

CARDIAC CONSULT

2022
ISSUE 3

Heart, Vascular and Thoracic News



TAKING TAVR TO THE ENTERPRISE LEVEL

p. 6

DEAR COLLEAGUES,

As this issue was being prepared, we learned that Cleveland Clinic had been recognized as having the nation's No. 1 program in cardiology and heart surgery for the 28th consecutive year by *U.S. News & World Report*. We are honored by the consistency of this recognition even as we attribute it to our Heart, Vascular & Thoracic Institute's commitment to continuous change, innovation and care improvement.



Our institute's mantra includes the phrase "we must innovate and change" while also confirming our commitment to preserving untouchable patient care and exceptional research and education. Change and preservation may seem incompatible at first, but prioritizing adaptation and innovation has in fact been the key to our program's enduring leadership over the decades. Any true culture of excellence is by nature a culture of change and continuous improvement.

The art of striking the right balance between preserving what works well today and innovating new solutions for tomorrow is evident throughout this issue of *Cardiac Consult*. For instance, the features on pages 12 and 14 spotlight innovative efforts to continue advancing the utility of cardiac magnetic resonance imaging and the potential and reach of leadless pacemaker applications. At the same time, the cover story explores how our TAVR team in Cleveland, after years of fine-tuning its practices and outcomes, is working systematically to replicate its successful processes in newer TAVR programs at Cleveland Clinic sites from Ohio to Florida to Abu Dhabi to London.

We thank those of you who have entrusted us with your confidence and collaboration over the past 28 years. We look forward to continuing to work with you to adapt and innovate on behalf of patients everywhere.

Respectfully,



Lars G. Svensson, MD, PhD

Chairman, Sydell and Arnold Miller Family Heart, Vascular & Thoracic Institute



Cleveland Clinic was named a top U.S. hospital in *U.S. News & World Report's* "Best Hospitals" rankings for 2022-23, as well as the No. 1 hospital in cardiology and heart surgery for the 28th consecutive year.



ON THE COVER — A photo taken during a transcatheter aortic valve replacement (TAVR) procedure on Cleveland Clinic's main campus. The cover story (see page 6) profiles how and why we are replicating our main campus TAVR protocol at more and more of our sites around the nation and the world.

SNAPSHOTS FROM THE AATS 102ND ANNUAL MEETING

Takeaways from three practical presentations of note

Cleveland Clinic cardiothoracic surgeons were well represented at the annual meeting of the American Association for Thoracic Surgery (AATS) earlier this year. Below are brief distillations of three practical AATS presentations by Cleveland Clinic staff.

5 TECHNIQUES TO ENHANCE MITRAL REPAIR RATES AND DURABILITY

By Marc Gillinov, MD, Chair, Department of Thoracic and Cardiovascular Surgery

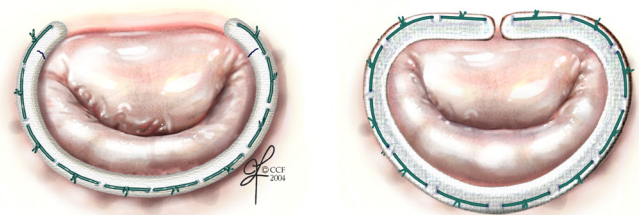
For too long, mitral valve repair has been mystified. The truth is, 95% of degenerative mitral valves can be repaired with only five techniques that are accessible to virtually all cardiac surgeons: (1) triangular resection, (2) sliding repair, (3) creation of artificial chordae, (4) commissuroplasty and (5) annuloplasty. Let's review these techniques in the context of the lesions they address.

Posterior leaflet prolapse. This is the most common lesion in degenerative disease and also the easiest to treat. For segmental posterior leaflet prolapse — i.e., cases with only one segment with ruptured, elongated chordae (usually P2) — do a *triangular resection* and then an annuloplasty. That's all; it's a simple, reproducible operation. If there is extensive posterior leaflet prolapse and a tall leaflet, resection plus a *sliding repair* will treat the prolapse and prevent postoperative systolic anterior motion.

Anterior leaflet prolapse. This lesion is often judged to be more complex, but it's actually straightforward to treat. *Make artificial chords* out of Gore-Tex or PTFE CV4 or CV5 sutures. Identify the segment of the anterior leaflet that prolapses, then take a CV4 suture and one of the needles and put it through the papillary muscle near the tip. That leaves a stitch through the papillary muscle and two needles. Each needle comes up through the anterior leaflet at the site of prolapse twice from the ventricular side to the atrial side, forming a figure of eight. The two needles finish near each other.

Place two sets of chords this way, but refrain from tying them yet. Next do an annuloplasty and look at the valve as well as the reference point, which is usually A1. Lift A1 as far as it can be lifted past the annuloplasty, and make it so that the new chords hold the leaflet to that level. This usually means making the chords a bit

FIGURE 1 — Illustrations of two types of mitral valve annuloplasty. An annuloplasty is employed for all repairs of degenerative mitral valves.



longer than it seems they should be. The chords can then be tied, which completes the technique.

Commissural prolapse. A complex jet is easy to repair through *commissuroplasty* — i.e., simply close the commissure. About 20% of the valve can be sewn shut, and as long as undersizing the annuloplasty is avoided, there will not be mitral stenosis. It's like an Alfieri stitch at the commissure.

All repairs. Finally, *annuloplasty* (Figure 1) should be incorporated into every single mitral valve repair. The type to use is up to the operator, as all work well. I favor a posterior band, which is flexible and easy to place, particularly with minimally invasive techniques. The key point is that annuloplasty is essential to completing any repair.

SNAPSHOTS FROM THE AATS 102ND ANNUAL MEETING

UPDATE ON THE OZAKI PROCEDURE

By Shinya Unai, MD, Staff, Department of Thoracic and Cardiothoracic Surgery

Originally reported in 2011 by Ozaki and colleagues in Japan, the Ozaki procedure is a new technique for reconstructing the aortic valve using glutaraldehyde-treated autologous pericardium. The procedure is applicable to various conditions — including aortic stenosis (AS), aortic insufficiency (AI) and endocarditis — and to bicuspid and unicuspid valve anatomies. Notably, it allows patients to avoid lifelong anticoagulation.

The procedure involves harvesting autologous pericardium and treating it with 0.6% glutaraldehyde solution. After starting cardiopulmonary bypass, the diseased valve cusps are excised and annular calcification is debrided. The size of new cusps is determined using Ozaki sizers, after which three cusps are cut from the treated pericardium and sutured to the annulus. The smooth side of the pericardium is placed toward the ventricle to reduce platelet consumption. To improve the strength of commissures, a 5-mm wing extension of the cusps is used for commissural fixation. Patients receive aspirin for six months after discharge.

The procedure offers numerous advantages, including preservation of natural motion of the annulus, a large effective orifice area, reproducibility, deep coaptation and no device cost. The lack of requirement for anticoagulation holds particular appeal for younger patients who want to avoid a mechanical valve.

From Cleveland Clinic's adoption of the Ozaki procedure (in 2016) through February 2021, we performed it in 47 adult patients (mean age, 51). Most underwent the procedure for AS or AI; three patients had combined AS/AI and five had endocarditis. Outcomes have been good, with no major postoperative complications (death, stroke or permanent pacemaker requirement). During follow-up, two patients required reoperation — one for endocarditis and one for aortic regurgitation — and two developed mild AI. Our use of the procedure has since accelerated, with 30 additional cases performed from March 2021 to May 2022 (Figure 2).

