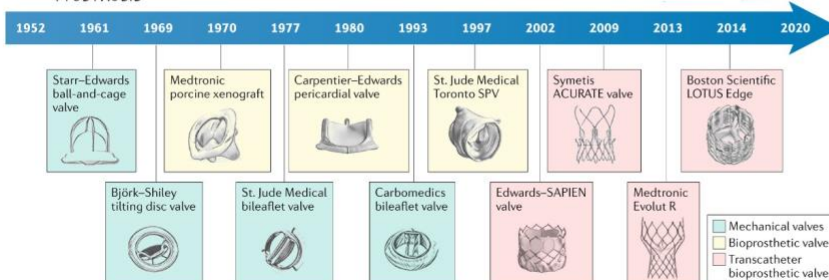
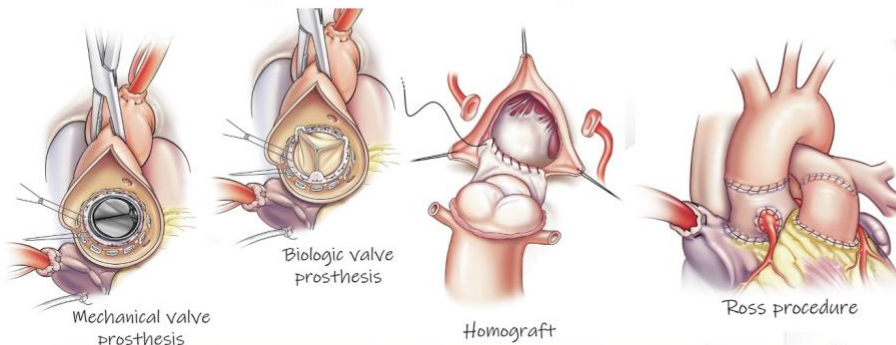


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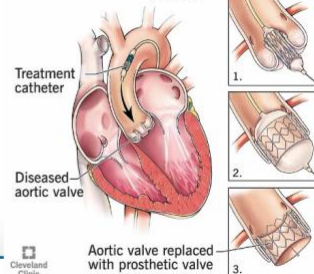


These are all the other little plastic surgical techniques we'll use to get these leaflets fixed and get them lined up and get them working well when we do valve repairs.

Valve Replacement Options



Transcatheter aortic valve replacement (TAVR)



When we replace valves, yes, we can pick mechanical, biologic. We even have cadaveric aortic valves, human, sometimes an allograft or a homograft is what it's called. The Ross procedure, where we take the pulmonary valve and put it in the aortic position. Lozaki procedure, where we take your own pericardium and fashion leaflets and sew it in.

We've seen all this develop over years. Now we've got a whole handful of transcatheter valves that have evolved over the last couple of decades. It's great to have all these choices, but it's important, again, that we think about the pros and cons of each one of these things and how it fits to your particular issues as a patient. And you want a team that can appreciate all of that and help you in the decision-making process.

TAVR in Younger Patients and Bicuspid Valves

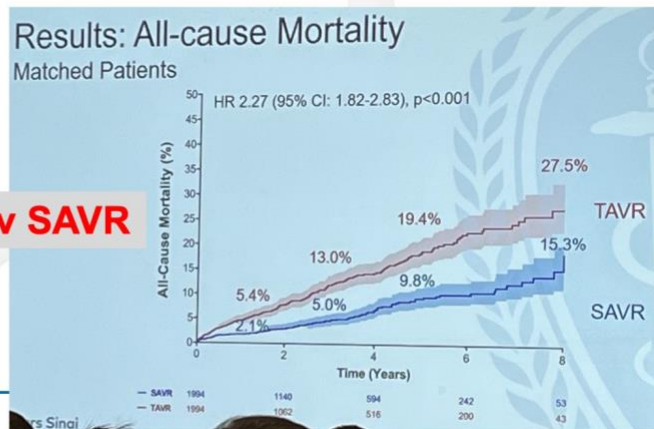
What we've learned is that even though we're seeing more and more use of transcatheter valves in younger patients, probably not a great idea.

SAVR vs TAVR Under 65

Bowdish M presented at AATS Toronto 4.27.2024

- 30d mortality similar (1.3% vs 0.9%, $p=.26$)
- New PM higher for TAVR (10.9% vs 5.7%, $p<.001$)
- TAVR death higher w/in 2y
- Reops same after 2y

HR 2.3 for Death after TAVR v SAVR



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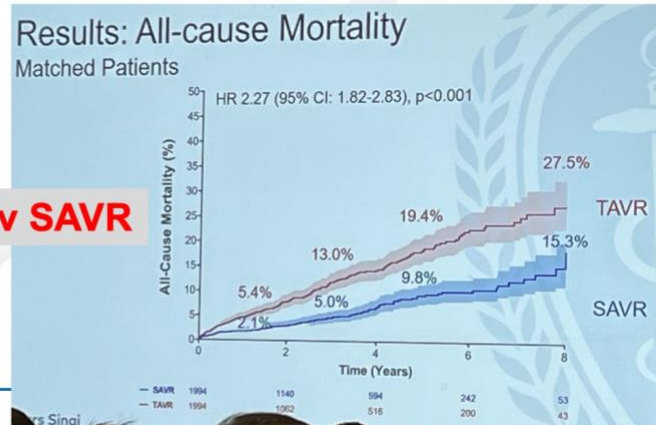
So far, we're looking at patients under 60, even though they're not really recommended to get it or get them anyway and they are not surviving as well as patients who get surgical valves. So think twice about that if you're 60 and someone tells you to get a TAVR. Make sure you've really thought through it and talk to somebody that can offer you a less biased viewpoint, someone that can give you all the options.

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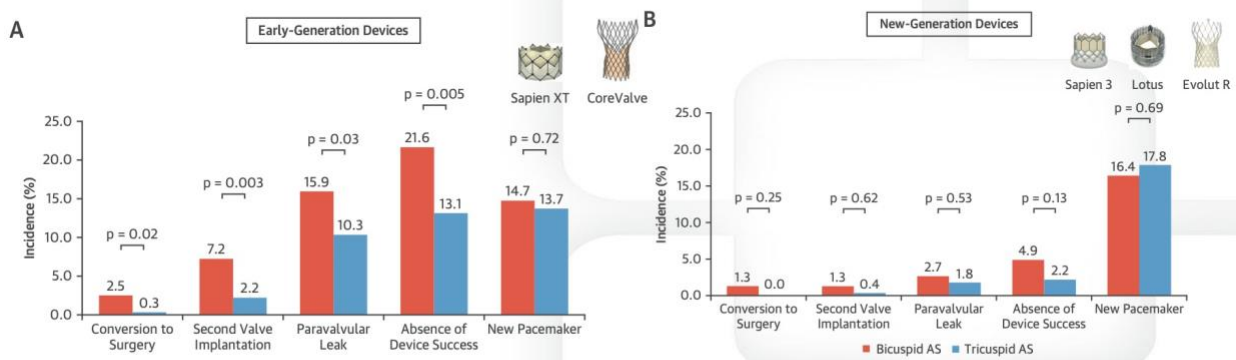


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This is another study where they looked at real-world data from the East Coast, and they found that the risk was higher for dying in a short period of time within the first decade when you got TAVR versus surgical aortic valves.

TAVR for Bicuspid AS Improving

- Select population → Mean age 77y/o
- Worse procedural success than for TAV (85% vs 91%)



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The problem with transcatheter valves into a bicuspid valve is it doesn't fit right because those two leaflets don't get out of the way when the stent expands. You can get leak around it. You can have more need for a pacemaker. Think about that lifelong care when you're making these choices.

