

## Robotic mitral-valve repair

DR HECTOR MICHELENA: Dear colleagues, good morning. My name is **Hector Michelena**. I am a cardiovascular consultant at the Mayo Clinic and part of the echocardiography laboratory, as well as the valve clinic. I have with me today on Mayo Clinic Talks **Dr Rakesh Suri**, who is the director of minimally invasive cardiac surgery and is a CV surgeon, professor of surgery. Today we will be discussing new ways of intervening on organic mitral regurgitation and particularly new minimally invasive platforms, such as the robotic platform, to deal with this common problem.

First thing that it's important for us to understand is that organic or degenerative mitral regurgitation is the most common cause for mitral-regurgitation surgery referrals in the US, and what I mean by organic degenerative, as we all know, is prolapse, flails, what used to be called click murmur syndrome and the Barlow's [syndrome] as well.

Fortunately, surgical techniques for mitral repair have evolved significantly in the past few years, and mitral repair now has become the standard of care with excellent operative outcomes and very minimal recurrence of disease.

An important issue that arises, particularly for us cardiologists when we're treating patients and when we're deciding on whether to send the patient for early surgery or not is that patients are worried about undergoing early surgery due to the prospect of postoperative debility, time that they're going to take off work, time that they're going to take off their lives. And sometimes both the patient and the cardiologist actually end up postponing early surgery, which has the potential of restoring expected survival, and we end up having a patient who develops heart failure or left ventricular dysfunction and has to undergo rescue surgery, which we all know is associated with worse survival and with worse heart failure in the future.

Today we wish to discuss: What are the things that we should know as cardiologists about the robotic mitral-valve repair, and what are the general indications and benefits for the patient?

I'm going to start, Rakesh, by asking you: Is the robotic operation the same operation that you would perform through a general open sternotomy? Or is it different?

DR RAKESH SURI: Thanks, Hector. It's a pleasure to be here with you today to discuss this very important topic. As you alluded to, the most important thing we can do for patients once they are diagnosed with severe mitral regurgitation is to get them to a mitral-valve repair surgeon at a center of expertise, which includes anesthesia expertise, echocardiographic expertise, and really a postoperative team-based approach to caring for these patients.

That said, open mitral-valve repair has been associated with gold-standard outcomes. In the current era, [in] centers like Mayo Clinic and other referent valve-repair centers, the repair rate is 99%, with one of the lowest mortalities of any cardiac surgical operation that we perform today. So when we think about taking that operation and changing it, people get a little nervous. Why are we considering a minimally invasive operation? As you alluded to, patients get on the web and they look for less invasive ways of accomplishing the same thing.

In other words, they are told they need a prophylactic operation to preserve their left ventricular function and improve their survival, decrease the chance of late heart failure. That really is intangible to them as young, asymptomatic, healthy individuals and, therefore, they get on the web. They search for less invasive options even though they may be less effective, and an example of this would be the MitraClip.

Now, what we attempted to do in addressing this challenge was the following: We sought to take our gold-standard Mayo mitral-valve repair, which has been performed here at Mayo Clinic for nearly 30 years, and try to duplicate its steps identically in the closed-chest environment. So what does that mean?

We utilize techniques, introduced by **Dr Dwight McGoon** and then perfected by **Dr Hartzell Schaff** and others over the years, and we aimed to perform these via small ports in the right side of the chest. Now, there are a couple of ways to accomplish this.

First, we started out utilizing thoracoscopic techniques, and that basically involves a camera and long instruments. With the advent of new robotic technology, this allows us even greater visualization, in other words, 10 times magnification, high-definition visualization of the intracardiac structures, and robotic arms that move just like our normal arms when we're performing open-chest surgery. Utilizing these two advantages of robotic surgery, we're able to duplicate the exact steps that we perform in open mitral-valve repair merely through small port-based incisions in the right chest.

DR HECTOR MICHELENA: Wouldn't you have a better view of the entire mitral valve with a good open sternotomy?

DR RAKESH SURI: That's a good question. You know, there's a convenient anatomic arrangement of the heart, thankfully, that allows us to approach the mitral valve through small incisions in the right chest that center around the right nipple. In other words, the mitral valve is directed or oriented toward the right nipple, and placement of ports around this anatomic landmark gain us very good access to the left atrium and the mitral valve.

As I mentioned, the high-definition robotic camera and visualization system allows us to image and view the valvar and subvalvar structures in a way that's really impossible utilizing an open sternotomy approach. That's not to say that we can't see the valve appropriately utilizing the standard open-chest sternotomy conventional operation, but it is to say that robotic visualization really enhances the surgeon's visualization of these complex structures when we're performing valve repair. This is something that's not really intuitive to people who haven't performed robotic surgery.

DR HECTOR MICHELENA: So the same techniques that you use to repair valves in an open fashion, you use those exact same techniques such that the outcome would be expected to be the same. What about safety of doing this approach?

DR RAKESH SURI: That's a good point. Any new technique that's introduced in medicine comes under the suspicion of being less safe, and that's appropriate. We need to prove to ourselves for the sake of our patients that what we're doing is safe. And we've actually been able to show that in our initial series as well as our propensity-matched series, in which we took two similarly risk-matched populations, one undergoing open sternotomy conventional mitral valve repair and the second population undergoing robotic mitral valve repair. Once again, propensity matching means that all

the typical risk factors that would be associated with elevations in mortality or morbidity after surgery were matched between the populations. In other words, they were as identical as could be accomplished outside of a randomized trial.