At a meeting of the Society of Thoracic Surgeons two years ago, our group teamed with Professor Ozaki and colleagues from Toho University to present preliminary data from a retrospective study that used propensity matching to compare outcomes with the Ozaki procedure versus the well-studied PERIMOUNT stented bovine pericardial valve. We demonstrated comparable intermediate-term outcomes between the two treatments in terms of valve re-replacement, as will be detailed in a forthcoming full study report. While the study suggested a steep learning curve for the procedure and there is a clear need for larger and longer studies, the Ozaki procedure appears to have a likely role in aortic valve treatment algorithms, especially for younger patients.



FIGURE 2 — Dr. Unai (on the left) leads a surgical team in performing an Ozaki procedure. Thirty Ozaki procedures were performed at Cleveland Clinic in the 14 months from March 2021 to May 2022.

SNAPSHOTS FROM THE AATS 102ND ANNUAL MEETING

LESSONS FROM THE EVOLUTION OF THORACOABDOMINAL AORTIC ANEURYSM REPAIR

By Lars Svensson, MD, PhD, Chair, Heart, Vascular & Thoracic Institute

Although often slow in coming, the rewards of translational research can be well worth the wait. That's a key takeaway from more than three and a half decades of investigation into strategies to prevent spinal cord injury (SCI) during repair of descending thoracic aortic and thoracoabdominal aortic aneurysms (DTA/TAA) (Figure 3).

I was invited to share lessons from more than 2,500 such repairs over the past 20 years at Cleveland Clinic, and one standout lesson is the value of adding intrathecal papaverine to the neuroprotective protocol for DTA/TAA repairs.

The roots of this lesson reach back to early in vivo research I was involved with in South Africa in the mid-1980s. In a study of neuroprotective strategies in nonhuman primates (*Ann Surg.* 1986;204:38-47), we found that intrathecal papaverine completely prevented paraplegia during cross-clamping of the thoracic aorta in all animals through a mechanism of enhanced vasodilation and blood flow augmentation through the anterior spinal artery.

Upon my arrival in the U.S. soon thereafter, Cleveland Clinic was the only U.S. center willing to grant IRB approval for the study of intrathecal papaverine as part of the neuroprotective protocol for DTA/TAA repairs. That research, which began in the late 1980s, resulted in the eventual establishment of a standard of care at Cleveland Clinic that includes intrathecal papaverine for spinal cord protection during these procedures.

That standard of care — which ultimately included additional neuroprotective strategies such as cerebrospinal fluid (CSF) drainage, moderate hypothermia and lidocaine plus atropine — has contributed to persistently improving outcomes for patients undergoing DTA/TAA repair at Cleveland Clinic. An analysis of more than 300 patients from 2002 to 2010 (*J Thorac Cardiovasc Surg.* 2012;143:945-952) showed that supplementing CSF drainage with intrathecal papaverine, apart from other neuroprotective strategies, was associated with a reduction of SCI from 19% to 6% ($P = 0.0006$). Permanent SCI was reduced from 14% to 5.2% with papaverine ($P = 0.01$). Moreover, rates of mortality, renal failure and other complications were reduced substantially from historical Cleveland Clinic results.

We eventually applied lessons in spinal cord protection from open procedures to endovascular procedures for DTA/TAA repair, including occasional use of intrathecal papaverine and more liberal use of CSF drainage.

FIGURE 3 — Three-dimensional CT reconstruction of a descending thoracic/thoracoabdominal aorta repair. Analysis of more than 2,500 such repairs at Cleveland Clinic over the past 20 years has shown declining rates of permanent spinal cord injury and death.



These cumulative lessons all contribute to the following outcomes across 1,670 DTA and 848 TAA repairs (including emergency cases) performed at Cleveland Clinic over the past 20 years (2002 through 2021):

- Mortality of 6.8% for open cases (N = 910) and 4.0% for endovascular cases (N = 1,608)
- Permanent SCI rates of 1.3% for open DTA and 4.9% for open TAA (SCI rates for endovascular procedures are not yet available)

Iterative studies and innovations over nearly four decades have brought us these reduced risks of death and SCI in DTA/TAA repairs, along with improvements in long-term survival. It has been a fascinating and rewarding journey — and one that's not yet over, as further refinements surely remain.

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TAKING TAVR TO THE ENTERPRISE LEVEL

How and why we are replicating our TAVR protocol across our U.S. and international sites

When it comes to transcatheter aortic valve replacement (TAVR), what happens in Cleveland shouldn't stay in Cleveland. That's the attitude Cleveland Clinic's Heart, Vascular & Thoracic Institute has taken toward promoting experience-based best practices to meet growing demand for this practice-changing percutaneous procedure.

"Since we started performing TAVR on an investigational basis in 2006 at our main campus in Cleveland, we have fine-tuned our practices and processes over thousands of subsequent procedures here," says interventional cardiologist Samir Kapadia, MD, Chair of Cardiovascular Medicine at Cleveland Clinic. "As Cleveland Clinic grows as a health system, both nationally and internationally, we are ensuring that those practices and processes get replicated at all other sites where we offer TAVR so that every patient can expect the very same safety, quality and outcomes, regardless of where they undergo the procedure."

Building on experience, data and cross-discipline collaboration

The fine-tuning Dr. Kapadia refers to started yielding results from the earliest days. "We performed 262 transfemoral TAVRs in our first six years of doing the procedure, with no deaths," he notes. "This was at a time when mortality was nearly 10% elsewhere. There were complications and difficulties, but we were prepared to deal with them in an expeditious and effective manner."

Key to that preparedness has been the TAVR team's multidisciplinary nature from the start. "An important part of the TAVR program's success over time has been the collegial relationship between the cardiology and surgical members of the TAVR team, beginning with patient evaluation and including procedural collaboration," says cardiothoracic surgeon James Yun, MD, PhD, a longtime member of the main campus TAVR team. "The presence of experienced cardiac surgeons invested in the TAVR team during the TAVR procedure directly contributes to patient safety not only by adding experienced hands and eyes to the procedure, but also by ensuring immediate surgeon availability when seconds count."

Drs. Kapadia and Yun note that the team continued to refine its TAVR protocol even after the TAVR program's successful early years. And they had more and more experience to draw from

after TAVR gained initial FDA approval for commercial use in late 2011 and accumulated additional indications in broader patient populations in the following years. "We continually analyze our results and make adjustments accordingly to best decide which valves to use, how to properly size and deploy them, and how best to evaluate patients in a multidisciplinary heart team format," Dr. Yun observes.

The outcomes data in the table on page 8 — among the most favorable of any TAVR program anywhere — are a testament to this approach. They also argue for disseminating Cleveland Clinic's TAVR practices in order to promote improved outcomes more broadly.

"We have aimed to do that by sharing insights from our experience beyond Cleveland Clinic through a series of peer-reviewed papers describing and documenting some of our best practices around TAVR," notes Dr. Kapadia. These papers have covered such issues as:

- › How to deal with emergencies (*Catheter Cardiovasc Interv.* 2014;84[5]:834-842)
- › How to reduce the stroke rate (*J Am Coll Cardiol.* 2017;69[4]:367-377)
- › How to reduce permanent pacemaker requirements (*JACC Cardiovasc Intervent.* 2021;14[2]:115-134)
- › How high valve deployment can reduce risk of conduction abnormalities (*Circ Cardiovasc Intervent.* 2021;14:e009407)
- › How to achieve same-day discharge for appropriate transfemoral TAVR patients (*JACC Cardiovasc Intervent.* 2022;15[6]:575-589)

Replicating processes across the system

Additionally, within the realm that Cleveland Clinic's main campus TAVR team can influence most directly — other hospitals

LEFT — Members of the TAVR team from Cleveland Clinic's main campus perform a TAVR procedure at Cleveland Clinic Hillcrest Hospital, a regional hospital where they are helping colleagues launch a new TAVR program based on Cleveland Clinic practices and protocols refined over the past 15+ years.