One-year outcome of transcatheter aortic valve replacement for bicuspid aortic valve stenosis: a report from the Japanese Nationwide registry (J-TVT registry)

CVIntTher. 2023

Takashi Mukai¹ · Hiraku Kumamaru² · Shun Kohsaka³ · Isamu Mizote¹ · Daisuke Nakamura¹ · Yutaka Matsuhiro¹ · Koichi Maeda⁴

• 2013

• 423 B

• HR M

• Concl

	TAV group	BAV group
N	16,802	423
Age		
< 65 years	41 (0.2)	8 (1.9)
< 75 years	586 (3.5)	50 (11.8)
< 85 years	7297(43.4)	201 (47.5)
85 years and above	8849 (52.7)	164 (38.8)



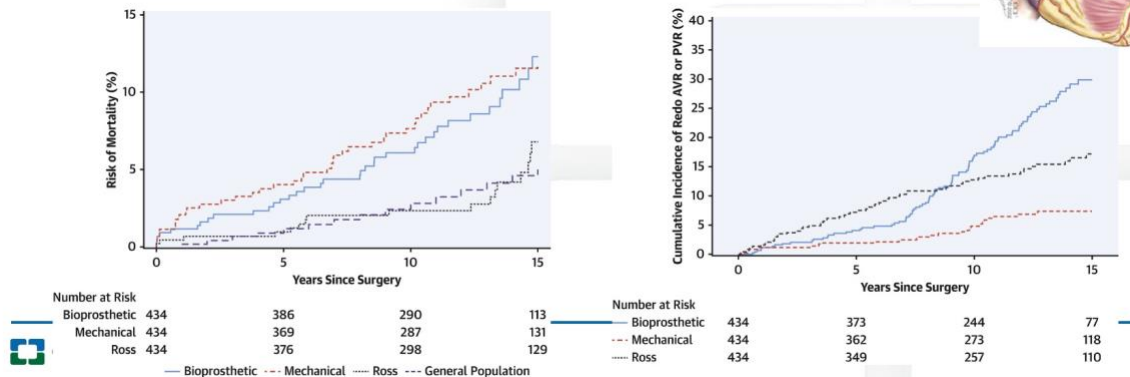
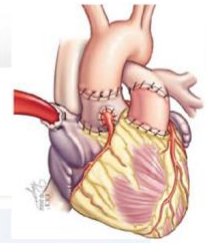
This Japanese data shows the same thing. They got a really good success on a whole bunch of people with bicuspid aortic valves. But if you look at the subset of patients who are mostly getting these bicuspid valves, they were in their 80s. Yes, there are some bicuspid valves that don't wear out until you're in your 80s. And maybe that's a good choice. But under 60, probably not a great fit.

Propensity-Matched Comparison of the Ross Procedure and Prosthetic Aortic Valve Replacement in Adults

JACC 2022

Ismail El-Hamamsy, MD, PhD, Nana Toyoda, MD, PhD, Shinobu Itagaki, MD, MSc, Paul Stelzer, MD, Robin Varghese, MD, Elbert E. Williams, MD, Natalia Egorova, PhD, David H. Adams, MD

- CA and NY Databases, 18-50y/o, 434 Matched Pairs



Another bit of data that talks about the Ross procedure compared to valves and young people under the age of 40, maybe when you're in your 40s or under 50, Ross might actually be something that lasts a really nice, long time and saves you maybe one less operation in your lifetime if you want to avoid anticoagulation.

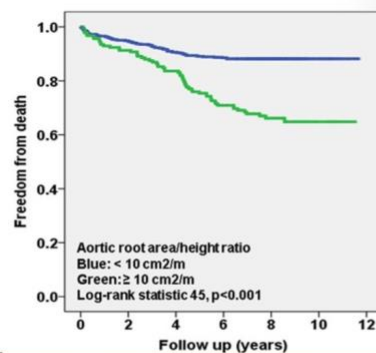
CHAPTER 7

Surgical Treatment of Aortic Aneurysms

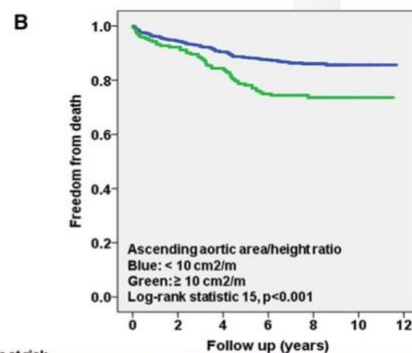
Dr. Eric Roselli: How do we treat aneurysms? How does it affect your approach when you have combined aortic valve disease? What do you need to know about bicuspid valves? We already talked a bit about that. When we say we repair your aorta, we replace it. And we use the size of your aorta to help pick that sweet spot of time when the risk is okay.

Better 'Guesstimates' of Natural History

- ~~Aortic Size Indexed to Body surface area (BSA)~~
- Maximum Area : Height ratio (> 10)



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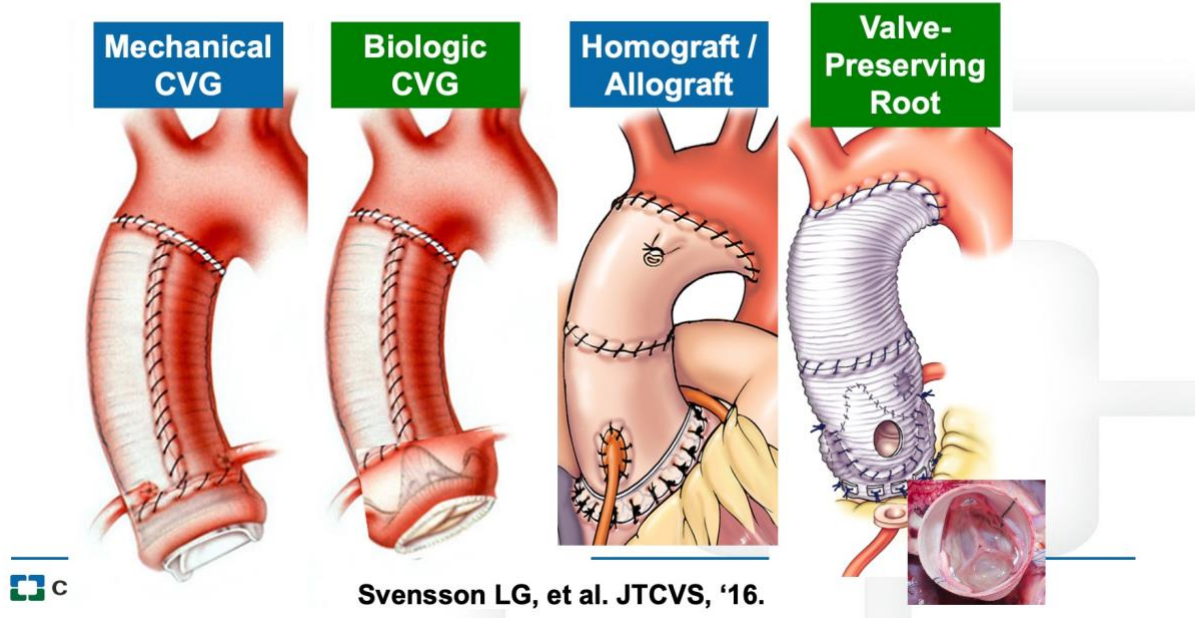


Masri, et al. Circulation, 2016

Aneurysm Size and Surgical Timing

We're trying to be more precise in that decision-making because a woman who's five feet tall and a man who's six-foot-seven shouldn't necessarily have the same size aorta. We were indexing this to body surface area and we realized that was a bad idea because if you gained weight, then your risk goes down and that makes no sense. I don't think there's really anything where you gain more weight or at least get into an obese zone that you're actually getting benefit. We've learned that if we can correlate the size of your aorta to your height, we can be a little more precise in the decision-making process.