DR HECTOR MICHELENA: And what did that show?

DR RAKESH SURI: That demonstrated that the complications associated with both types of surgery were very low, in fact, lower than has been alluded to in recent trials such as the **EVEREST II** trial; the risk of mortality much less than 1%, in fact, less than 0.5%; and the risk of morbidity very low, lower than that expected from other recent publications.

So the important point to our patients and to our cardiology colleagues is this: Mitral-valve repair is one of the best-tolerated and lowest-risk operations that we perform via sternotomy, and that holds true too with robotic mitral-valve repair if it is performed by appropriately prepared and trained teams.

DR HECTOR MICHELENA: Now, let me ask you a question, which actually is brought by what you're saying about properly trained people. In our current era of surgical evolution in this area, are we able to repair all categories of leaflet prolapse? Because, you know, there's this—I don't know if it's a myth or not; I hope you can clarify this—but there's a belief that repairing the anterior mitral leaflet is much more complex and has a much higher rate of recurrence of mitral regurgitation. So my question is: Can you actually in the current era repair both leaflets to the same extent and can you also do it robotically?

DR RAKESH SURI: Again a very important point, Hector, Thanks for bringing this up. There's a fair amount of misinformation that's perpetuated even in the current day about the differential repair rates of different leaflet-prolapse categories. So I'd like to correct some of that.

Really in 2013, the reparability or the ability to exact a repair in patients with posterior leaflet prolapse, anterior leaflet prolapse or bileaflet prolapse is equivalent, and we would quote that as 99%. Why the 1% wiggle room? Well, this is the reason. Patients with prolapse who have leaflet retraction or extensive calcifications are those in whom the repair rate is lower and the recurrence rate can be higher and, therefore, those are the patients in whom we would encounter a surprise in the operating room that would perhaps lead to an increased chance of mitral-valve replacement. But in essence, if a patient comes to us in 2013 with any category of leaflet prolapse, we tell them that the repair rate is 99%.

What's important is that because we're utilizing these same techniques, the same stitches, identical annuloplasty bands placed in identical manners in open-chest and robotic closed-chest surgery, the repair rates are understandably the same. In fact, based on our published data on robotic mitral-valve repair at Mayo Clinic, we have 100% repair rate to date for degenerative leaflet prolapse. That's not to say that we won't require replacement to be performed in some patient in the future; however, in nearly 500 robotic mitral-valve operations performed to date, we have been able to repair 100% of patients with leaflet prolapse.

DR HECTOR MICHELENA: How has the learning curve been in terms of operative times? One would think that with all this technology and all these small cameras and small ports inserted into patients it would take much longer than an open surgery.

DR RAKESH SURI: That's a good discussion, Hector. Any new technology that's introduced, whether it is in business or medicine or even athletics, requires a learning curve and, understandably, there was a learning curve that we navigated successfully with our team, and that team includes, as I mentioned, cardiologists, surgeons, anesthesiologists, and nurses, as well as others.

That said, we've maintained a safety profile that was well within the range expected, based on the **Society of Thoracic Surgery** database. Currently our cross-clamp times, ie, the time that the heart's shut off during a repair operation in robotic surgery, is in the range of about 30 to 40 minutes for posterior leaflet prolapse, and for more complex anterior bileaflet disease, in the range of about 45 to 60 minutes.

Just to give you an example, Hector, that's about two-thirds what the national average is for open mitral-valve repair surgery performed in the US.

DR HECTOR MICHELENA: Now, here's the question of the day and the most important one for us cardiologists and patients, which is, what are the real advantages for the patient of undergoing this procedure?

DR RAKESH SURI: Well, we sought to offer robotic mitral-valve repair to deliver a less invasive operation to our patients and, therefore, we really didn't expect any other outcomes aside from that which we focused on.

We were surprised that we observed the following: Patients became more capable of being extubated earlier following valve repair. In fact, currently we extubate all of our robotic mitral-valve repair patients on the operating room table following closure of the right-sided ports. Oftentimes they are transferred to the floor the same night of surgery, and what's interesting is when I make rounds in the evening, I can often find them walking themselves in the intensive care unit to their floor bed.

That expedited care pathway or that expedited curve of recovery continues on toward dismissal, Hector. Our robotic patients are dismissed from the hospital on average three days following operation, and that compares favorably with open-sternotomy patients, who remain in the hospital approximately five to seven days after operation.

The advantages don't stop there though. We recently analyzed our postdismissal outcomes and found that early quality of life following robotic mitral-valve repair is slightly better compared with open patients during the first year following surgery, and, importantly, particularly during this time of economic challenge in our economy, patients are able to return to work significantly more quickly following robotic mitral-valve repair than open operation.

DR HECTOR MICHELENA: It's been a great pleasure having you, Rakesh. A couple of messages for our cardiology colleagues is that we must know our surgeons, we must know our surgical teams and what they are capable of, and we should be offering patients the best possible care available, whether that includes referring a patient to a

highly specialized center for mitral-valve repair, but we should be advocates for our patients. And I hope to see you next time.

DR RAKESH SURI: Thanks, Hector. It's great to see you.