TAVR VOLUME AND OUTCOMES AT CLEVELAND CLINIC, 2018-2021					
	2018	2019	2020	2021	Total
Number of cases	495	696	679	652	2,522
Mortality	0.2%	0.0%	0.4%	0.6%	0.3%
Stroke	0.2%	0.3%	1.0%	0.4%	0.5%
Aortic regurgitation (≥2+)	0.8%	0.3%	0.3%	0.4%	0.4%
New permanent pacemaker	5.0%	1.2%	2.5%	2.9%	2.7%

in the expansive Cleveland Clinic health system — they are disseminating their TAVR practices by exposing their colleagues at other locations to exactly how TAVR is done at Cleveland Clinic’s main campus and then providing support and resources to enable them to replicate those processes at their sites.

The effort has taken place close to home — several years ago at Cleveland Clinic Akron General, which is 40 miles south of Cleveland and joined the Cleveland Clinic health system in late 2015 — and further afield, at Cleveland Clinic Florida in Southeast Florida as well as internationally. On the international front, TAVR is well established at Cleveland Clinic Abu Dhabi in the United Arab Emirates and at Cleveland Clinic London, which swiftly established the busiest private TAVR program in the United Kingdom within weeks of opening its inpatient program in spring 2022.

“The aim has been to analyze our TAVR data and understand our results, and then to build similar TAVR teams and care systems at other locations,” Dr. Kapadia explains. “That means ensuring that any TAVR procedure we offer involves proper patient selection, proper patient evaluation by a multidisciplinary team (including cardiac surgery, cardiology, cardiovascular imaging), proper execution of the procedure, and proper discharge mechanisms and follow-up. And it all has to be done safely and in a value-based way that is financially sustainable.”

How it happens

The effort involves a multifaceted process. Typically, teams from the other Cleveland Clinic locations — including physician, nursing and database team representatives — visit the main campus to spend time with and observe the TAVR team during procedures. The visit also exposes them to how the interdisciplinary main campus team collaboratively evaluates TAVR candidates and advises them on transcatheter versus surgical AVR. And it provides exposure to the main campus team’s record-keeping system as well as its infrastructure and processes for TAVR data collection.

When the new site is ready to start TAVR procedures, interventional cardiologists from the main campus TAVR team will go to the new site and perform procedures for several days, observe the new team doing procedures and be available to field questions. Additionally, video systems have been set up to allow the main campus team to observe TAVR procedures at other sites via livestream and advise on procedural questions as needed. “This system has allowed highly skilled operators at other sites in the enterprise to fine-tune their care, even in real time, to provide the most up-to-date procedures and results through collaboration,” says Amar Krishnaswamy, MD, Section Head of Interventional Cardiology at Cleveland Clinic’s main campus.

On an ongoing basis, the main campus TAVR team takes questions about challenging cases and reviews all other sites’ TAVR data and outcomes, offering advice when requested. As it does for other major cardiovascular procedures, Cleveland Clinic has set up a dashboard so its Heart, Vascular & Thoracic Institute leaders can review TAVR-related data at the enterprise level, allowing them to flag any issues and follow up with a given site as needed.

TAVR teams at other sites also may make periodic visits to Cleveland to keep current. “We try to visit the main campus for a week every year to learn the latest optimal techniques,” says Mahmoud Traina, MD, a staff cardiologist with the TAVR team at Cleveland Clinic Abu Dhabi. “We always learn small improvements in technique that we bring back to our patients in Abu Dhabi. For example, we have optimized our technique to include single-sided access, higher valve implantation and single-device closure to achieve similarly low rates of complications to serve as the benchmark for our region.”

Key to enterprise-level TAVR integration is the standardization of record-keeping and database practices. “Sometimes definitions can be tricky,” Dr. Kapadia explains. “So we ensure that all our sites are using the same definitions, such as how to define procedural start and finish times and what constitutes

a readmission. This promotes apples-to-apples comparisons when we combine our data across sites, and it makes it easier to analyze data and advance quality initiatives. This is important, as our Heart, Vascular & Thoracic Institute makes a point of publicly reporting outcomes encompassing every patient we treat.”

[Recruitment, redesign, research and more](#)

The integration of every new TAVR site involves its own special circumstances. Heart, Vascular & Thoracic Institute leadership from Cleveland was involved in recruiting staff specifically for launching TAVR programs at Cleveland Clinic Akron General and Cleveland Clinic Florida. Leaders from Cleveland also advised on the redesign of hybrid operating rooms at both sites to best accommodate the Cleveland Clinic approach to TAVR.

“The Heart, Vascular & Thoracic Institute’s commitment to developing a world-class TAVR program at Cleveland Clinic Akron General has brought life-changing and lifesaving capability close to home for countless residents of Akron and communities south of Cleveland,” says Akron General cardiothoracic surgeon Joseph Lahorra, MD. “Our Cleveland colleagues used a ‘team of teams’ approach by opening their labs and meeting room doors to our TAVR team, as well as operating with us in Akron, to fully share their experience and expertise. The result has been outstanding outcomes, as there have been no TAVR mortalities since the inception of the program here in 2019. We are in constant communication with the team in Cleveland to review challenging or higher-risk cases to determine the best approach and treatment venue.”

The enterprise-wide integration of TAVR programs also extends to research efforts for sites within the U.S. For example, it has allowed Cleveland Clinic to enroll patients in several TAVR-related clinical trials at its Akron General and Cleveland Clinic Florida hospitals in addition to its main campus site, promoting more extensive and effective contributions to research protocols.

“Being part of our enterprise’s integrated TAVR program provides access to advanced technologies and expands the cohort of patients who can benefit from this lifesaving therapy,” says cardiologist Emad Hakemi, MD, of Cleveland Clinic Florida in Weston, Florida. “This has translated to access to cerebral protection devices, postprocedural prolonged rhythm monitoring protocols and the capacity to offer our patients access to important clinical trials, such as TAVR UNLOAD, EARLY TAVR and others.”

And the expansion of the Cleveland Clinic TAVR model to new sites is an opportunity for learning all around, as was the case when Cleveland Clinic London started doing TAVRs after its opening this past spring. “The London team is highly experienced,

“We ensure that all our sites are using the same definitions, such as how to define procedural start and finish times and what constitutes a readmission. This promotes apples-to-apples comparisons when we combine our data across sites.”

— SAMIR KAPADIA, MD

so it was rewarding for me to be exposed to some European nuances of TAVR when I spent a few days with them in London sharing our systems and processes,” says Dr. Kapadia.

“We greatly value the collaboration with our colleagues in Cleveland and are always keen to streamline our procedural protocols and care pathways to ensure the best outcomes for patients,” says Professor Bernard Prendergast, DM, FRCP, Chair of Cardiology at Cleveland Clinic London, who holds a standing conference with the Cleveland team every two weeks.

The most recent expansions of the model are taking place this summer, as Cleveland Clinic’s Hillcrest and Fairview hospitals — regional hospitals in Cleveland’s east and west suburbs — begin to offer TAVR following the process outlined in this article.

“This effort empowers TAVR teams at all of our sites with the collective TAVR expertise and resources that the full Cleveland Clinic enterprise has to offer,” Dr. Kapadia observes.

