

Announcer: Hello, I'm Patty Pellikka cardiologist at Mayo Clinic and President-elect of the Mayo Clinic staff. It's my pleasure to be joined here today by Dr. Joe Dearanu, professor of surgery and the immediate past chair of our Department of Cardiovascular Surgery, and Dr. Elizabeth Stephens, who is associate professor of surgery in our department of cardiovascular surgery. Our topic today is about reoperation, and this is certainly an important topic. I think that the patients that we see now have are living longer and we're seeing more complicated cases, and so re-operations have become more of a thing. Joe, tell me how many re-operations can a patient have?

Dr. Joseph Dearani: Well, Patty, first it's great to be here and thanks for hosting this, this timely topic because it is becoming very, very common. There's no absolute number. I think it gets individualized in terms of when it may be too late, but I think it depends on a number of things. Patient age, you know, the total number of previous operations, what the nature of those operations were, you know, what the ventricular function is like. I, I make the point with the residents all the time that I would much rather do a third or fourth time re-operation with somebody with normal ventricular function than a primary operation and somebody with poor ventricular function. So I think there's no absolute number. Clearly the, the higher the number, the risk starts to gradually creep up, particularly when you get to the fourth and the fifth sternotomy. But there are a large number of variables that get factored into the decision making. And, you know, there can be a third or a fourth time redo, you know, that could be a lower risk than a, you know, a first or a second time. You know, redo depending upon, you know, other variables, comorbidities, you know, other organ system function and what the exact operation is that you are going to be doing, because some operations are not terribly complex and others are very complex. So, you know, if it's a simpler operation, you know, at a fourth or a fifth time sternotomy, that's gonna be much more feasible than a very complicated operation where maybe multiple valves are involved and, and so on. So individualization and, and all these other variables weigh heavily into the decision making.

Dr. Patricia Pellikka: Elizabeth, what are some of the most common reasons for that need for reoperation repeat sternotomy?

Dr. Elizabeth Stephens: Well, thank you again for having us. This is a great topic and always good for discussion for our colleagues as well. So a few things come to mind. One would be residual disease. So in other words, they had an operation and there might be a shunt that still has, you know, some flow through it or, or some other things that would be considered residual disease. There's also recurrent disease, so that's something, for instance, like a valve repair where there's some residual regurgitation and that progresses, or like an aortopathy or something like that where you get additional progression. And then we also have some operations that have limited durability. So conduits that we put in, we know have limited durability. Same with some of our bio prosthetics and even mechanical valves. We have over time, you know, panned, ingrowth. So those are a few of the reasons we commonly see in the congenital population. We often advise patients and families that we expect, you know, multiple operations throughout their lifetime, but those are a few of the, the reasons.

Dr. Patricia Pellikka: I know the STS score says that reoperation, it's one of those things that adds to the patient's risk. But Joe, is it true that the risk of reoperation is sometimes the same as the first time operation?

Dr. Joseph Dearani: Yes, it certainly can. For there, it's like that for, you know, a number of, of procedures. And I think as, as Dr. Stephens was alluding to, I mean, the most common reason for reoperation, it's a structural heart defect. And whether it's the adult population acquired disease or congenital population, the vast majority are valve related of some sort. And so aortic stenosis redo aortic valve replacement. Again, if, if ventricular function is, is normal, the risk of operation can be very similar to a primary operation, particularly in a program where there are a lot of re-operations commonly being performed. And the, the specific surgeon also, you know, has a practice that involves, you know, a moderate number of re-operation. So the more you do, the better you get and the more routine it becomes like. So yes, it is true that some, you know, may have risks very similar to, you know, the previous operation

Dr. Patricia Pellikka: Joe mentioned ejection fraction. But Elizabeth, what else matters for patient selection for reoperation? I presume functional status is pretty important too.