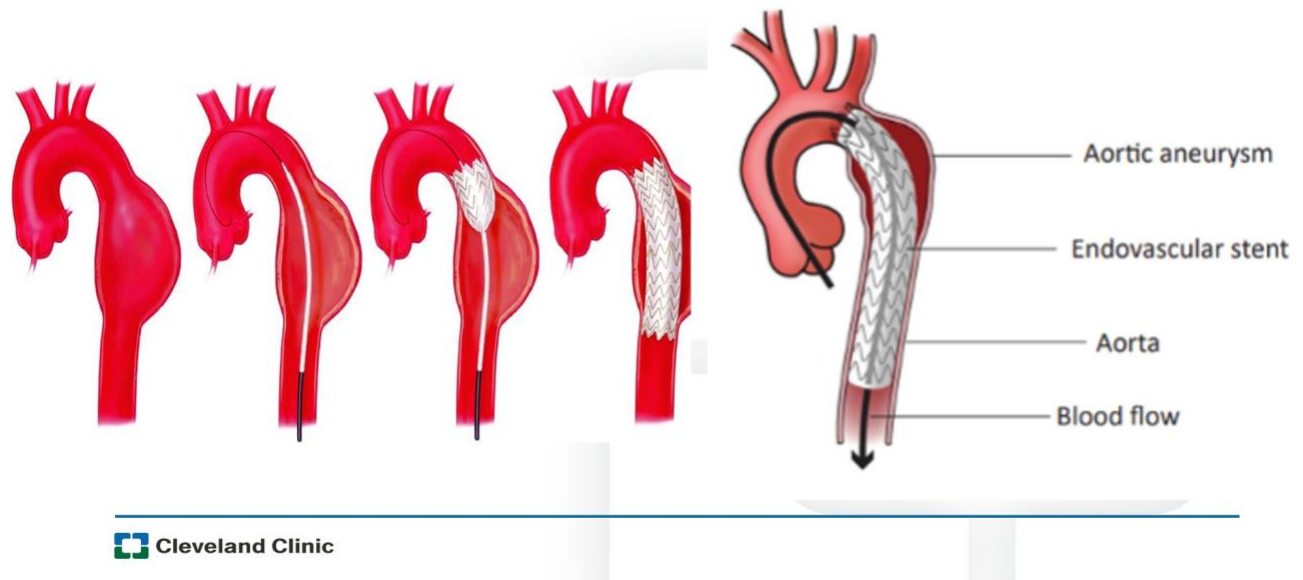
Four Common Root Procedures



Combined Aorta and Valve Procedures

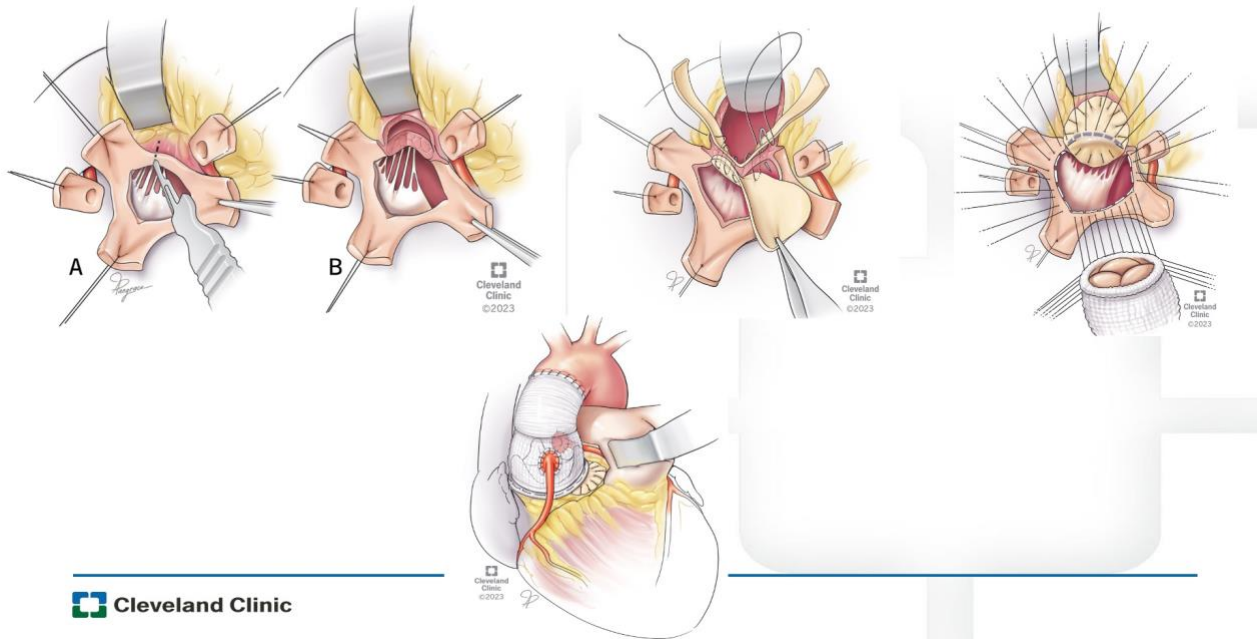
Then when you have combined aorta and valve disease, we can do these combined operations where we're replacing the aorta with a graft, with a valve in it, either a mechanical valve or a biologic valve, or maybe we replace the whole thing with this cadaveric homograft/allograft. Mostly we do that when there's an infection involved, or as we talked about a little bit already, something real – this beautiful valve sparing route where we take care of the aorta and re-implant the valve and maybe repair the valve at the same time. When you get your ascending aorta repaired, you're getting it replaced. It's not wrapped. We cut it out it is a new piece of hose in there. That's lasting your lifetime. It's this stuff. It's this fabric hose, a little bit stretchy, real easy for us to sew to. We cut and sew and we tailor it, or if it's involving part of your aorta downstream in the straight segmentary aorta, we can fix it from the inside, what we call an endovascular repair.

Endovascular Aortic Repair (Inside)



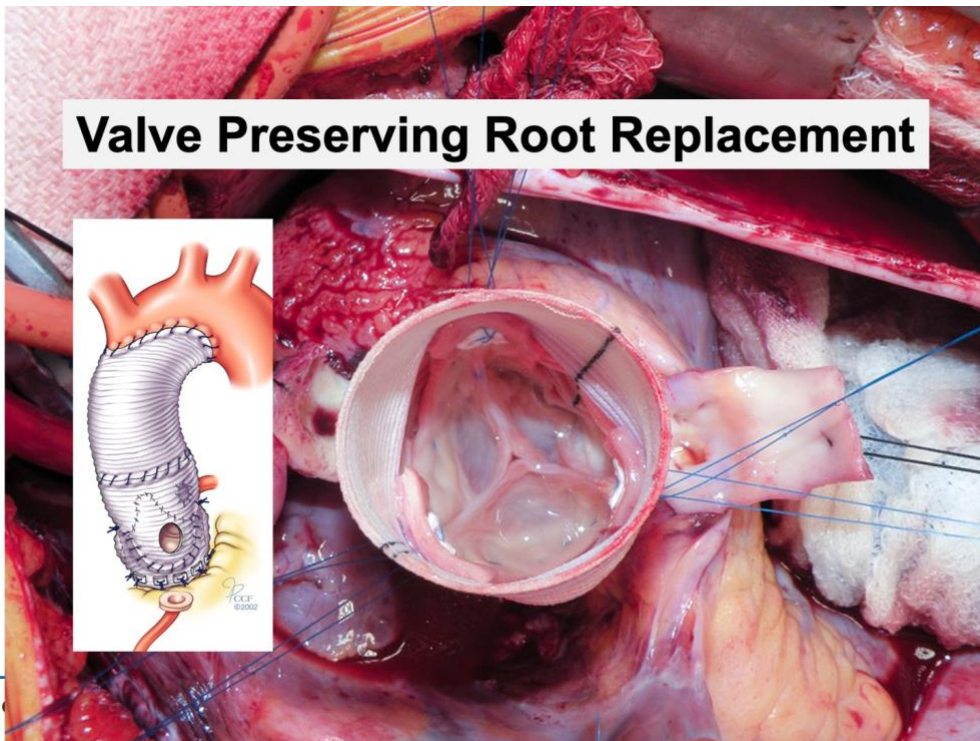
The principle is still the same. We replace the bad aorta with a new piece of hose. It's not a stent; it's a stent graft. So the graft is the hose, but because we're delivering it from a puncture in your groin and we're not sewing it in by hand, the stents are what hold it in place. So it's like a sleeve on the inside. Then the aorta heals around it. The blood flows through that fabric hose, so either open or endovascular techniques.