“Making care more regional also allows patients to remain closer to home and to their established support systems, which is especially important when going through a major procedure that carries emotional stress,” adds Dr. Krishnaswamy.

“Sharing the knowledge and expertise of both our cardiologists and our surgeons in this way ensures that patients can be confident they will receive the highest standards of Cleveland Clinic treatment regardless of which location they choose for their TAVR care,” Dr. Yun concludes.

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RACIAL CARE GAPS CAN BE CLOSED IN ACUTE TYPE B AORTIC DISSECTION

Comprehensive management is key to delivering comparable outcomes

Despite significant differences in risk factors, demographics and socioeconomic factors between Black and white patients presenting with acute type B aortic dissection (TBAD), equivalent management and short-term outcomes between the two cohorts can be achieved. So finds a retrospective single-center study from Cleveland Clinic published in the *Journal of Vascular Surgery* (2022;75[6]:1855-1863.e2).

The findings suggest that TBAD affects the most socially and economically vulnerable populations regardless of race while also underscoring the importance of taking an integrated, multidisciplinary, population-based approach to aortic disease, the researchers conclude.

“We found that Black patients presented with TBAD about 10 years earlier in life and with a lower level of health maintenance than their white counterparts, but this did not result in outcome differences within our system,” says the study’s corresponding author, Levester Kirksey, MD, MBA, The Walter Buckley Endowed Vice Chair of Vascular Surgery at Cleveland Clinic.

Study rationale and design

Racial disparities in risk factors and management are well documented in cardiovascular disease, including for some vascular conditions. However, few studies have addressed potential racial disparities in TBAD. Hypertension is the primary risk factor for TBAD (Figure), and healthcare access and early uninterrupted health maintenance are fundamental to its prevention. Since hypertension medication adherence and healthcare access differ across racial and ethnic groups, the researchers sought to explore the extent to which racial disparities may exist in TBAD treatment and outcomes.

They retrospectively identified consecutive patients with TBAD admitted to the cardiovascular ICU at Cleveland Clinic from 2015 through 2020. Patients were included in the analysis if they self-identified as Black ($n = 57$) or white ($n = 123$) and were managed medically or surgically for TBAD.

The Black and white patient cohorts were compared in terms of demographics, socioeconomic factors, insurance type, previous cardiac/aortic interventions, antihypertensive medication, medication adherence, number of primary care and emergency department (ED) visits in the prior two years, and TBAD management outcomes. Socioeconomic status was quantified using the Area Deprivation Index, which is based on variables including education, employment, housing quality and poverty.

How the cohorts stacked up

The two cohorts were statistically comparable on all but the following characteristics:

- Age, with Black patients younger than white patients (mean, 58.9 vs. 67.6 years)
- Prevalence of end-stage renal disease and anemia, which was higher among Blacks for both
- Likelihood of prior aortic aneurysm intervention and coronary intervention, which was higher among whites for both

TBAD anatomic features and management were statistically comparable between the two cohorts, including the proportion of patients with complicated dissection, the proportion with high-risk features in the setting of uncomplicated dissection, the proportion who underwent surgical intervention during hospitalization and the type of surgical intervention used.

Differences emerged, however, in several indicators of health maintenance and in some demographic metrics:

- Black patients were more likely to be on three or more antihypertensive medications ($P = 0.005$) and less likely to adhere to prescribed medications ($P < 0.001$).
- Black patients had fewer primary care physician visits ($P = 0.03$) and more ED visits ($P < 0.001$) before their TBAD event.
- Black patients had higher Area Deprivation Index scores ($P < 0.001$), indicating increased adversity.

In contrast, the two cohorts had the same median APACHE II score (9) and the same median hospital length of stay (7 days) and statistically comparable rates of readmission and 30-day mortality.

Takeaways from the study

“We found that despite significant differences in risk factors, demographics and socioeconomic characteristics between Black and white patients with acute TBAD, the two cohorts were similar in prevalence of complicated dissection and high-risk

morphologic features, and they received similar management and achieved similar near-term outcomes,” observes Dr. Kirksey.

He notes that the lower health maintenance care received by Black patients prior to acute presentation — reflected by fewer primary care visits, greater ED utilization and poorer hypertension management and therapy adherence — is consistent with these patients’ higher Area Deprivation Index score. However, the Area Deprivation Index score of the study’s white patients with TBAD also indicated high deprivation relative to national benchmarks. “This suggests that TBAD is a condition that particularly impacts vulnerable populations and under-resourced communities regardless of race,” Dr. Kirksey says.

It’s notable, he adds, that the APACHE II score — a marker of case severity — was comparable between the two cohorts even though Black patients were nearly 10 years younger than their white counterparts. “For Black patients to be that much younger and still have the same collective APACHE II score indicates that they had a higher chronic disease comorbidity profile,” Dr. Kirksey says. “This underscores the role for health maintenance in preventing TBAD in Black patients with aortic disease, which should be an implementation research priority.”

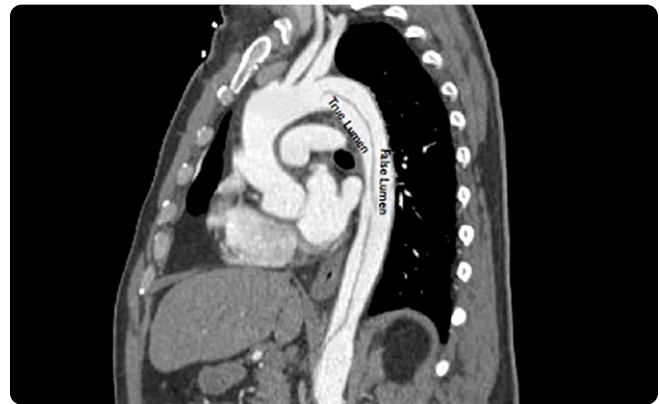
The case for a population-based approach

Such an emphasis has been a focus of Cleveland Clinic’s aortic disease management in recent years. “We are increasingly treating patients with aortic disease in a more population-based manner that identifies those at elevated risk for acute dissection — because of hypertension or suboptimal follow-up for hypertension therapy — and manages them more aggressively for purposes of prevention,” Dr. Kirksey explains.

The effort is highly multidisciplinary and devotes attention to three phases of management: (1) preventing development of TBAD, (2) in-hospital care if an individual develops acute TBAD and (3) post-discharge surveillance to prevent recurrence. Optimal management of complex aortic disorders requires collaboration and active communication among multiple specialists, and this care must continue for the remainder of the patient’s life.

Central to the prevention-oriented phases of management — before any hospital care of TBAD and then after discharge — are cardiologists such as Vidyasagar Kalahasti, MD, in Cleveland Clinic’s Aorta Center. They determine the best therapies for patients identified with aortic disease and provide or coordinate maintenance therapy and monitoring via check-in visits, remote blood pressure monitoring and other strategies. These same strategies are employed for patients following an intervention for acute dissection, to provide accelerated surveillance to avoid progression or recurrence. Patients are given a cuff for home

FIGURE — Imaging study showing a type B aortic dissection (TBAD). Cleveland Clinic’s population-based approach to aortic disease aims to identify patients at elevated risk for acute TBAD (due to hypertension or suboptimal follow-up for hypertension therapy) and manage them more aggressively for purposes of prevention.



blood pressure monitoring and are seen frequently — often via a mix of in-person and virtual visits — to ensure hypertension control and avoidance of hypertensive complications.

