

**Kendal Williams, MD (Host):** Welcome everyone to the Penn Primary Care podcast. I'm your host, Dr. Kendal Williams. So one of the most significant advances in medicine for the last 10 years has been transaortic valve replacement; the ability to replace an aortic valve through a catheter-based procedure. And so that has changed the dynamic of how we think about aortic stenosis, uh, and certainly has changed what it means to us in primary care.

I, myself have had probably three or four patients over the last year or two who have undergone TAVR procedures. So I, I brought on the program to talk with us about not only TAVR, but aortic stenosis generally, some true experts in it. Dr. Howard Herrmann is the John Bryfogle Professor of Medicine at Penn. He is the Section Chief of Interventional Cardiology at the Penn, and also the director of the HUP catheterization lab and the director of the TAVR Program. Howie, thanks for coming on.

**Howard Herrmann, MD:** Thank you very much, Kendal. It's a pleasure to join you tonight.

**Kendal Williams, MD (Host):** Dr. Carl Reynolds is an old colleague that I send some of my more difficult patients. He is an Assistant Professor of Medicine at Penn, a former Penn Chief Resident after completing his residency program here. He is a clinical non-invasive cardiologist, primarily based at Presbyterian. Carl, thanks for coming on.

**Carl Reynolds, MD:** Thanks, Kendal. Good talking to you.

**Kendal Williams, MD (Host):** So, I've invited you two on to talk about some of the great advances that have happened, you know, in the last decade in the management of aortic stenosis. But I thought the best thing is to, to actually start with a baseline of information, cause we're speaking to a large audience and we really want to review the basics first.

So, let's talk about aortic stenosis generally. If my practice is any indication or even my family is any indication, it's a pretty common. I have an uncle with, with an aortic valve. I had a great aunt who passed away from aortic stenosis, so it's a pretty common thing. I think it's almost as much as 12% of people over 75 years old will have at least one valvular disorder. Is that right?

**Howard Herrmann, MD:** It is. About two or 3% of all people over the age of 65 have some degree of aortic stenosis, and it goes up as you get older. So, as you approach ages 75 and older, as much as five to 10% of the population will have some degree of aortic stenosis.

**Kendal Williams, MD (Host):** So most of the time in primary care it's, we're seeing patients primarily who come to us. We might pick it up as a murmur on exam, and then send people for an echo. Occasionally a patient will present with symptoms. You know, I remember this sort of old saw that I learned way back when that in general, stenotic murmurs, could still be fixed when they present with symptoms, whereas regurgitant murmurs the were often too late. That's generally true, right Carl?

**Carl Reynolds, MD:** Yeah, I think that holds true for the most part that aortic stenosis in particular, is something that we can safely wait until more advanced disease occurs before, thinking about doing something about it as, as opposed to some of the regurgitant lesions where you really have to focus in on other kind of non-bedside ways evaluating progression.

**Kendal Williams, MD (Host):** So, let's just talk about this process, if you will. Usually there is some predisposition to aortic stenosis, either because of a bicuspid aortic valve or, because of rheumatic fever or some other condition that leads to sensitivity of the valve. Over time you get constriction, and calcification of the valve, which a process that seems to be part of the same calcification process that occurs with all atherosclerotic disease. Can you comment on that?

**Howard Herrmann, MD:** Sure. So as you pointed out, there are different causes of aortic stenosis. Rheumatic fever in this country is relatively rare. It can lead to aortic stenosis, more commonly to aortic regurgitation. But in people who are under the age of 65, the most common etiology of aortic stenosis is that they were born with a bicuspid valve. And the turbulence gradually leads to calcification and they tend to present at a younger age, than patients with senile calcific aortic stenosis which is more a disease of the elderly and we see that prevalence increase as you get past the age of 70 and is the most common cause when we see octogenarians or nonagenarians with severe aortic stenosis. It is a calcium deposition on the valve.

It does not really share the same pathophysiology though as atherosclerotic lipid plaquing that we see in, say, coronary arteries. So it is a different pathophysiology, more like a bony disease. There are some interesting new understandings of that pathophysiology that involve things like lipoprotein little a as part of the pathogenesis.