Dr. Elizabeth Stephens: Well, that's a great question. I think one of the things that we realize, both from a cardiology side and from a surgical side, is not all reoperation is the same. And one of the recent, we did a study of almost 2000 patients undergoing reoperation in the adult congenital practice. And on multi-variable analysis, actually the, the re-op number was not significant in terms of mortality. So there was a step up in absolute mortality between the groups. But when you risk adjusted for the comorbidities, it actually sternotomy number was not a factor. So what we learned from that is a lot of it is the, the baggage that comes once you get to your fourth, fifth, or in that study we had a number of patients who were on their eighth sternotomy. I think it's also very different when you've had, you know, three sternotomies as a young infant and then go, you know, 10 years or 20 years. That's a much in terms of adhesions and things like that, that's a lot different ventricular function and other factors are certainly important. A separate part of that is the reentry. And so when we're looking at a, a patient coming for a reoperation and a reduced sternotomy, we look for certain anatomic factors as well as physiologic factors that make the reoperation specifically reentry more dangerous. And, and that study injury on reentry was 0.5%. So it's not very common, but things like a dilated aorta adherent to the sternum or a conduit that's in the chest wall, and particularly patients who still have shunts in their hearts that would make the reoperation more risky than other types of reoperations. I think Joe made a really important point in terms of comfort level and experience of the surgeon in the center. So, you know, we're lucky here at Mayo that we do a lot of reop sternotomies, including high number reop sternotomies which is not true from, you know, in many institutions. And I certainly learned so much from Joe about specific surgical techniques. So you're much more comfortable when you get to, you know, fifth, sixth sternotomy or things like that. And that's, that's something that's unique to Mayo and we're really grateful for.

Dr. Joseph Dearani: You know, I just to add on one, just another point I think that's really important for the cardiologist is, is when you were talking about ejection fraction, you know, one of the, there's a couple things around ventricular function and ejection fraction that I make a point, you know, with the residents first is that if is, I worry about dilated ventricles, you know, dilated ventricles are a red flag, particularly if they're dilated because of a regurgitant lesion because the ejection fraction is often gonna initially be worse after the operation, in contrast to an obstructive lesion like aortic stenosis where the ventricle's not gonna be dilated. And even if the systolic function is below normal, you're expecting it to, to be better. And then if you topple coronary artery disease on top of that, you know, if you're talking about an operation where you're gonna get good revascularization and you're fixing a structural heart defect, that was an obstructive lesion. The ejection fraction's gonna be better when you're done. And so I'm more enthusiastic about offering a patient like that surgery as opposed to someone that's got severe aortic regurgitation with a left ventricle that's severely dilated, an ejection fraction of 25%. That's a, you know, that's gonna be a much a more slippery slope. So, so all of that really weighs into the decision making. And then finally what they look like before surgery. And I, again, I I make reference to the reference resident residents all the time because they really, patient selection is such an important variable for the surgeon. And, you know, we talk about the eyeball test and if you go into the, you know, the, the clinic, the outpatient room and you see the patient's got ascites and it's got lower extremity edema and is on 120 milligrams of Lasix a day and their creatinine is 1.9, that is a, that is a problem, you know, and, and so I think that the, the paper that Dr. Stevens has referred to where, you know, we've gotten really good and we've gotten by many of those patients are younger and their ventricular function is often really close to normal before surgery. So it just gives you a lot more wiggle room compared to somebody that's got a lot of these other, you know, setbacks going into the operating room. So all of it back to the individualization, you know, thing is really key and the cardiologist plays a really important role here as a sort of a filter and a screener before we get involved.

Dr. Elizabeth Stephens: And I think to Joe's point, one of the things that really came out, you know, the eyeball test can be hard to quantify, but when we looked at analysis once you got to an urgent operation or emergent the risk of mortality and more combined morbidity and mortality increased substantially. So that was a much higher signal than some of the other, you know, kind of typical factors. I think it just points to appropriate medical management referral at an appropriate state and not getting to a place where you're really behind the eight ball and struggling because then you're at a very high risk.

Dr. Patricia Pellikka: Yeah, those are great points. We need to follow our patients carefully and and make sure that they're aware and familiar with their disease so that they bring any new symptoms to our attention quickly. Joe, could you tell us about minimally invasive approaches? I know you've been doing these for a long time. Can you do those at reoperation?