“Outpatient follow-up after initial treatment of TBAD is extremely important to help patients understand their condition using heart models and imaging,” Dr. Kalahasti says. “We explain the risk factors that led to the dissection, such as high blood pressure and smoking, and the need for lifelong care to prevent complications. It’s also when patients are most receptive to making changes.”

When patients present with acute TBAD, the Aorta Center’s multidisciplinary interventional component is activated. Patients are rapidly transferred for triage in an ICU, where they are evaluated by three teams — cardiology, vascular surgery and cardiothoracic surgery — to determine the specific underlying pathology and collaboratively formulate a tailored management plan, including endovascular and open surgical options. This rapid management process for acute TBAD cases was developed by Aorta Center Director and cardiothoracic surgeon Eric Roselli, MD.

“Our new study is important because it demonstrates how we can level the playing field for patients once they enter a multidisciplinary system providing expeditious, comprehensive and lifelong care for life-threatening aortic conditions,” Dr. Roselli says. “It also highlights the importance of our expanding efforts to include the entire healthcare community and the public to improve awareness of aortic disease so we can prevent more of these potential catastrophes from happening.”

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NEW CARDIAC MRI INITIATIVES AIM TO DRIVE NEXT WAVE OF ADVANCES IN CARDIAC CARE

Focus is on giving patients a better imaging experience while acquiring more data

Current-generation cardiac magnetic resonance imaging (CMR) exams involve a lengthy and cumbersome process. Patients must repeatedly hold their breath throughout the hourlong scan, which can be exhausting or even prohibitive for many in poor health.

In addition, the technologist must continuously adjust controls on a panel similar to those in a jet's cockpit. And although CMR provides more information than other cardiac imaging modalities, a considerable amount of acquired data is unexploited because of processing limitations.

"CMR is the most valuable imaging technique for diagnosing and monitoring cardiac disease, but because of its complexity and poor patient experience, it is underused," says Deborah Kwon, MD, Director of Cardiac MRI at Cleveland Clinic, who is spearheading new cardiovascular imaging initiatives under the Advanced Imaging and Simulation Center. "We are driving efforts to create high-performance CMR by improving efficiency and patient comfort while simultaneously augmenting image quality and accuracy of diagnosis."

One central initiative is the Advanced Imaging and Simulation Center for MRI, led by Christopher Nguyen, PhD, Director of MRI Research, who arrived at Cleveland Clinic in April 2022 from Harvard Medical School. An expert in developing novel CMR techniques, Dr. Nguyen and his team are focused on several major innovations, including those discussed below. Central to their efforts is a new 3T MRI scanner at Cleveland Clinic dedicated exclusively to cardiovascular research under Dr. Nguyen's leadership.

Simplifying the CMR experience

Conducting a CMR exam requires extensive training, as technologists must make hundreds of decisions during a single session. The complexity introduces much variability among different technologists — and even among exams conducted by the same technologist — which can render comparisons inexact for clinical and research purposes.

"We are taking advantage of new technical advances in hardware and software to simplify the CMR interface," says Dr. Nguyen. "We aim to develop a single push-button exam, using data to allow the machine to run on 'autopilot' for tasks currently performed manually."

From the patient's perspective, CMR exams today are "like running a marathon," Dr. Nguyen observes. Because capturing images is slow and the heart beats fast, breath-holding is required while each of about 100 images is taken. The next-generation scanner will use a continuous acquisition approach, capturing rather than avoiding motion (see *Nat Biomed Eng.* 2018;2:215-226 and *Magn Reson Med.* 2022;87:474-487) and yielding more revealing images (Figure 1). By 2023, Dr. Nguyen expects to bring the exam time down to 20 to 30 minutes, with the patient breathing freely throughout. He reports that when he's testing the prototype, he instructs patients to try to "just take a nap."

Digital twin prediction models

With the help of deep learning and noise-reduction techniques, the new dedicated MRI machine will be able to incorporate the massive amount of data it acquires, providing images with much more information than offered by current exams (see *Front Physiol.* 2021;12:694940). Dr. Nguyen explains that while a typical MRI obtains 1 to 2 gigabytes of data during a scan, the new scanner can acquire 100 gigabytes.

This wealth of data will not only provide additional clinical information to help the patient, but it can be used to help others — an unusual circumstance in clinical imaging. Data related to multiple anatomic and functional parameters from hundreds of similar hearts can be combined to create a "digital twin." Such models can be used in multiple ways to inform research and personalized clinical care (see Figure 2). For instance, various treatments can be compared using outcomes of a conglomerate of similar hearts from patients who received each therapy. This can greatly benefit research and help determine the best path forward for an individual patient.

Digital twin technology can also give patients a glimpse into their future. "We can show patients a 'Tale of Two Hearts,'" Dr. Nguyen explains. "We can say, 'This is what your heart will probably look like in 10 years if you continue smoking, and this is how it will likely look if you quit.'"

Visualizing microstructure

The imaging acquisition and processing advances are also enabling new developments on a micropathologic level by using a novel diffusion tensor CMR technique pioneered by Dr. Nguyen (Figure 3). Like finding cracks in a building, this new technique can detect aberrant helical cardiac muscle fiber architecture caused by early disease before other imaging modalities can detect it (see *JACC Basic Transl Sci.* 2018;3:97-109 and *Radiol Cardiothorac Imaging.* 2021;3:e200580). Visualizing microstructure can also be a boon for electrophysiologists: because atrial fiber orientation reflects electroconductivity direction, the ability to visualize and map electrical pathways can help identify ablation targets to treat atrial fibrillation.

Dr. Kwon notes that this innovative microstructural imaging and machine learning will also be useful for advancing research and has the potential to play an important role in settling controversies. She cites the differing results of the COAPT and MITRA-FR trials of transcatheter mitral valve repair with the MitraClip™ device, with the former finding improved outcomes using the device relative to medical therapy alone and the latter finding no benefit.

“Perhaps certain patterns of remodeling that result from the underlying cardiomyopathy — too subtle to detect by current evaluation methods — determine whether only some patients benefit from this device,” says Dr. Kwon. “Current guidelines call for assessment by echocardiography before MitraClip is employed, but micropathology may provide the ability to derive more optimal selection criteria to better predict outcomes.”

Innovation spurring more innovation

Dr. Kwon describes the Advanced Imaging and Simulation Center for MRI as a “team of teams,” with close collaboration among engineers, technologists, data scientists, clinical informatics specialists and physicians in various disciplines. This allows for seamless interchange between the research and clinical realms and the promotion of clinical relevance and rapid translation.

“The new CMR capabilities will also help drive device development and improved techniques,” she says. “By more efficiently providing better images, combined with digital twin technology and machine learning, the new innovations will launch the next generation of advances in cardiac care.”

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Contact Dr. Kwon at 216.444.8526 and Dr. Nguyen at 216.636.5819.

FIGURE 1 — Evolution of the CMR exam. Conventional CMR exams (top) acquire thick 2D slices from multiple views and require the patient to hold their breath numerous times. The next-generation CMR exam (bottom) will be shorter while collecting a complete dynamic 3D volume at each phase of the cardiac cycle under completely free breathing conditions.

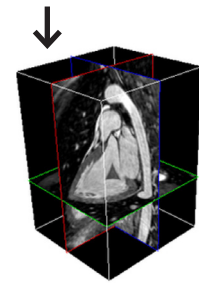
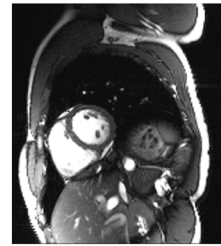


FIGURE 2 — A representative patient-specific CMR-based biomechanical mesh from digital twin technology. This mesh can simulate the patient's heart to recapitulate their cardiac motion, hemodynamics and remodeling.