But right now we don't have any treatment that actually works medically to slow that progression. So statins have not been shown to be beneficial in aortic stenosis, and we don't really have any medical therapy. And so that's why these

mechanical therapies, whether it's open heart surgery or TAVR, become so important as treatment options.

**Kendal Williams, MD (Host):** Howie I want to circle back on bicuspid aortic valve because we occasionally in primary care see patients that come in and will tell us, you know, my brother has an a bicuspid aortic valve and I want to be checked for it. There is some genetic predisposition here in sharing of the risk, right?

**Howard Herrmann, MD:** Absolutely. It's about a 5% prevalence. So if you have a relative with a bicuspid valve, you have a much higher than normal chance of having a bicuspid valve, but it's still only about 5% in in transmission. But patients who have a bicuspid valve should certainly have their family members checked for that so they can be followed prospectively for the development of either bicuspid aortic stenosis, or the concomitant aortic root enlargement that often accompanies bicuspid valve disease.

**Kendal Williams, MD (Host):** So if we have a patient that comes in with either symptoms and maybe we should just go over the symptoms. We don't see them very often. I think you as cardiologists probably do see patients present with symptomatic disease. Right Carl? What are the most common presentations that you see?

**Carl Reynolds, MD:** Yeah, I think that shortness of breath and general heart failure type symptoms are the most common way that you might first see a symptomatic aortic stenosis patient. We also think of course of angina and that may happen more commonly in somebody who has concomitant severe coronary disease. And then you get the changes like syncope or presyncope that can occur with suddenly standing. And, you know, those are generally people who are truly pretty severe AS patients by then. So it's, I'd say it's rare to see a patient who has newly discovered AS just from symptoms in the cardiology clinic, but not it's not impossible. We usually see it as a referral from one of you guys who've picked it up first.

**Howard Herrmann, MD:** You know, it's interesting, those, those three cardinal symptoms that you mentioned, Carl, chest pain, shortness of breath, and syncope. They were first described just about 50, 52 years ago by Eugene Braunwald, and he wrote a very seminal paper documenting the progression of disease in patients with those three symptoms.

That paper was based on 12 patients and has become you know, a legendary publication because today we still talk about those three symptoms and how that

relates to the rapid decline in survival if you have aortic stenosis with that. It's really an a, an amazing paper and an amazing historical footnote to this whole story of AS.

**Kendal Williams, MD (Host):** And Howie, as I remember it was, oh gosh, this has taken me back one year, five years. So you know, if it's CHF, it's one year. I think that before potential mortality, three years for angina, five years for syncope, something like that. Right?

**Howard Herrmann, MD:** Yeah. I mean, we do think of it that way, but nowadays it's really, uh, difficult sometimes to tease out whether those symptoms are due only to the aortic stenosis or as Carl pointed out to concomitant coronary disease or some other problem. I saw a patient this week in the office who presented with syncope, but he was dehydrated from a GI bug at the time.

And so, really it wasn't his aortic stenosis per se that caused the syncope. It was the GI bug and the dehydration. So you have to be a little careful figuring that out. But, all of those symptoms are, are worth keeping in mind.

**Kendal Williams, MD (Host):** I think one of the questions that we often have as primary care physicians is just thinking through the echo findings that we see on somebody gets, uh, an echo for any number of reasons. It comes back with measurements of the aortic valve. So, the big thing is the valve area.

My understanding is severe is considered less than one centimeter squared. And less than that you can potentially expect symptoms. And Howie, just like you, patient you just described, we have these patients that we're always wondering, you know, is it the valve or is it, is this the contributor? And my understanding always was that if you were above one centimeter squared, that it's unlikely to be the main contributor to any symptoms.

**Howard Herrmann, MD:** True with some caveats. I mean, it does depend a little bit on the calculated number. So echo gives us a number of different things about aortic stenosis. It tells us about the peak and mean gradient, which is probably the most reliable measure that comes off the echocardiogram. And then the valve area is calculated from a combination of that gradient, the velocity, and the LV outflow tract diameter, which can introduce some errors and then there's also the flow. Some patients have low ejection fractions or low flow due to other medical problems like mitral regurgitation or tricuspid regurgitation, and that can mask the amount of flow through the valve and therefore it can lower the actual gradient. So we have this classical high flow,

high gradient patient. We have the classical low flow, low ejection fraction patient. And then, in some elderly patients, we have these very thick concentrically hypertrophied ventricles that can't fill well. And so they have low flow and low gradients, what we call paradoxical low flow, low gradient aortic stenosis. So there are these variants.