Aortic Root Enlargement

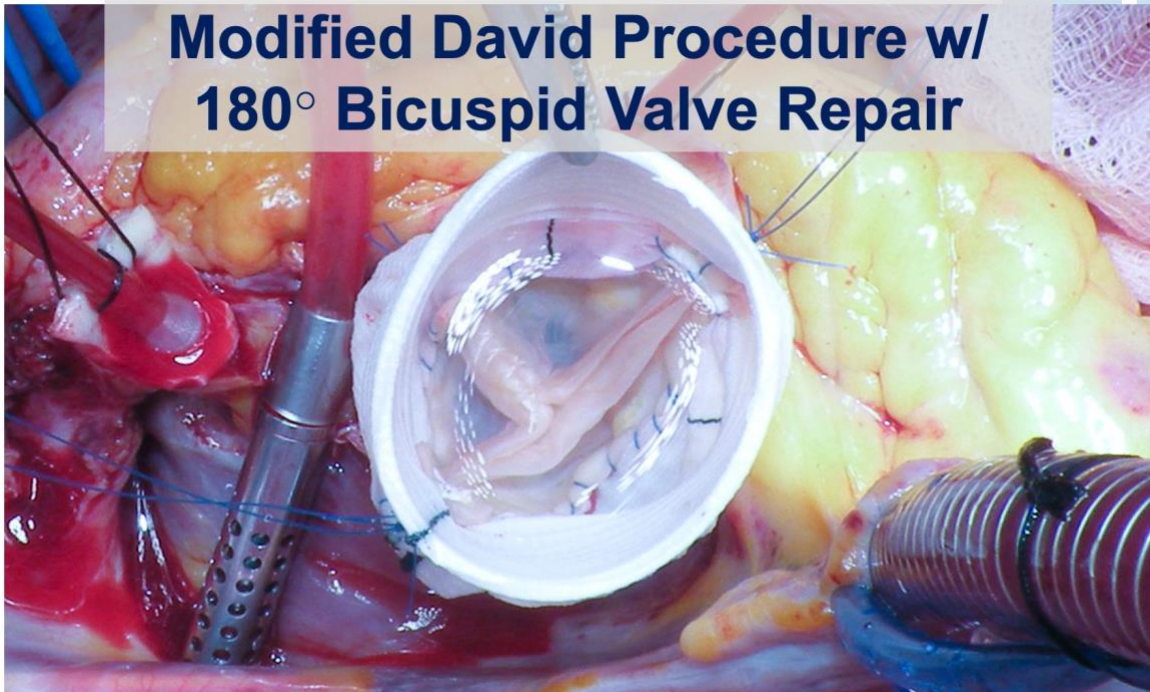


A couple other techniques that are of interest, if your valve opening to your heart is not very big and we don't think the new valve is going to be sufficient or efficient, which would be durable, we can do a series of different kinds of operations where we enlarge the root of your aorta or save your valve. Even with bicuspid valves with an aneurysm, we can do a David re-implantation and save that valve.

Valve Preserving Root Replacement



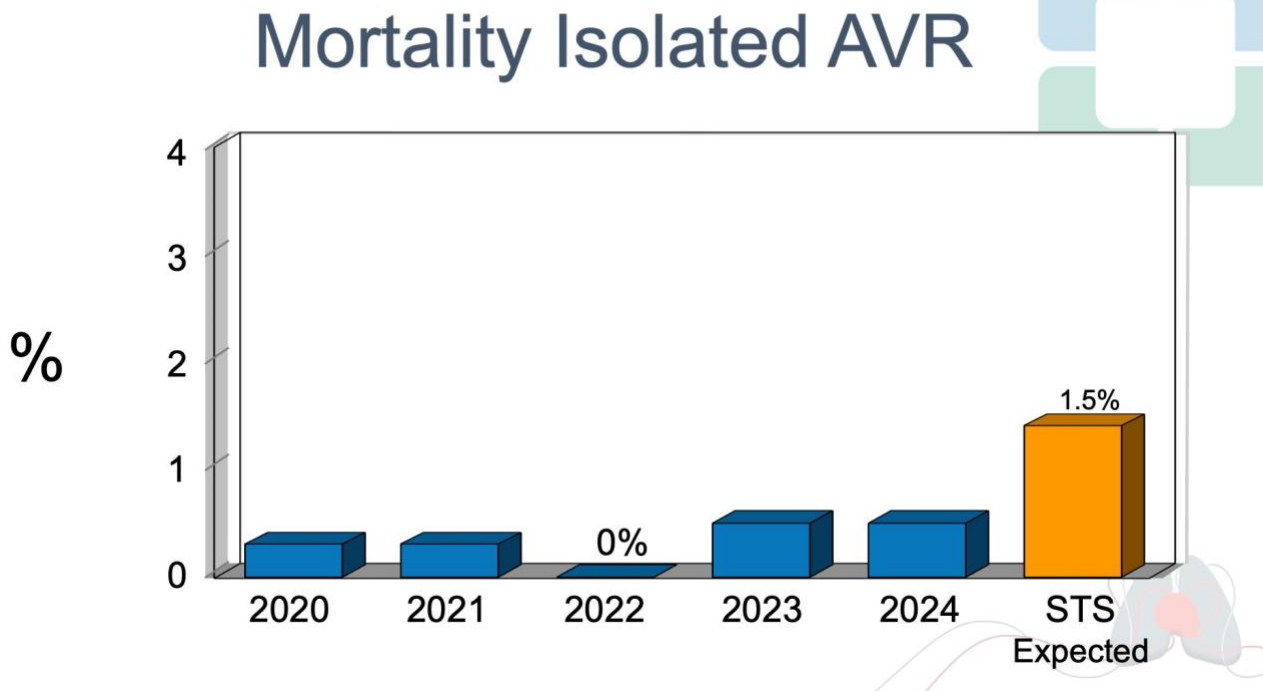
Modified David Procedure w/ 180° Bicuspid Valve Repair



CHAPTER 8

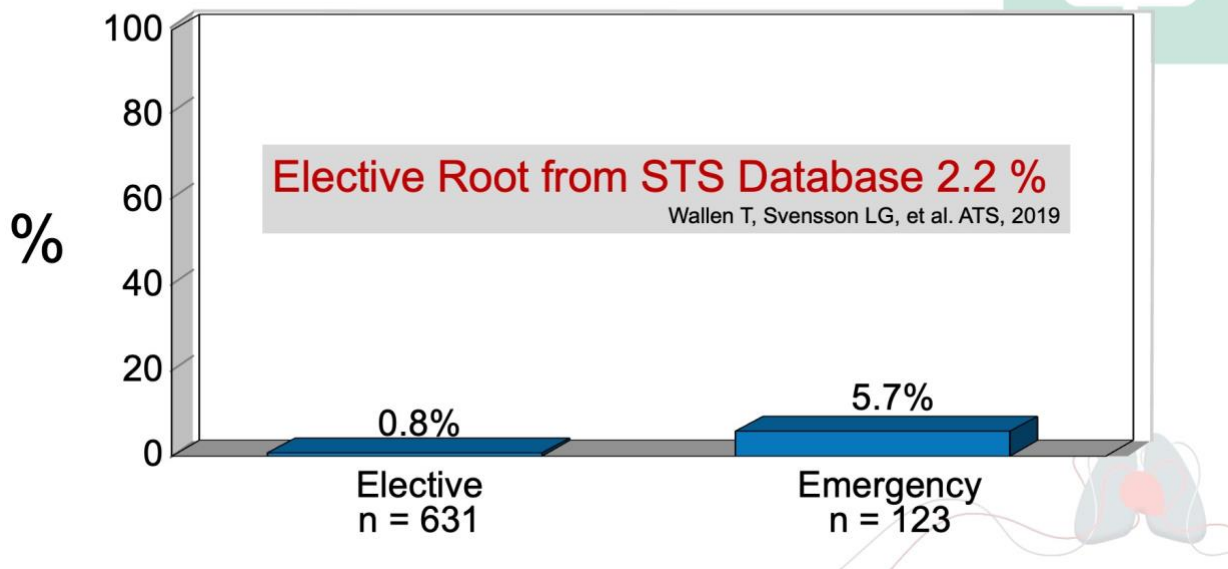
Patient Outcomes & Repeat Operations

Dr. Eric Roselli: What are the outcomes? It's safe, especially at centers of excellence. At all centers, the risk of death is pretty low for an isolated aortic valve, about 1.5%. In Cleveland, it's about a third of that, but pretty close to zero.



True for aortic surgery too. The national average at some big centers is maybe 2.5, 3% risk of death from aortic surgery. In Cleveland, it's less than 1. We're the biggest center in the world.