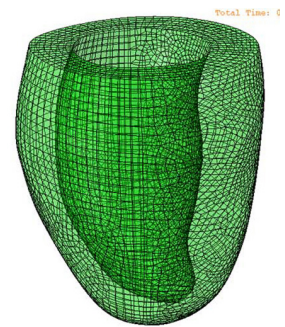
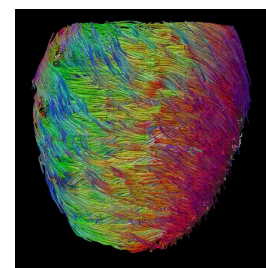
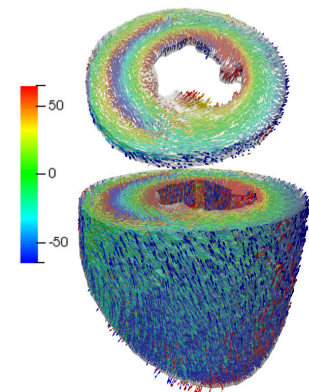


FIGURE 3 — Microstructural imaging enabled by diffusion tensor CMR. By tracking diffusion of water molecules, microstructure on the level of 100 μm can be characterized, revealing the underlying myocardial helical fiber architecture or its helicity. The helicity maps (top) show a smooth transition from endocardial right-handed helical fiber structure (red) to epicardial left-handed helical fiber structure (blue).



TWO STEPS FORWARD IN EVOLVING LEADLESS PACEMAKER TECHNOLOGY

Trials launched of first leadless pacemaker/defibrillator system and first dual-chamber leadless pacemaker

In late 2021, the MODULAR ATP trial of the world's first leadless pacemaker/defibrillator system was launched with implantation of the system in the study's first two patients — both at Cleveland Clinic. Three months later, the world's first dual-chamber leadless pacemaker system was implanted in the first U.S. patient — again at Cleveland Clinic — as part of the new international Aveir DR i2i Study.

The implantations were successfully completed by electrophysiologist Daniel Cantillon, MD, who is global principal investigator of MODULAR ATP and a co-leader of the Aveir DR i2i Study. He is excited by how far leadless pacemaker technology has come since 2014, when he and Cleveland Clinic colleagues performed some of the initial implantations of the first single-chamber leadless pacemakers in pivotal trials.

“We view the new leadless pacemaker/defibrillator system as an important solution for getting patients away from the long-term problems associated with transvenous implantable cardioverter-defibrillators [ICDs],” says Dr. Cantillon, Research Director and Associate Section Head of Cardiac Electrophysiology and Pacing. “And patients who need dual-chamber pacing have not been well served by transvenous leads, so enthusiasm for dual-chamber leadless pacemaker technology is high.”

Leadless pacemaker/defibrillator system

The MODULAR ATP trial (NCT04798768) is evaluating the effectiveness and safety of the Modular Cardiac Rhythm Management Therapy System, which combines the EMPOWER™ Modular Pacing System and the EMBLEM™ MRI Subcutaneous ICD, all from Boston Scientific (Figure 1).



FIGURE 1 — The Modular Cardiac Rhythm Management Therapy System. *Photo courtesy of Boston Scientific.*

Designed to treat sudden cardiac arrest without transvenous leads, the system uses pacing stimulation to painlessly disrupt lethal fast rhythms such as ventricular tachycardia and provide emergency backup pacing for dangerously slow rhythms like asystole. If pacing fails to restore sinus rhythm, the system's defibrillator component delivers a shock as a last resort.

The pacemaker component uses a flexible, telescoping catheter delivery system that facilitates its attachment to the myocardium, making it potentially safer. The absence of leads avoids common problems that affect about one in six patients with a traditional pacemaker/defibrillator within three months of implantation, including lead fractures, dislodgements and venous occlusive disease.

What's most notable, Dr. Cantillon says, is that the pacemaker communicates with the ICD component. When the subcutaneous ICD detects a lethal arrhythmia, it analyzes the rhythm while charging its battery in preparation for delivering a lifesaving shock. In those crucial seconds, it sends a coded message through the patient's body to the pacemaker, instructing it to produce a specific sequence of preprogrammed electrical pulses.

“Prior studies suggest this can successfully terminate up to 75% of cases of monomorphic ventricular tachycardia, which is by far the most common lethal arrhythmia,” Dr. Cantillon notes.

If the pacing succeeds, the ICD stands down and diffuses its charge, and the patient remains unaware that the intervention occurred. If it fails, the ICD immediately delivers the rescue shock.

MODULAR ATP is a single-arm, open-label study that will enroll up to 300 patients at 50 centers in the U.S., Canada, Europe and Asia. Like other enrollees, the study's first two patients at Cleveland Clinic have heart failure and had been receiving shocks from transvenous ICDs that were painful and resulted in psychological trauma.

System- and procedure-related complications will be assessed through six and 12 months. How often the system delivers rescue therapy without delivering shocks will also be examined.

“This system must be handled by extremely experienced operators and implanted in the right patients,” Dr. Cantillon cautions. “If we take the time to do it right and get good data for FDA submission, this system might be commercially available in two to three years.”

Beyond this trial, Dr. Cantillon is energized by the promise that modular wireless technology holds for the millions of patients with heart failure worldwide who need ICDs to protect them from sudden cardiac death. While some don’t need pacing support and can receive the subcutaneous ICD alone, others need both the ICD and a pacemaker. The modular aspect of emerging technology means these elements can be added at different times.

“Once you demonstrate the feasibility of using the patient’s own body to send and receive signals, you can branch out,” Dr. Cantillon explains. “We expect future technological iterations to allow coordination of multichamber leadless pacing with the subcutaneous ICD to serve even more patients who require pacing support for exercise and physical activity.”

“This is a great development in device therapy for our patients that will ultimately lead to better clinical results with less long-term risk,” adds his colleague Oussama Wazni, MD, MBA, Section Head of Cardiac Electrophysiology and Pacing at Cleveland Clinic.

Dual-chamber leadless pacemaker

The launch of the Aveir DR i2i Study (NCT05252702) has brought electrophysiologists one step closer to a goal Dr. Cantillon and colleagues have pursued for years: eliminating complications caused by surgical pacemaker pockets and transvenous leads. “Cleveland Clinic is a major referral center for lead extraction, and we have seen horrendous infections, fractured leads and venous occlusive disease,” Dr. Cantillon says.

The single-arm, open-label study is investigating the safety and effectiveness of Abbott’s Aveir™ Dual-Chamber (DR) Leadless Pacemaker System (Figure 2) in 550 patients with an indication for dual-chamber pacing.

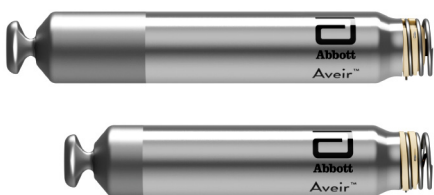


FIGURE 2 — The Aveir Dual-Chamber (DR) Leadless Pacemaker System. Photo courtesy of Abbott.

The two components of the dual-chamber system are implanted via a catheter inserted in the femoral artery through the groin. One pacemaker is placed in the right atrium, the other in the right ventricle. They communicate beat by beat to regulate the heart rate.

Operators should expect a learning curve. “From our experience with the single-chamber leadless pacemaker, we figure it will take 10 implantations to become proficient,” Dr. Cantillon says.