The variants are about 10 to 20% each. The majority of patients have this high flow, high gradient, situation. And the number I like to keep in my mind is the mean gradient of 40, the peak gradient of about 64, the valve area of about one. Those should all be triggers to thinking about the patient as having severe aortic stenosis.

**Kendal Williams, MD (Host):** So it's an at that stage that you might anticipate symptoms could develop?

**Howard Herrmann, MD:** Exactly, although it's a bell-shaped curve. So we have patients who have symptoms at mean gradients of 32 and other patients who get up to 48 mean gradient before they get symptoms. So it's a combination of severe aortic stenosis and symptoms that really leads to the lowered life expectancy, and that's where you want to intervene.

**Kendal Williams, MD (Host):** So Carl, at what stage you're, you're reading echoes maybe on your own patient, let's say at what stage are you calling Dr. Hermann and thinking about aortic valve replacement?

**Carl Reynolds, MD:** Well, that's a great question. One of the things that we've come to really shift the way we think about aortic stenosis, uh, in the TAVR era. We used to follow that old paradigm of, you know, don't worry about it until it's clearly symptomatic. But, you know, one of the challenges I think is that sometimes we get patients who are not terribly active and they don't really test their stamina much and may not really get symptomatic early on or even like with severe AS. And so, I think it's as, as a practicing cardiologist, I'm always careful to make sure that it's not a patient that is just very sedentary and isn't really probing the limits of their physical endurance because you can get severe AS and, even very severe AS in patients who profess to have no symptoms.

So, really truly a functional status assessment I think is important. And that might even include getting them on a treadmill and seeing what ha, you know, how much they can walk. If they can only walk for a few minutes and then they poop out, then that may be a red flag. The answer to your question is it, it depends.

But, certainly if I have somebody who has severe aortic stenosis and symptoms, it's a kind of a no-brainer. It becomes more complicated when you get the people that say they have no symptoms or if they have symptoms that might be related to something else rather than their valve.

**Howard Herrmann, MD:** That's a super good point, Carl, and I think it also adds to the that this has changed a little bit in the TAVR era. When the only option for a patient was open heart surgery, you know, you really wanted somebody to be somewhat symptomatic before you took the risks and the mortality and morbidity of recovery from open heart surgery to recommend it.

But in the TAVR era, it's a little easier to recommend it for a patient who's not too symptomatic because the recovery is so quick. And, and we are doing studies now in patients who are both asymptomatic with severe aortic stenosis, as well as patients who have moderate aortic stenosis and maybe another risk factor like left ventricular dysfunction and starting to think about doing TAVR earlier because it is a little less morbid than open heart surgery.

**Kendal Williams, MD (Host):** So this has really expanded the field of potential patients for aortic valve procedures and, and replacement because you're potentially getting earlier patients and then you're also getting these patients that simply could not get an open replacement in the past because they were just too ill or too old or, you know, functionally dis declined.

I have a 97-year-old patient who just had a TAVR, so, you're really expanding the number of people who may end, end up getting these procedures.

**Howard Herrmann, MD:** Yeah. And, and even the patients who, even if we thought we could operate on a 88 year old or an 89 year old patient who has severe aortic stenosis, the patients may not have wanted open heart surgery, but are willing to have a procedure like TAVR in order to feel better or live a little longer.

**Kendal Williams, MD (Host):** So before we jump into TAVR, I just wanted to cover two other points. One is to just benchmark us on these numbers. So we talked about one centimeter as being sort of the where severe aortic stenosis begins. We all know this term, critical aortic stenosis. Carl, is there a number in your head where you regarded as sort of critical?

**Carl Reynolds, MD:** Not to be an ageist here. I think that term critical has kind of falling out of favor a little bit. Some of the old guard still maybe use it some,

but as primarily an echo reader, I, I like the term very severe and that has you know specific echo numbers associated with it.