Root Replacement Mortality

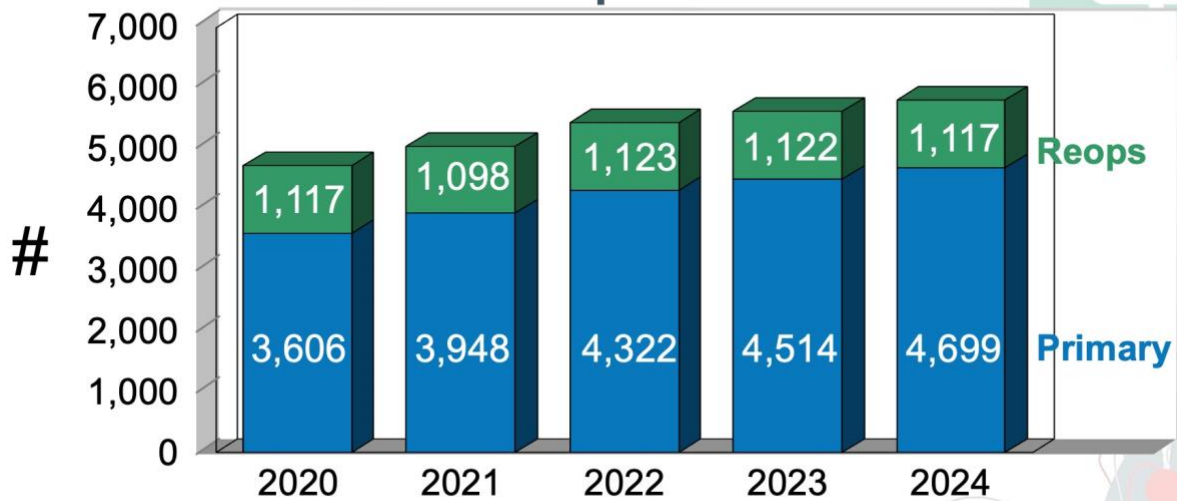


If you look at root replacement where we're not only replacing the aorta and the valve and putting the coronaries in, again, incredibly safe. When it's planned operation, it's less than 1%. Even in emergency situations, it's single digits. So it's almost a 94% risk of surviving even in emergencies if you come here or to a dedicated center.

Reoperations and TAVR Explants

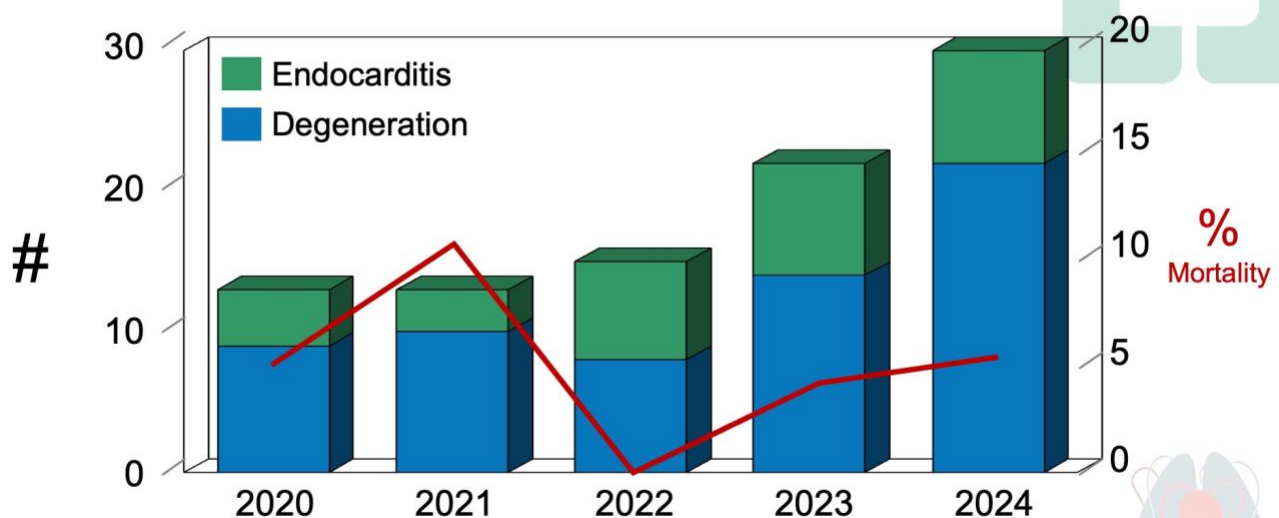
We do a lot of reoperations. A lot of these, because the valves wear out, we got to reoperate them or we got to reoperate on the aorta. It's about 20% of what we do in Cleveland.

Total Number of Cases and Reoperations



And you can see because of that experience or whatever center you go to and you need a reoperation, you make sure they feel comfortable in their experienced with that. Our risk of death from reoperations is incredibly low.

TAVR Explants



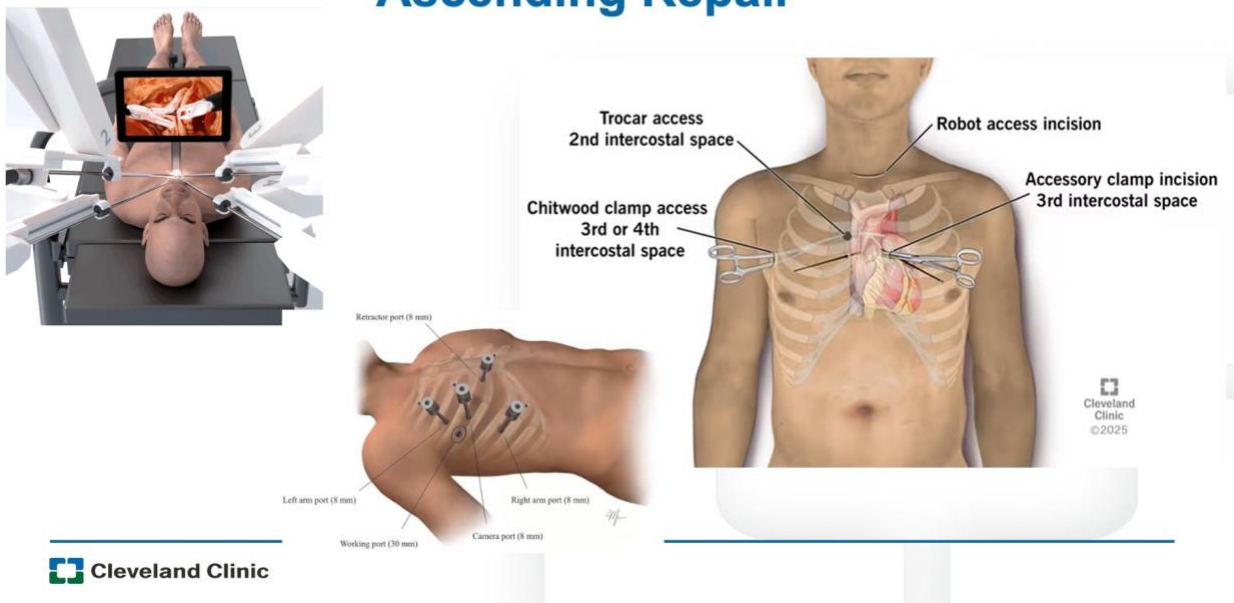
We're seeing more and more people who had these TAVRs, maybe they put in when they were under 60 and it wears out in a short period of time. They got to come back and get it reoperated on. We're seeing more and more of these coming. We're getting better at it. The risk of dying from that still a little higher than we'd like. You see the red line is like around 5%. Some other centers is much higher. But I think people are figuring out how to do those operations safely. We realize that's something that we're going to have to continue to learn about.

CHAPTER 9

The Future of Aortic Surgery

Dr. Eric Roselli: What's next? I talked a little bit about these robotic approaches. One of my colleagues here is doing these really cool robotic approaches where he drops in through the base of your neck like a thyroid operation.

Robotic Aortic Valve and Ascending Repair



A few centers are now doing these aortic operations with the robot where we go in through between the ribs. There's some new technology.

Enrolling now...