Two aspects of the procedure require special attention, he adds. First is the light hand required when attaching the pacemaker to the right atrium with its helix cinching device. “Because atrial walls are thinner than ventricle walls, great care must be taken to avoid perforations or tears,” he explains.

Additionally, the two pacemakers must be positioned correctly for direct communication — “eye to eye,” as he puts it — before they are released from the catheter. This allows the two devices to work together to achieve synchronous contraction between the heart’s upper and lower chambers, an essential feature for a dual-chamber pacemaker system.

The Aveir DR system was built for long-term retrievability and replacement, Dr. Cantillon notes, as each pacemaker contains a docking button that facilitates retrieval and replacement down the road.

Any patient who qualifies for a traditional dual-chamber pacemaker may enroll in the study, so long as all existing leads and fragments can be removed before the study device is implanted. “We’ve offered enrollment to patients who have already experienced clots, broken leads and venous occlusive disease, as well as those who want to preempt such problems,” Dr. Cantillon explains.

Eventual approval of the dual-chamber leadless pacemaker would allow the vast majority of patients who require pacing to have a wireless option. “There’s still work to be done to completely replace transvenous leads in patients requiring biventricular pacing and conduction system pacing,” notes Dr. Wazni. “However, the dual-chamber leadless pacemaker represents a major advancement.”

Dr. Cantillon reports that he is a consultant for Boston Scientific and has financial interests in Abbott related to consulting, speaking and service on scientific advisory boards.

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Contact Dr. Cantillon at 216.445.9220 and Dr. Wazni at 216.444.2131.

CASE STUDY IN COLLABORATION

STRENGTH THROUGH INTERPROFESSIONAL COLLABORATION: A SECOND-OPINION SERVICE FOR AFFILIATE AND ALLIANCE HOSPITALS

How it works, and reflections from a longtime alliance hospital

Second-opinion case review has been a long-standing offering of the Advisory Services program of Cleveland Clinic's Heart, Vascular & Thoracic Institute (HVTI), and for good reason — physicians and other caregivers recognize that collaboration and consultation results in the best care.

Cleveland Clinic HVTI physicians are highly invested in care collaboration, regularly discussing cases with their colleagues to determine the best plan of care for patients. They also recognize that physicians at other institutions may sometimes have limited opportunities to discuss unique, complex or high-risk cases with colleagues in diverse cardiovascular subspecialties.

That recognition prompted HVTI Advisory Services to formalize a process whereby physicians at hospitals that have affiliate or alliance relationships with HVTI can request a second-opinion case review from Cleveland Clinic when they would like an additional perspective on the plan of care for a patient. Such requests are frequently made for input on surgical/procedural timing or appropriateness, staging of a procedure or whether there's a need to escalate care. Other requests may center on unique anatomy or consideration of a specialized approach to a given case.

"At Cleveland Clinic, we routinely discuss cases among our colleagues — cardiologists, interventionalists, surgeons — to enhance our plan of care for any procedure that is interesting or unique or may pose a higher risk of mortality," says Edward Soltesz, MD, MPH, HVTI's Director of Cardiac Surgery Affiliate and Alliance Programs. "Good decision-making goes hand in hand with technical expertise in achieving high-quality outcomes, and physician judgment is critical in appropriate planning and execution of a successful procedure. We encourage our affiliate and alliance physicians to use our second-opinion process to review complex and unique cases with Cleveland Clinic physicians and determine the best strategy for the patient."

How it works

The HVTI Advisory Services team developed standardized workflows between Cleveland Clinic and its affiliate/alliance hospitals to allow for seamless electronic transfer of radiology images and patient documents to facilitate a virtual second

opinion (Figure 1). The affiliate/alliance hospitals are provided a contact list for HVTI's consultant team to support their second-opinion requests for any case requiring expertise in cardiac surgery, interventional cardiology, electrophysiology, heart failure or cardiovascular imaging. Patient documents and images are reviewed by an HVTI physician, and findings and recommendations are then communicated to the requesting physician.

Since 2012, over 970 second opinions have been delivered by Cleveland Clinic to its affiliate and alliance hospitals and other select hospitals through this service. As shown in Figure 2, a majority of second-opinion requests involve surgical cases.

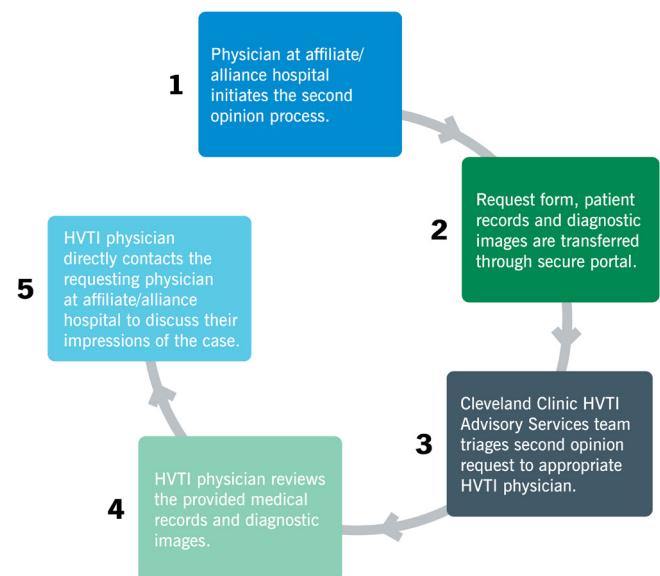


FIGURE 1 — Schematic showing how the HVTI second-opinion process works for affiliate and alliance hospitals.

SECOND OPINIONS OFFERED THROUGH HVTI ADVISORY SERVICES

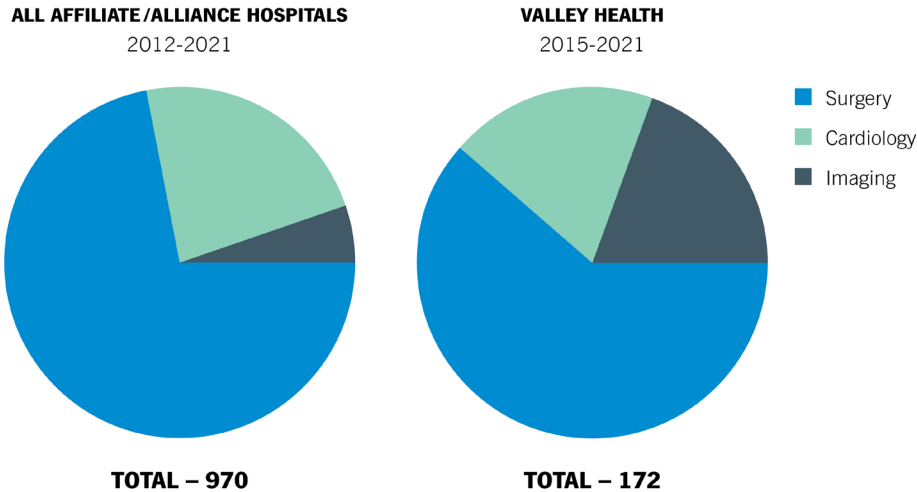


FIGURE 2 — Graphs detailing utilization of HVTI's second-opinion service by all affiliate and alliance hospitals (left) and by Valley Health System (right).

One organization's experience

Cardiologists and surgeons at The Valley Hospital in Ridgewood, New Jersey — part of Valley Health System — have regularly used the second-opinion service since Valley began its alliance relationship with Cleveland Clinic's HVTI in 2015.