We look at the, um, peak velocity across the aortic valve, and if it, if it's at four meters per second, it's generally considered severe. If it reaches five, that's where it gets to be very severe, and we know that those patients tend to have a worse outcomes, even if they, seemingly are asymptomatic still.

So those are the numbers that, you know, really in my mind are, kind of more of the hard points, if it's a patient who can get a TAVR or a, or you know, a surgical.

**Howard Herrmann, MD:** Yeah, I agree. I, that word critical has bad connotations, both for the patient and for the physician. So we like to think of it more as mild, moderate, severe, and, and as you said, maybe very severe as well.

**Kendal Williams, MD (Host):** Well, let me ask a sort of similar question, and that is, you know, there are medications you want to avoid in patients with advanced AS, right? You don't, you'd want to avoid preload reduction, right with nitroglycerin and other things. At what stage does that become a factor? We don't use nitro as much as we used to. Uh, I guess we still do in patients who present with chest pain, but it's not, used as ubiquitously as it was before. But nevertheless, when do we need to start thinking about, avoiding certain medications? Because we're worried about it accelerating a decline, an acute decline in somebody's status.

**Howard Herrmann, MD:** Yeah, I think those are excellent points. We want to avoid both preload and after load reducing agents, to some extent in patients with severe AS. So nitrates are definitely ones that we want to avoid, but we also want to be careful not to overly treat their blood pressure. So we sometimes let patients have a little bit more permissive blood pressure.

We don't want to make them syncope. We don't want to use, especially if they are for other reasons, let's say on a beta blocker where they can't increase their heart rate because their stroke volume is going to be limited by the mechanical obstruction to outflow from the ventricle. So we have to be careful with both preload and after load agents. And then I also caution patients about heat, exerting themselves. They should avoid saunas. They should avoid dehydration. I, for instance, this week, did a TAVR on a patient who was very asymptomatic but had severe aortic stenosis, but was a very avid, long-distance bicycle rider.

And he just wasn't willing to give that up. And I was getting more and more concerned as his valve crossed into that severe category that I would either have to limit his lifestyle or offer him a treatment for his valve so he could continue his lifestyle. And we discussed that in detail. And after some shared decision making, he decided he wanted to have his TAVR even before he became symptomatic, so he didn't have to cut back on his, his lifestyle. So all of those go into a good discussion with our patients about when to intervene.

**Kendal Williams, MD (Host):** The other point, I think the other marker, we, we get echo reports back, that say moderate AS or mild AS. Carl, when you have somebody in your office, that moderate AS on the echo, when do you repeat it? I'm trying to get that sense at the question of the pace of the disease, you know, how quickly does this progress?

**Carl Reynolds, MD:** Yeah, I mean there are nomograms that are published about this, but I think the general recommendation would be if you have mild AS or maybe even, on the more mild side of moderate, you don't have to follow it super often. I mean, I, I usually think of an, of an interval around every two years if there's no change in symptoms. Then if they get, you know, a little bit more into like borderline moderate to severe, it may be more often than that. But in general, with some exceptions, it's a pretty slowly progressive disease process. Although I've been surprised at times. no question. Not everybody you know, reads the textbook, so to speak.

**Howard Herrmann, MD:** Yeah, I think those are good general rules of thumb. I mean, I think it for the average patient, and that's where it becomes difficult, as you pointed out, not everybody's average. Gradients increase at about 10 millimeters of mercury per year. Maybe a valve area decrement of about 0.1 or 0.15 centimeters squared per year.

So if you have a valve area of 1.5, one to two years is reasonable. If you have a valve area of 1.1 or 1.2 maybe one year at most. And as they start getting close to one, or if they're severe with no symptoms, I'm starting to see those patients every six months with an echocardiogram. So it varies. And the other thing that goes into that is because not every patient's average, if you have a few years where it hasn't changed much, you can space that out a little bit. But sometimes, every so often we do see a patient who progresses more rapidly than expected. So, uh, we don't want to miss that. And the key is telling those patients to report any change in symptoms promptly, and not wait till their annual visit six months later to tell us they've been short of breath for six months.