Began Q4 '25, now in Phase 2

Arcevo™ LSA
Hybrid Stent Graft System

ARTIVION

ARTIZEN
Trial

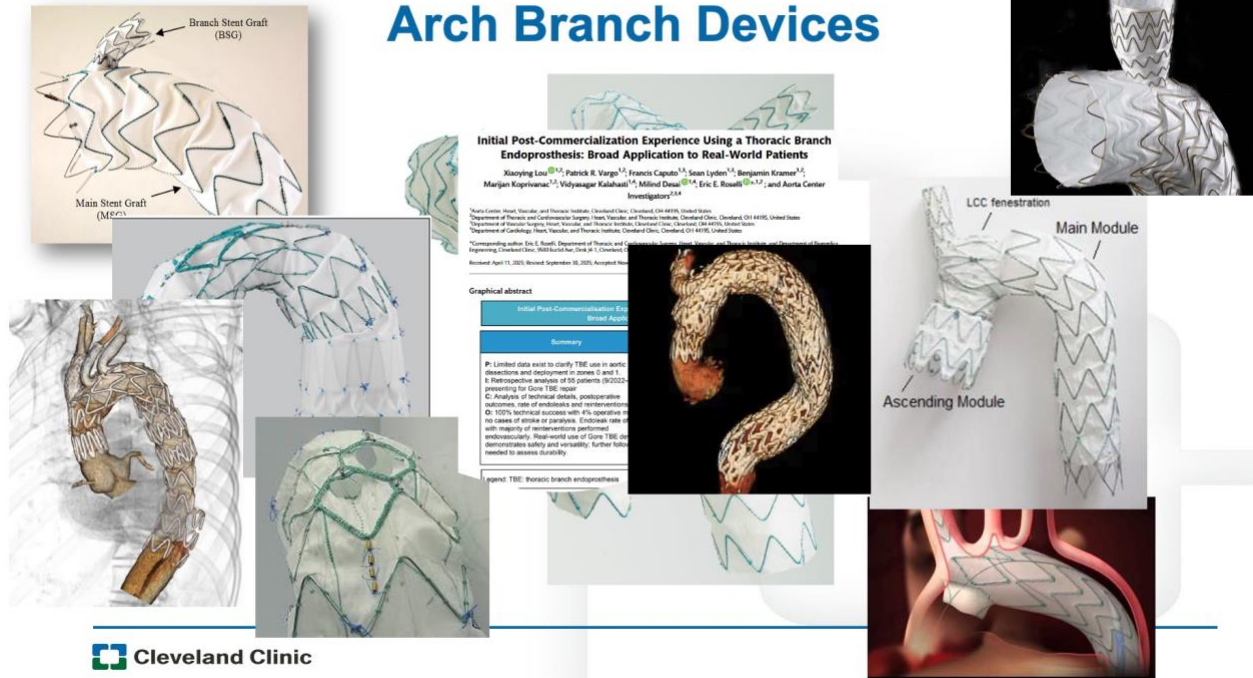
Investigational Device

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This technology will be available very soon for more complex arch repairs. Other parts of the aorta, we've also got these really complex, novel devices that have branches built into them so we can even fix more parts of the aorta without opening you up. That's true in the abdominal aorta. It's now true in the arch of the aorta. We're seeing more and more of these devices are currently investigational.

Arch Branch Devices

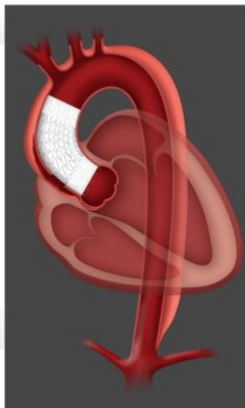


Investigational Endovascular Technologies

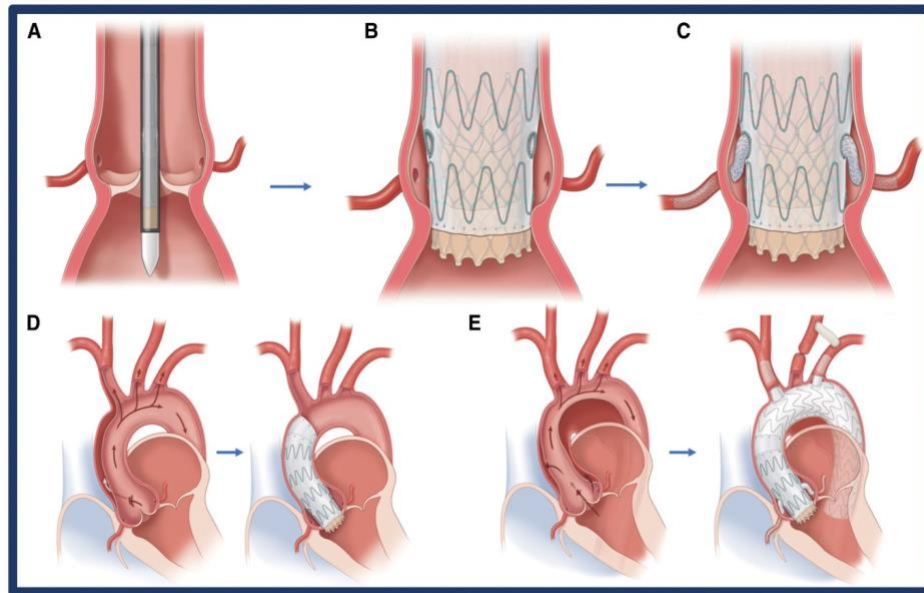
A couple of simpler versions are available commercially, but we're going to see these triple-branch devices starting in trial really soon. We're about to finish enrollment, hopefully very soon. I'm the principal investigator of this study.

Ascending Stent Grafting

- Growing "off label" clinical experience →
- Industry and FDA collaboration
- Site specific design
- EFS study completing now



We're a new device that allows us to treat the first part of the aorta with a stent graft through the groin. It looks simple, but this is a really complex space. Remember, we've got to be between the heart and the brain with these devices. And so they've developed a device that allows us to be a little more precise. Your anatomy has to be the right fit, though. That's the thing. So most of the ascending aorta is still done open, but there are some people who don't have options, and we've now got maybe some more endovascular options for them.



 Cleveland Clinic

Mehrdad Ghoreishi. *Circulation: Cardiovascular Interventions*.
First-in-Human Endovascular Aortic Root Repair (Endo-Bentall)
for Acute Type A Dissection, Volume: 16, Issue: 10, Pages:
e013348, DOI: (10.1161/CIRCINTERVENTIONS.123.013348)

We'll see more of these where we see an endovascular option where you got a TAVR tied into one of these endovascular devices. That's also very investigational, but a lot of exciting things happening in this space. We'll continue to develop new technologies to make things safer and more accessible to people who need really these life-threatening problems addressed.

CHAPTER 10

Patient Questions & Answers

Adam Pick: Dr. Roselli, I cannot thank you for taking the time to put together those remarks, really helpful; I learned a lot. I'm sure the patients learned a lot. Congratulations to you on all these great accomplishments from the development of new technologies to the outcomes. And so congratulations to you and your team. And speaking of team here at heartvalvesurgery.com, we got a team of patients and those patients have got some questions for you. And so we got 59 questions, Dr. Roselli. Let's go. Let's do some rapid fire here and see what we can get done over the next few minutes.

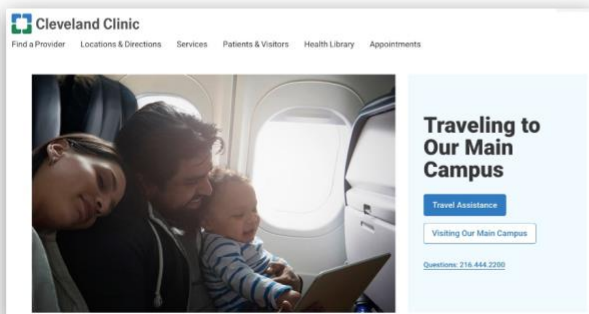
Patient Question: Traveling for Surgery and Cardiac Rehab

Adam Pick: This is coming in from Gene. I get this question all the time, which is, "I have a bicuspid aortic valve and aneurysm for ascending aorta, likely needing replacement of both. My question for Dr. Roselli is, for patients coming from out of state, how long does a patient need to stay in Cleveland? And this is one of my love languages, which is cardiac rehab. Can my family drive me back to Florida at the time to do my cardiac rehab at home?"



Travel to Cleveland Clinic / Cardiac Rehab

Gene asks, "I have a bicuspid aortic valve and aneurysm of ascending aorta likely needing replacement of both. My question for Dr. Roselli is for patients coming from out of state, how long (on average) does a patient need to stay in Cleveland? And can my family drive me back to Florida at that time to do my cardiac rehab at home?"