"The Valley Hospital is a respected Cleveland Clinic HVTI alliance member that is known for its exceptional patient care and, like Cleveland Clinic, understands the importance of collaboration between hospitals/healthcare providers," says Suma Thomas, MD, MBA, Vice Chair of Strategic Operations in HVTI. "This has been demonstrated by Valley's use of the second-opinion process to optimize patient care."

As detailed in Figure 2, 172 second-opinion requests from The Valley Hospital were completed through the end of 2021.

"These second-opinion consultations have been extremely valuable in adding the experience and perspective of the outstanding clinicians at Cleveland Clinic to our excellent general cardiologists and subspecialists here at Valley," says Gerald Sotsky, MD, Chair of Cardiac Services for the Valley Medical Group. "Our patients benefit greatly from this team-based, collaborative approach."

The longtime alliance relationship between Valley and Cleveland Clinic's HVTI allows for a comprehensive understanding of Valley's capabilities and resources. This ensures that recommendations offered through the second-opinion process involve reasonable and actionable treatment strategies.

Valley patients notably appreciate their physicians' ability to collaborate with physicians at the nation's top-ranked program for cardiology and heart surgery (per *U.S. News & World Report*), as it gives them confidence that all treatment options are being considered. "It is very reassuring to me as a surgeon when I can offer my patients a second opinion from Cleveland Clinic," says Juan Grau, MD, Director of Cardiothoracic Surgery at The Valley Hospital. "I can lean on the experience of one of the premier cardiac surgery programs in the country and know that my patients will receive a thorough review of their specific clinical issues to augment my own expert opinion. The team at Cleveland Clinic sees an extraordinary volume of clinical cases, and that expertise supports me in my clinical decision-making, allowing me to provide optimal care to my patients here at Valley."

In some particularly complex cases, multiple physicians may be involved in a second-opinion request to determine the best course of action. "As the only heart failure cardiologist at Valley, I find it immensely valuable to have access to the world-class heart failure team at Cleveland Clinic for second opinions on difficult cases," says Kariann Abbate, MD, Medical Director of Heart Failure Cardiology and of the Cardiac Care Unit at The Valley Hospital. "The advice I have received has expanded my knowledge base and skill level. Our patients and their families are reassured when they know the Cleveland Clinic heart failure team is helping to enhance their care."

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[For information on affiliation and alliance opportunities with Cleveland Clinic's HVTI, email Amanda Leseska at leseska@ccf.org.](mailto:leseska@ccf.org)

CME PREVIEW

‘MASTERING THE MITRAL VALVE’ COURSE RETURNS WITH ENHANCED CASE-BASED FOCUS

A Case-Based Approach to Mastering the Mitral Valve: Imaging, Innovation and Intervention

JW Marriott Essex House
New York City
Fri.-Sat., Dec. 2-3, 2022

Information/registration: ccfme.org/mitralvalve22

Case-based instruction has been central to Cleveland Clinic’s popular end-of-the-year CME courses on mastering the mitral valve and aortic valve in New York City since they were introduced in 2017. This year’s offering doubles down on that case focus, with virtually all sessions featuring a case considered from multiple subspecialty perspectives — clinical cardiology, interventional cardiology, cardiac surgery, cardiovascular imaging — to provide a maximally comprehensive take on managing mitral valve disease.

“With a case-based approach to every facet of mitral valve disease, expert faculty will inform decision-making that has become increasingly challenging as new options emerge,” says course co-director Marc Gillinov, MD, Chair of Thoracic and Cardiovascular Surgery at Cleveland Clinic.

12 sessions led by 18 experts over 1.5 days

Those expert faculty include 18 cardiology subspecialists and cardiac surgeons from Cleveland Clinic and other leading U.S. institutions. They will address all major areas of contemporary mitral valve care in 12 focused sessions spread across a full Friday and the following Saturday morning. Sessions consist of several 10- or 15-minute presentations by multidisciplinary experts followed by an interactive panel discussion and Q&A.

After a primer on the latest in mitral regurgitation (MR) imaging and management in the first session, subsequent Friday sessions offer case-based deep dives into various specific clinical scenarios — ventricular arrhythmias and MR, atrial arrhythmias and MR, ischemic MR, mitral annular calcification, and hypertrophic obstructive cardiomyopathy — before concluding with multidisciplinary perspectives on complex scenarios.

Tricuspid valve disease covered too

Saturday’s agenda starts with looks backward and forward in mitral and tricuspid valve disease from three subspecialty

perspectives: clinical cardiology, interventional cardiology and cardiac surgery. First is a review of takeaways from the most important papers in mitral and tricuspid valve disease over the past two years, which is followed by a “crystal ball” session projecting what’s likely to emerge in clinical, interventional and surgical care of these conditions in the next few years.

Much of the rest of Saturday morning is focused on tricuspid valve disease, with individual case-based sessions devoted to various subspecialty takes on tricuspid regurgitation (TR) and torrential TR. Saturday’s agenda concludes with a session on managing post-intervention issues in both mitral and tricuspid valve disease.

The course’s practical, case-based orientation is reflected by a sampling of presentation titles:

- › “Fundamentals of Mitral Imaging: Which Tests and When?”
- › “Can I Just Follow the Patient with Severe MR?”
- › “Can I Do a Low-Risk MV Repair, and What Would I Do and Why?”
- › “TEER vs. TEER + AF Ablation vs. TEER + LAAC in Degenerative MR and Persistent AF”
- › “Is a Clip Feasible in Severe TR with Unremitting Heart Failure?”

A perfect time to visit New York

“This will be a great course encompassing not only treatment of mitral valve disease but also state-of-the-art imaging now being used for decision-making in these patients,” notes course co-director Brian Griffin, MD, Section Head of Cardiovascular Imaging at Cleveland Clinic.

And beyond the merits of the course itself, adjournment shortly after noon on Saturday leaves the rest of the weekend for exploration of holiday-season New York City. “This course will be made more special by the fact that the Big Apple is at its most delightful this time of year,” Dr. Griffin adds.

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For more details and registration, visit ccfme.org/mitralvalve22. Early-bird discount pricing is offered through Oct. 3.

This activity has been approved for AMA PRA Category 1 Credit™.



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SAVE THE DATES FOR CME

Advancing Cardiovascular Care: Current and Evolving Management Strategies

Fri., Oct. 7, 2022

Columbus Marriott Northwest, Dublin, Ohio

Information/registration: ccfcme.org/columbusCVcare22

Cardiovascular Update for the Primary Care Provider

Thu.-Fri., Oct. 20-21, 2022

Marriott Cleveland Downtown at Key Center, Cleveland

Information/registration: ccfcme.org/cvupdate22

A Case-Based Approach to Mastering the Mitral Valve

Fri.-Sat., Dec. 2-3, 2022

JW Marriott Essex House, New York City

*Information/registration: ccfcme.org/mitralvalve22
(see page 18 for a detailed preview)*

Valve Disease, Structural Interventions and Diastology Summit

Thu.-Sun., Feb. 9-12, 2023

Eden Roc Miami Beach, Miami Beach, Florida

Information/registration: ccfcme.org/echo

7th Annual Advances in Congenital Heart Disease Summit

Thu.-Sat., Feb. 16-18, 2023

Orlando World Center Marriott, Orlando, Florida

Information/registration: ccfcme.org/congenitalheart23

Comprehensive Care for the Lifetime Treatment of Adult Congenital Heart Disease

Fri.-Sat., March 31-April 1, 2023

InterContinental Chicago Magnificent Mile, Chicago, Illinois

Information/registration: ccfcme.org/achd23

These activities have been approved for **AMA PRA Category 1 Credit™**.

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