**Kendal Williams, MD (Host):** Carl as a general cardiologist, when do you want patients referred to you? We see an echo. It's moderate. I think we'll all say if they're severe, we'll send them to you. But if it's moderate, you want us to follow it or do you want to follow it?

**Carl Reynolds, MD:** I think it really depends on the comfort level of the, of the clinician, honestly. I mean, I, I think we're always happy to see patients at any stage. And I think that certainly as you get more into the solid moderate range, it probably makes sense to refer regardless. But, you know, and also maybe patient driven too. I think a lot of patients get maybe more specific questions about what a TAVR entails, and I think as the questions get more specific and the more technical, maybe going from internal medicine to cardiology and then from cardiology to interventional cardiology is the, is a natural progression, to answer those questions. But I don't think it's ever too early, honestly, to refer.

**Kendal Williams, MD (Host):** So, my uncle is, was a, probably a 74 year old man who presented, who got the flu, got admitted to the hospital with shortness of breath, and we thought it was all flu. He was up in a rural hospital, northeast Pennsylvania and, you know, he had an echo and it was recognized. He actually had very advanced AS, and he needed to have his valve replaced.

So TAVR was just beginning to get a foothold at that point. It was not first line. And so he was offered the opportunity for biomechanical valve versus, uh, you know, a bioprosthetic valve, and had a bioprosthetic valve placed so that he could avoid anticoagulation. What goes into that decision now? I assume there are some patients that still do, are good candidates for surgical therapy.

**Howard Herrmann, MD:** Sure. In general, under the age of 65 or 60, we kind of favor a little bit mechanical valves if patients are willing, particularly, under 60, because it's a once and done. But it does have the disadvantage of anticoagulation and some patients don't want that. We have to worry about what we're going to do when the bioprosthetic valve wears out.

So a surgical bioprosthesis should last on average close to about 15 years. A little longer in the elderly, a little less long in the younger patient. So if you're 55 and you get a bioprosthetic valve, we're going to have to think about what we're going to do when you're 65 or 67, and maybe even again when you're 77 or 80.

And so the lifelong management of aortic stenosis involves thinking about not only the first valve, but the second, and sometimes rarely the third valve. As you get older, the risks of anticoagulation become more prominent and more

severe, and we know we have options at least once to put a TAVR valve inside a surgical valve.

That's a tried and true procedure now. It's been done for over 10 years. It works quite well, especially if the surgical valve is placed properly, a sizable valve and the coronaries are, are the surgeon's mindful of the coronary location; putting a TAVR valve in a surgical valve is pretty easy. We're just now starting to put TAVR valves in TAVR valves, and that can be a little more difficult because we create that tube graft out of the first valve.

And so the risk of coronary obstruction can become an issue depending on where the first TAVR valve was placed, its location relative to the coronaries and the type of valve. The lifelong management becomes a little more complicated, although the fact that we can do TAVR in surgical valves, TAVR in SAVR, allows us to think about a longer timeline for a bioprosthesis than we would have 20 years ago.

**Kendal Williams, MD (Host):** If you're going to do TAVR over a valve, does it matter if it was bioprosthetic or mechanical?

**Howard Herrmann, MD:** Well, yeah, we can't, we cannot do TAVR in mechanical valves, period.

**Kendal Williams, MD (Host):** So let's talk about TAVR because this whole thing seems like magic to me in some way. You know, now that I've educated myself on it, I understand it a little bit better. But, thinking through it in theory, I thought I had this image of these, you calcified, you know, hemisphere golf ball sized things that are sitting there and you're going to, you're going to replace that valve through a catheter that just seems magical to me. Can you explain what actually happens?

**Howard Herrmann, MD:** It is a little bit of magic. When it was first done by Alain Cribier in France in 2002, I think many people thought it was magic and that it would never work, and he proved us all wrong. And over the last 20 years, the field has really matured. We're on third generation devices. There are half a dozen different devices available in Europe, three approved in the US, a fourth about to be approved. And they work all very similarly in that they push the calcium to the side. Some of them, one of them uses a balloon to do that. It's a balloon expandable, sort of large stent with leaflets inside it.