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Dr. Eric Roselli: Yeah, 100%. So the hospital stay is on average about five days. We usually have you come in a day or two beforehand to do some pre-op workup, maybe a heart

catheterization. And then we ask you to stay in Cleveland a couple days after your discharge. It's safe for you to leave. We wouldn't let you out of the hospital. But we ask you to stick around for a couple of days if you come a long way so if something pops up in a delayed fashion, it's really easy for us to handle it. We have you check in with a nurse practitioner before you get on the road. You can fly back. Drive back to Florida is a long drive. You can fly. There's no problem. As long as you're not the pilot on the plane, you can fly back home. So I say typically expect to be here maybe about 10 days.

Adam Pick: Got it.

Dr. Eric Roselli: Cardiac rehab can be done anywhere. There's great rehab everywhere, even in some of the most rural parts of the country. I send patients back and they get good cardiac rehab done.

Patient Question: Traveling from Out of State

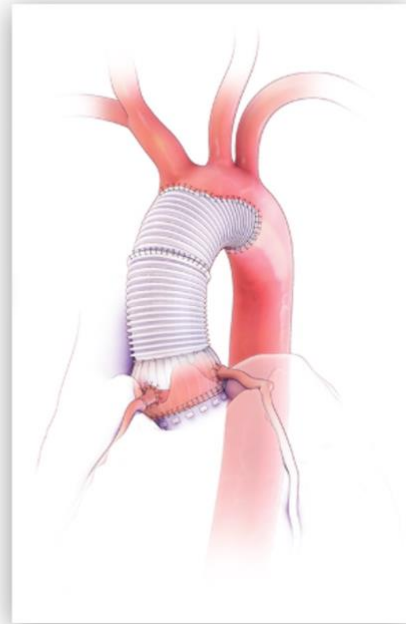
Adam Pick: Dr. Roselli, how many of your patients are actually coming to you from Ohio versus coming to you from other places in the country?

Dr. Eric Roselli: Yeah, as a group, about 40 to 45% of our patients come from more than 300 miles away, so mostly out of state. And in my practice, it's probably double that.

Patient Question: Aneurysms After Dacron Graft Repair

Adam Pick: All right, let's move on to Rose. Great question here. "I had an ascending aortic aneurysm repaired with a Dacron sleeve during my BAV surgery, bicuspid aortic valve surgery nine years ago. My last echo showed a small aneurysm of 3.2 centimeters, which shocked me because I thought the Dacron sleeve was a permanent fix. Is this common? And then a follow-up is keeping my blood pressure in check the best way of preventing it from growing? If it would need repair again, would I need an open heart surgery?"

Rose asks, "I had an ascending aortic aneurysm repaired with a Dacron sleeve during my BAV surgery nine years ago. My last echo showed a small aneurysm of 3.2 cm which shocked me because I thought the Dacron sleeve was a permanent fix. Is this common? Is keeping my blood pressure in check the best way to prevent it from growing? If it would need repaired again, would I need another OHS?"



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Dr. Eric Roselli: Rose, I appreciate your question, but honestly, I don't really quite understand it. So 3.2 centimeters is not an aneurysm. Again, without looking at your images, I'm not giving you medical advice here. I don't know your details. It's possible that maybe there's a little area where something's pooching out, like one of those saccular aneurysms I was talking about, where someone sewed something in that's 3 centimeters. Then that might be an issue or something broke down but otherwise, 3.2 is normal. And no, the Dacron is permanent and durable. But where it's fixed in place, again, if it broke down a little bit, there's a little blister or something pooching out, it may or may not be something that needs to be addressed. Even those things, though, a lot of times we can watch them because they scar in pretty tough. That's all I can give you without seeing your actual images. But I wouldn't panic about it too much. Just get a little more detail about exactly what they mean when they tell you small aneurysm. And an echo is not a great way to see it. CAT scan is much more detailed.

Patient Question: Choosing a Valve During Reoperation

Adam Pick: Eric, you've really helped me understand over the time how important the lifetime management of valve disease is. And so let's talk about reoperations. Chris asks, "When a tissue valve fails," and here's an example of what looks like a very calcified valve, "how does Dr. Roselli determine which valve to use next, a tissue or mechanical?"



Source: TCT MD

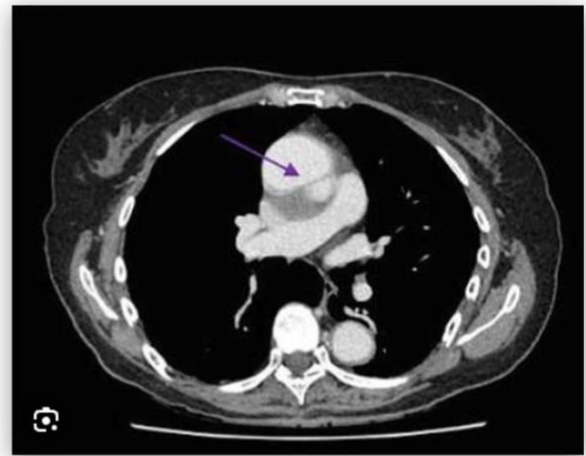
Chris asks, "When a tissue valve fails, how does Dr. Roselli determine which valve to use next (tissue vs. mechanical)?"

Dr. Eric Roselli: Yeah, a lot of the decision is the same decision that goes in the first time you chose a valve. What are your desires about anticoagulation or not? What is your longevity? How many operations are we looking at for you? Usually, we replace the valve with the same valve you picked up front. If you picked a biologic valve and you've outlived it, it's probably because you wanted to avoid anticoagulation. There is the option to do a transcatheter valve inside of a biologic valve, but we don't really know how durable those are going to be yet. We're feeling pretty confident you should get about 10 years out of one of those. Could it be longer? Not clear. The lifespan of a surgical valve, the average lifespan is more like 15 for most people, as long as you get a big enough valve. The bigger valves are more efficient. A more efficient valve lasts a little longer, less wear and tear.

Patient Question: Conflicting Aortic Measurements

Adam Pick: This is a question that I get three, four times a week, which is just all about diagnostic confusion for patients. Chris says, "I have an aortic aneurysm at the aortic root as diagnosed by CT scan with contrast. I do not have any symptoms. I've had many scans over the years that vary greatly. For example, my '22 CT scan with contrast measured 50 millimeters. And then just last week, a CT scan reported no sign of an aneurysm. The rest of the years, the measurements range from 3.9 to 4.8. Why is this?"

Chris asks, "I have an aortic aneurysm at the aortic root as diagnosed by CT Scan with contrast. I do not have any symptoms. I have had many scans over the years that vary greatly. For example, my 2022 CT scan with contrast measured 50mm and then just last week a CT scan reported no sign of an aneurysm. The rest of the years the measurements range from 3.9 to 4.8. Why is this?"



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Dr. Eric Roselli: It's just frustrating. So we are biologic creatures. We're not linear, so your aorta comes up out of your heart in an angle and if we don't get the CAT scan done with the dedicated strategy to look at the aorta, the person reading it might just take some measurements that really don't mean a whole lot. So a couple of things are at play. First of all, you want the contrast to be timed right inside the aorta. And if we're looking at your aortic root, I want you to get a gated CAT scan. That means you have EKG leads that correct for the motion. The heart is – a you wouldn't believe it if you saw what it looked like inside an open chest. That heart is cranking in there violently. And that aortic root, which sits inside the heart, is moving a lot. So if there's motion artifact, they can overestimate by measuring the blurry edges of this thing, just like you take a photo of someone running down the street. You got to have your lens speed or – I'm not a photographer, but you can appreciate that.

Then when they do the imaging analysis – so the image you show here in a CAT scan is just the standard way where you're cut straight across. Nowadays, we have these complex, really simple to use and readily accessible to everybody computer programs where we can look at the aorta in the right plane. So if your aorta is coming out at an angle, you want to make sure the measurement you're taking is cutting across it at a right angle, just like you cut a cucumber on an angle, it looks bigger than it is. If we're just taking a weird oblique cut across the aorta they might overestimate the size.

I don't know why you're getting a whole bunch of these weird numbers it doesn't go from 3.9 to 5 in a minute or even in a year There's probably something about we're not comparing apples to apples here or red apples to red apples here. This is why you want your cardiologist to be an

imaging specialist or the person seeing you to be someone maybe at an aorta center, has a better sense of what they're looking at and get into the details and make sure the study is done with the right algorithm and being analyzed the right way.

Patient Question: Genetics and Family Screening

Adam Pick: I hope that helped you, Chris. Let's move over to Julie with a question about genetics. Again, being diagnosed with these life-threatening diseases, as you've relayed earlier, Dr. Roselli, it can weigh on the mind. And Julie asks, "In the genetics of the whole disease category, I've been diagnosed with an aortic aneurysm. I'm freaking out about me and my kids. What should I do? Screening tests they should get?"