Dr. Joseph Dearani: So this is one of the more common questions from a patient actually is can it be done in a less invasive approach? I would say that there are highly selected situations when it can be done. There is, it's, it's possible to do some redo mitral and tricuspid operations with the robot. You know, we, the technology is advanced for that is, is possible. I would say that it's the exception rather

than the rule that something like that would be offered. And one of the, you know, one of the things that I learned from one of my mentors, Dr. Schaff, who I think is, is well known to you is that, you know, you can do anything you want through a median sternotomy when you're a cardiac surgeon. Any, any untoward event, any curve ball that you, you can handle through a median sternotomy, you are have a little bit of a handicap issue. If you start trying to do things through a less invasive approach and then encounter a problem, the ability to, to reconcile it and handle it safely is often limited. But there are some situations where a right thoracotomy may be appropriate for mitral or tricuspid surgery and somebody that's had previous bypass surgery and has a graft dependent circulation that would make a rest sternotomy quite hazardous where a thoracotomy approach may be more feasible. So I would say it's done in selected circumstances and it's very, very surgeon dependent and there's no right or wrong answer. I think it's really what the surgeon and the program is most comfortable and has the most experience doing.

Dr. Patricia Pellikka: Elizabeth, could you comment on the length of hospital sit stay and postoperative recovery time for re-operation versus the first time?

Dr. Elizabeth Stephens: Yeah, that's a great question. I think it does again, depend on the case and the patient. So when you're doing like a third time reop pulmonary valve replacement in a young youngish 20, 30-year-old, they're probably gonna still get extubated on the table. They're probably still gonna stay in the ICU one night. But that's different from, you know, a multi valve re-op where the function isn't as good and then you might expect in the ICU longer needing more inotropic support and overall a longer hospital stay. So I think there is a spectrum as you get to the more higher risk or or larger number of sternotomies, you're probably looking at a, a longer length of stay and a longer ICU length of stay. But we certainly try to progress patients as appropriate. And again, depending on, on the the patient, they could still be in and out of the hospital in a similar time as a primary sternotomy.

Dr. Patricia Pellikka: We're fortunate to have cardiac surgeons that take on these challenging cases at Mayo Clinic and do such a great job with difficult situations. Tell me about outside of here and how often are surgeons available, cardiac surgeons able to do reoperation, what percent or could you estimate on who does these?

Dr. Joseph Dearani: Well, I I would say that for the adult cardiac surgeon, well for the pediatric heart surgeon, I mean, you know, re-operation are everyday business for, for us because there's so many examples where it's predictable and anticipated that they're gonna be back in the operating room. So, so it's the, you know, there's not a day that goes by where, you know, one of our cases it's not a redo on the adult side though. I mean I think it's pretty common on the adult side too. Nowadays. I think any, any, you know, cardiac surgeon that has a relatively steady busy practice, there's gonna be a percentage of patients that are gonna be redos. It may be 10%, maybe 5%. And I think it depends on what the nature of the problem is in terms of whether, you know, they're willing to take it on, you know, some are gonna be more, you know, some, you know, very experienced coronary surgeons are gonna be much more

likely to do a re-operation that involves coronary surgery. Whereas, you know, a, a cardiac surgeon that focuses mostly on valve surgery is gonna be less likely to wanna do a redo coronary operation and vice versa. So I I, I mean I think that, you know, cardiologists work with their local surgeons and I think surgeons are generally are, you know, know what their limitations are and if they feel like it's, it's not appropriate for them, depending upon the nature of the problem, the magnitude of the problem, you know, there usually is a lower threshold to refer those kinds of patients to a center where, you know, there's a, a much, you know, the multidisciplinary, you know, team is intact and they're accustomed to it. That's what I, I think, I mean I

Dr. Patricia Pellikka: Thank you Elizabeth. Do you agree with that?

Dr. Elizabeth Stephens: Yeah, I think people are aware of their surgeon's practice patterns and certain, you know, adult surgeons will have a niche of, you know, re-up aortic surgery or, and some may be doing cabbages and not be doing as many re-op. So I think, I think there is significant variation. I agree completely with Joe that if you're a congenital surgeon we do a ton of re-op including relatively high number of ops, especially if you're doing adult congenital disease and you're a busy congenital surgeon. So I think that's a little bit of its own practice just 'cause we do so much of it and we have a number of tricks that, you know, we've learned over the years and Joe's taught me that, you know, helps us plan for when things might go, you know, off the path a little bit and have backup plans. So we always have, you know, these are a structure, you know, this is a structure I might get into, this is my plan to get the patient safely through and having not just plan A but B, C, and D.