The other one that is used in the US is a self-expanding valve, so it's constrained with a membrane, and the membrane is gradually released inside the aortic

valve. In both cases, it pushes the calcific leaflets to the side, uses the metal cage of the device to hold the stenotic valve out of the way. And then inside are either bovine or porcine leaflets that open and close the same way a surgical valve does.

And despite the fact that we don't take the calcium out, the hemodynamics are actually as good, in some cases, better than surgical valves because there is no sewing ring. Because these are fairly flat stent like devices. We can get a, an orifice area that is as good, if not better than a surgical valve, without taking out the old valve. The downside is that there sometimes are leaks around the outside, some sealing issues because it's, we're not cutting it out and we're not sewing the valve in. That's one risk. The risk of pacemaker may be a little bit higher than it is with surgical valves, but other than that, it seems to work as well. Last, as far as we know, as, as long as surgical valves do, although we don't have the same 15 year follow up yet on latest generation valves that we have for surgical prostheses. Overall, the recovery is of course, markedly better, and most patients are going home in one or two days as opposed to the seven day hospitalization for a surgery procedure and the one to two months of further recovery at home while you recover from the effects of cardiopulmonary bypass.

**Kendal Williams, MD (Host):** So the actual procedure itself is safe. What are we looking at in terms of a complication rate?

**Howard Herrmann, MD:** The risk of dying with the procedure is about 1%, very similar to surgery. The risk of stroke is about two to two and a half percent. The risk of a pacemaker is five to 10%. And that's really, those are really the main risks.

**Kendal Williams, MD (Host):** Those risks are similar, at least in terms of mortality rate to CABG, as I recall, right?

**Howard Herrmann, MD:** Well, CABG is a little different because you have to throw in often some LV dysfunction and other things and I would say that the risks are similar to surgery for aortic valve replacement. And in the studies that have been done so far, certainly less risky for high risk patients than surgery, similar to better than surgery for low risk patients in the randomized trials.

And this is an area I should point out where we have a good evidence base. Very few things in cardiology have been studied in as many randomized trials and nothing in the area of valvular heart disease besides TAVR. And we have

half a dozen, if not more well designed large scale randomized trials comparing TAVR to surgery in different risk populations.

**Kendal Williams, MD (Host):** So, as I mentioned, when my uncle had his valve, I, I think TAVR had not yet become first line therapy, but it, but it is now, right, Howie?

**Howard Herrmann, MD:** Yeah, I mean, it's, it is a first line therapy. It has a class one indication, but there is always some shared decision making. Particularly for a young patient about what we're going to do when the first valve wears out. Some of the differences in small, mild paravalvular leaks or the risk of pacemakers. So we always have a discussion with patients. For patients who are over the age of 80, the discussion almost overwhelmingly favors TAVR. For patients under the age of 65, probably overwhelmingly favors surgery for most of the patients, and it's in that group between age 65 and 80, where we have to think about the relative risks and do some shared decision making.

But most of those patients still end up choosing TAVR in my experience with rare exceptions. The young patient with a bicuspid valve might choose a first surgical valve knowing that they can get TAVR later more easily, then a TAVR in TAVR, for instance.

**Kendal Williams, MD (Host):** Carl, when you have a patient in front of you and you're starting to go through whether TAVR is a good idea, do you have a little elevator speech that you do, or some sort of, uh, framing that you often use that we can borrow?

**Carl Reynolds, MD:** Yeah. Well, yes, I think I do. I would say that one early discussion, especially with the older and more frail patients I think that I, we all want to still hold on to, uh, common clinical sense, right? Like, just because we can put a new valve in, in somebody's heart, it's not always the right thing to do if there's other competing issues that are going to limit the patient. Right? So I think patients have a tendency sometimes to kind of latch on to the fact that we have this great, semi magical therapy for heart valve disease, but we don't have it for memory loss and severe arthritis is going to limit mobility and things like that.

So I think it's always important to, for the patient and the family to have a perspective on that, because I've certainly seen patients who have gone and gotten a TAVR and then they get upset that, you know, in six months when they

come back that they still can't walk, but they can't walk because you know, they have no muscle mass in their legs or they have severe arthritis.