Julie asks, "I have been diagnosed with an aortic aneurysm. I'm freaking out about me and my kids. What should I do? Screening tests they should get?"

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Dr. Eric Roselli: Don't freak out. You need to ask, again, the right person these questions. So more and more, we're learning that thoracic aortic aneurysms are probably something related to a congenital abnormality or genetically triggered problem, like I alluded to a little bit in the talk. I didn't get way into the whole genetic. You gave me a couple of huge topics to cover, Adam. Even when we see families where multiple family members are affected by this and we do the genetic screening, we're only hitting about 20 or 30% of the time. It's because we don't know all the genetic mutations yet. There is now a commercially available screening panel we can do that screens for about 40 plus gene mutations. If you have one of those, then we know a fair amount about those, and we can guide that. If we know you have an aneurysm, then we

start with you with that workup to figure out what's going on, Julie. If you're young, then you should talk to someone about getting genetic screening.

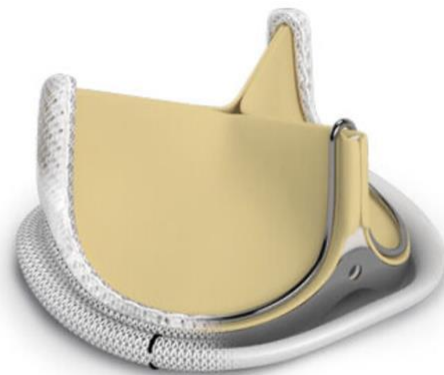
If we screen you and you don't hit for one of those genes we know about – like I say, it's like looking for a needle in a haystack. You got to know what the needle looks like to find it. We know about what 40 needles look like so far. So if you don't, then they have to do good imaging. At some point, depending on the pattern of your aneurysm, they might want to screen your kids. But it doesn't affect them when they're little, especially if they don't have the genetic mutations that we know about. So I would say, maybe you start with you at the genetic screening. And then if it's negative, you get imaging in your kids before they're off your insurance, before they're 26 years old.

Patient Question: Tissue Valve Lifespan

Adam Pick: Let's move on to probably one of the most common questions that I receive, which is about aortic valve replacements and their lifespans. Phil asks, “Is there anywhere I can find published data on the lifespans of various heart valves? I have an Edwards 29 millimeter bovine valve from 2015. I've heard a common failure point is between seven and nine years. Is that accurate?”

Lifespans of Heart Valve Replacement

Phil asks, “Is there anywhere I can find published data on the lifespans of various heart valves. I have an Edwards 29mm bovine valve from 2015. I've heard a common failure point is between 7-9 years. Is that accurate?”



Source: Edwards Lifesciences

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Dr. Eric Roselli: That's too soon. So again, there are several studies. Most of them are not very big. They're a few hundred valves. The problem is not everybody gets their data registered in a

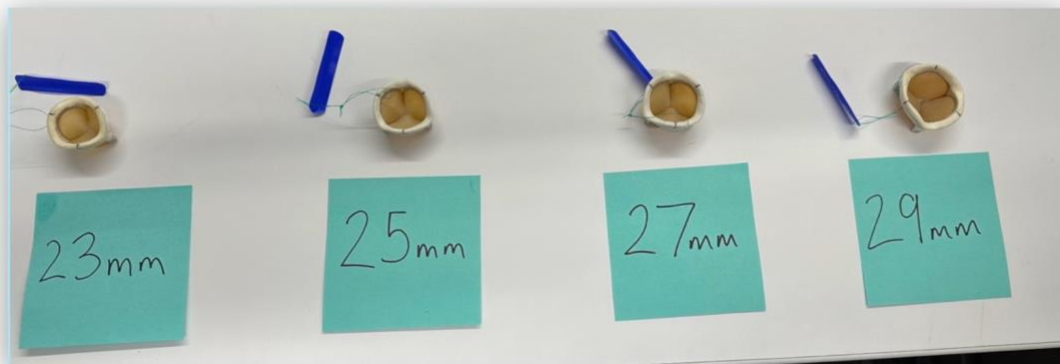
prospective way where we monitor them over a period of – into this second decade. Pretty consistently, we'll see these Edward's 29 millimeter bovine valves are going to get you through that first decade. It's in the second decade when we start to see failure, so I tell folks maybe 10 to 20 years or like 12 to 18 years with 15 years being an average. One of my patients recently when I was talking about said oh, like the lifespan of a medium-sized dog? I'll say, yeah, it's about right. Just like you can't predict how long that medium sized dog is going to last, we can't predict whether you're going to get 12 or 15 or 18. What you did get was a large valve. We know that the data on those Edwards valves is pretty decent. The biggest study is the one from the Cleveland Clinic. We studied over 12,500 of those. And we found that the more efficient the valve was, the longer it lasted.

Patient Question: Aortic Valve Sizing

Adam Pick: Eric. I just want to dive deeper because this does come up a lot these days, which is, “How has valve sizing changed in your practice over the last 30 years? And what should patients ask their medical teams about valve sizes given their specific anatomy?”

Aortic Valve Replacement Size

Adam asks, “How has valve sizing changed in your practice over the years? What should patients ask their medical teams about valve sizes given their specific anatomy?”



Source: Bo Yang, MD, Michigan Medicine

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Dr. Eric Roselli: Well, the valve size really hasn't changed much. They label things a little bit differently. I think there's a greater appreciation for this idea that we might want to upsize a valve for folks if we think they have the chance to outlive a valve. Look, 20 years ago, all the people we were operating on were really old little ladies that weren't going to outlive a biologic

valve. Now we're doing more and more valves in younger people, and we're thinking about what's going to happen next, what's going to be the next phase.

And so it's interesting. I just talked about that study where we looked at durability related to valve efficiency. What I mean by efficiency was the gradient across the valve. So interestingly, it was the gradients, that description of flow through the valve correlated with the durability of the valve, but the valve size did not. It's not just the valve size that we put in. There's a whole bunch of other complex things going on with flow. Remember the picture I showed of the 4D MRIs with the swirling flow going through and different angles. That biologic space is so complex. But in general, if we think you're going to outlive a valve, we want to err on the side of giving you a bigger valve so that you have more laminar flow. Easy flow through that space puts less stress on the valve. Then the physics of flow are not much different once you get above 25 millimeters.

Patient Question: The J-Valve

Adam Pick: Got it. Let's go real time to Robert Bourne, who asked a question. I'm getting lots more questions about this. "What is the status of the J-valve?"

Dr. Eric Roselli: It's a transcatheter valve for patients with leaky valves. Most patients with predominantly regurgent valves that have healthy leaflets are going to do way better with the valve repair than they are with some transcatheter replacement. So it's a niche device. And so far, it's coming along. But I don't know that we have enough really real-life experience in enough patients that haven't been super-selected in a trial and everything else for me to say much more than that. It seems to be a pretty decent valve and if it's your physician who understands this space thinks it's the right fit for you, that's reasonable to consider but I don't think it's going to replace valve repair. It's more for people that maybe a little higher risk for open surgery or something like that.

Closing Remarks

Adam Pick: Robert, I hope that helped you. And we've been talking about valve sizing. We've been talking about upsizing the valve. I wish, Dr. Roselli, we could upsize the webinar. I want to respect everybody's time. But before you hang up, I just want to ask you – please don't yet, because I'm going to ask you to complete the survey for us. I just want to take a very quick moment to offer a very humongous thank you to Dr. Roselli, the entire team at Cleveland Clinic for their support of not only this webinar but all of the patients in our community. I want to thank all the great people in our community for attending today and doing everything that we can to get the best outcomes for our hearts. And I'm going to be popping up a survey right now. It's five questions. If you could please finish it, I would really appreciate it. And Dr. Roselli and everybody in our community, thanks for being here today. And as we always say, keep on ticking. Thanks so much, everybody.

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 30+ free eBooks about heart valve disease and treatment options for aortic, mitral, pulmonary and tricuspid valves.
- [Heart Valve Learning Center](#) - Visit the Heart Valve Learning Center to access over 4,000 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 over 1,500 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 300 educational videos filmed by the HeartValveSurgery.com film crew about heart valve surgery