Dr. Patricia Pellikka: Great. And you've recently looked at our Mayo Clinic experience with reduced sternotomy. Where is that published and how might we connect our reader?

Dr. Elizabeth Stephens: Yeah, so Ahmed has done an amazing job with this paper and we really learned a lot from it. Honestly. I think we always have our impression of Remy, but that's in J-T-C-V-S and I think you'll be able to put a link there, but it goes through, you know, different, different risk factors we looked at in terms of both mortality and combined morbidity and mortality and really helpful research.

Dr. Joseph Dearani: You know, one of the things we, we haven't talked about that I think we be just important to touch on is touch the advances in, in imaging techniques, which really helps the planning of re-operations also helps determine potential risk, you know, to, it's so much different now than it was, you know, 15 years ago. I mean now the imaging really tees it up for the surgeon and, you know, 3D models and there are some situations where you might actually print a model out and, and actually do the operation in your office before going to the operating room. And then of course, you know, virtual reality is coming into vogue right now. So the, the, the imaging is making the job of the surgeon easier and easier and easier as particularly in a population like this where it is, it can be quite challenging.

Dr. Patricia Pellikka: Well, I'm glad to hear that we certainly work together very well. Yeah. That the, the way to measure quantitative volumes and index them for body size. Right. We've a lot of progress there as well as three dimensional anatomy and, but in spite of all the advances we've made with percutaneous therapies in cardiology, it seems like there's still a very important role for cardiac surgery and reduced sternotomy.

Dr. Joseph Dearani: Yeah, I was, I I'm glad that you brought up the topic of percutaneous therapy. 'cause I know one of the things that, that Dr. Stevens and I do, you know, when, you know in the congenital population where we know that there's going to be anticipated procedures over the course of a lifetime, we counsel the patients and the families that the interventions are a combination of percutaneous procedures and surgery. And when we looked at an earlier, you know, an earlier paper on, on on older patients with congenital heart disease, the risk did get up when you got up to the fifth and sixth sternotomy. So I, I explain to patients and families now that we try to orchestrate their lifetime so that they never get to the fifth operation. You know, that when there's a role for percutaneous therapy to temporize delay, you know, over the course of a lifetime that deletes an operation or two probably. And so, you know, this is the most natural marriage in medicine, you know, the, the non-invasive and the interventional cardiologist and the cardiac surgeon. And we do need to work together to try to, you know, plan out, you know, a pathway for any given patient so that you know, their quality of life is good and we minimize the cumulative number of interventions and operations that they actually get over the course of a lifetime.

Dr. Elizabeth Stephens: And I think that's something we're really lucky at Mayo to have such a close collaboration. So often Joe or myself will be discussing a patient with interventional cardiology and we'll decide maybe surgery goes first, but we specifically just, you know, plan the operation so that their next intervention can be cath based or maybe based on the patient's, you know, anatomy and physiology, we decide we should do cath first, but we also kind of have some input on what are you gonna put stent wise or you know, in terms of the RVOT to help make sure that there's surgical intervention, which may be the following, one is as safe as possible. So I think we're really lucky here that there is such a strong positive relationship between the two teams.

Dr. Patricia Pellikka: I completely agree. And it's wonderful that we can offer therapies to complex patients with very low surgical risk. So thank you both for visiting with me today.

Dr. Joseph Dearani: So Patty, thank you. The take home message for all of your colleagues, I would say is the following reoperative cardiac surgery is safe under almost all circumstances for most patients. Secondly, we wait too long sometimes because there's a fear that the risk is higher and patients are trying to avoid yet another operation. And I think when you look at the literature and you see where the risk is increased, most of the time it's because we've waited too long. And so it's another message to,

you know, the cardiologist, you know, before we get the class four heart failure, you know, you know, once the writing is on the wall to be open to a re-operation before, you know, while it can still be performed safely and at low risk. And, and again, it's a, it's a team sport and, and, and we must work together on this, you know, for the benefit of, of our patients.

Dr. Patricia Pellikka: I agree. I think in the future we'll be using the databases that we've accrued and advanced imaging and artificial intelligence and merging it all together to decide on the optimal strategy for the given patient who's sitting right there in the office.

Dr. Joseph Dearani: You're right.