So it's not a panacea of course. But sometimes patients want it to be, but you know, that's an early discussion in some patients that I think is important. And then, you know, I, I guess I, as far as my elevator speech, I would just go into some of the general mechanics and as Dr. Hermann's already said, you know, about like the fact that the hospital stay is generally very brief, one or two nights. That it's similar in some ways to an angioplasty, in that there's a catheter involved and, punctures rather than large incisions. I think that's an important distinction for patients to make.

And, there still is a recovery, even though a lot of that may occur at home. There still is going to be a need to do things like exercise or even go to cardiac rehab afterwards to regain strength. And, you know, medications are still oftentimes important if there's any kind of LV dysfunction, for example. I oftentimes, am a little bit realistic with patients because I want them to understand that it's not as simple as like a turnkey, everything's fixed. You're done.

**Howard Herrmann, MD:** I would also add there, there are sometimes, more rare now than 10 years ago where technical considerations make surgery or TAVR, a better option for a given patient. If a patient doesn't have femoral access because of severe peripheral vascular disease, we've gotten pretty clever at finding ways to put these valves in through other sources, through the inferior vena cava, through a left subclavian cut down, even through the carotid artery.

Um, but there are patients who just don't have good access for these devices, and there are similarly patients who are just better treated with surgery, very small annulus patients where they can get a root enlargement at the same time and get a bigger prosthesis and vice versa. There are patients who have porcelain aortas who just are not candidates for open heart surgery.

People who have had radiation to the chest for Hodgkin's disease maybe, and have developed severe calcification of the aorta and can't be cross clamped. So there are sometimes patients, few percent on each end that are just better for one or the other treatment, and we have to recognize that as well.

**Kendal Williams, MD (Host):** So, one of the issues we face in primary care, particularly as folks pass the age of 80, and it's a similar issue that we face with joint replacement, is, as you get older, the thing that often gets people is frailty. And so you really need to keep moving. And I could see the situation being

often that the aortic valve and the inability to walk without dyspnea, for instance, to be limited by that, could actually be a life-limiting factor for that patient only because they end up becoming more frail, more quickly.

And, you know, fall and have a hip fracture or something like that. And so, you know, when we get to 80, we have the same discussion about joint replacement. There's a timing issue. You want to get people while they're still quite vital, and before they get to that stage of frailty. So I'm, I'm sympathetic to what you're saying, Carl, about, how to time this.

**Carl Reynolds, MD:** Yeah. And I think it gets back to our earlier discussion. In the old days, it was all about having a severe valve area by echo or cath and then having symptoms and maybe, especially in these borderline patients, if they have severe AS, we may, you know, be best off to move forward, rather than waiting. Because you're right. I mean, you start to, if you don't use it, you'll, you'll lose it. And, muscle mass can be hard to build back for elderly patients.

**Howard Herrmann, MD:** I think one of the ways I think of it is we know when patients have, say you're a 72 year old patient, low risk for surgery, and you have severe aortic stenosis and symptoms. We're doing surgery or TAVR for two reasons. One, to improve their quality of life and reduce their symptoms. And secondarily, because we know we're going to improve their long-term survival. When you're 92, and you're very limited and you have severe aortic stenosis and some symptoms; often the discussion is really more about their quality of life than it is about their survival. We don't know how long a 92 year old is going to live and what other medical problems they have, and so it does become a little bit more about their quality of life and a little less about their long-term survival and, and we have to frame our discussions with the patients along those lines.

**Kendal Williams, MD (Host):** So Howie, we talked about the procedure and alluded to the recovery being fairly quick in most patients. You have patients home within a couple days. They're not on anticoagulants, are they on any medications at all?

**Howard Herrmann, MD:** Generally the only treatment that's needed is aspirin. If they have other indications for anticoagulation such as atrial fibrillation, then we'll use an oral anticoagulant and not use aspirin. And there are some studies suggesting you don't need even the aspirin in some patients, especially if they have a, a bleeding risk.

There are also some studies that have shown we can do TAVR's outpatient. There are now case reports and small studies showing you can do the procedure at eight in the morning and get the patient home by 6:00 PM. Not that, that's our goal. The average in the US is a day to a day and a half in the hospital.

And sometimes these elderly patients just need two days in order to get back on their medications and get back on their feet. So I don't really try to push patients out on first day. I think at Penn we generally have a slightly longer than average length of stay, but it's still an average of two days instead of an average of 1.5 days.

So, it's still pretty quick recovery. Remember, we don't use general anesthesia anymore. We don't intubate the patients. They're almost entirely done under conscious sedation. The procedure takes on average an hour to an hour and a half, and patients can get up and walk the same day or next morning at the latest. And go home very quickly.

**Kendal Williams, MD (Host):** This is terrific. I mean, it's really terrific after watching my uncle go through, uh, an open valve replacement and being in the hospital for two weeks and rehab for another three or so. I mean, this is really a major advance. This has to be very exciting for both of you.

**Howard Herrmann, MD:** It has been one of, as somebody who witnessed the first stents and the first angioplasties in my career, this ranks up there as, as probably the most successful interventional cardiology procedure I've been able to witness and take part in.

**Kendal Williams, MD (Host):** So let's finish by just asking the question, you know, how do you want patients to come to you? You know, I asked Carl at what stage we should be referring to him, at what stage and what are the mechanics, I guess, Howie, of getting patients to you?

**Howard Herrmann, MD:** Well, we have, you know, a very large program at the University of Pennsylvania. We do the combination of Presbyterian Hospital, Hospital at the University of Pennsylvania, and even Chester County Hospital, a total of over 600 TAVRs a year. We have a very large program at each hospital that includes our TAVR coordinators and both the surgeons and the cardiologists who take care of these patients.

And, there are more than a dozen of us who do TAVR procedures and we do them all jointly, cardiac surgery and interventional cardiology together. So any of us are happy to see these patients in referral. So you can refer them directly

to me, to one of our surgeons, to the TAVR group phone number as well, and our nurse practitioners will find the earliest spot for a patient to be seen.

So, it shouldn't be difficult. If you have any problems, if anybody does, feel free to contact me and we'll get them in to see one of our TAVR specialists wherever is most convenient for the patient, whether it's at Presbyterian, Chester County, or HUP.

**Kendal Williams, MD (Host):** That's terrific. I had thought that it was the case that the CT surgeons were doing them as well, so you made that point that it's both interventional cardiologists and CT surgery trained physicians that are doing these procedures.

**Howard Herrmann, MD:** We do them as a team. And that is a Medicare national coverage decision requirement that for reimbursement, both a surgeon and an interventional cardiologist have to be present for the critical parts of these procedures, even though they're a little more interventional, than they are surgical. We love having the surgeon perspective both, for the outpatient arena to help decide whether TAVR's appropriate versus surgery. And also during the procedure where our surgeons have become quite skilled at, at doing the procedures with us.

**Kendal Williams, MD (Host):** That's terrific. Before we close, is there anything else to tell the Penn Primary Care community? I, I think we've gone over some of the most important aspects in terms of the discussions we're going to have with our own patients about what to expect when we refer them forward, and then the issues of when to refer. But there are any issues that you can think of that we haven't covered?

**Howard Herrmann, MD:** The only thing I'd add is that, TAVR now has been around for 20 years. It's been in, we did our first one at Penn in 2007. It's been approved for over 10 years and it's opened a door to all the other valve therapies. So we are doing transcatheter valve replacements of the mitral valve, under investigational protocols, the tricuspid valve under investigational protocols, and even the pulmonic valve for the appropriate adult congenital patients.

So we have a whole robust program now at Penn in transcatheter valve repair and replacement. And it's not just TAVR anymore. It's really all of the valves, that can be done through a catheter-based approach.



**Kendal Williams, MD (Host):** Well, I hope to have you both back on to talk about mitral valves. Carl and I had talked a little bit about this, uh, a few days ago and had even considered bringing that into this discussion, but it's probably one that deserves its own full discussion cause it's a little more complicated. But I do want to have you both back to do that.

**Howard Herrmann, MD:** Great.

**Carl Reynolds, MD:** That'd be great.

**Kendal Williams, MD (Host):** Well, thank you both for coming and thank the audience too, joining us for the Penn Primary Care podcast. Please join us again next time.