MedStar Health

MedStar Heart & Vascular Institute

Cardiovascular Physician

A clinical practice and research publication.

VOLUME 18 | NO 2 | SPRING 2022

Critical infrastructure for complex disease management.

Infiltrative and hypertrophic cardiomyopathy | **COVID-related myocarditis** | **CMD** | **Aortic dissection**

Perspective from Stuart F. Seides, MD, physician executive director, MedStar Heart & Vascular Institute

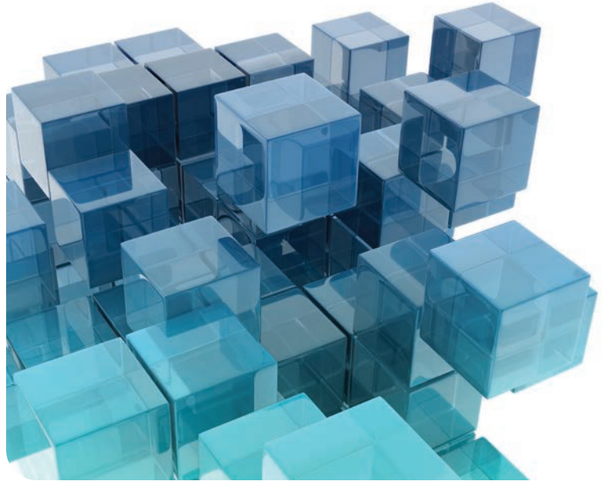
Building an infrastructure of care, brick by brick.

As the well-known adage goes, "Rome wasn't built in a day." This speaks to the fact that great things are conceived and developed over time. The second, and perhaps lesser known, half of this saying is "…but they were laying bricks every hour." This attests to the need for not only time, but diligence, perseverance, and commitment—continuous effort toward the goal.

At MedStar Heart & Vascular Institute, we have been "laying bricks" for more than 50 years, creating the infrastructure we believe best supports our patients and those who care for them. To that end, we prioritize attracting top talent, acquiring the latest technology, and developing innovative tools—critical components that are all part of the larger whole.

The benefits of a thoughtfully and purposefully built infrastructure are particularly evident when managing complex diseases. Take, for example, infiltrative and hypertrophic cardiomyopathies (see pages 3 through 8). To appropriately diagnose and treat these conditions, we rely on advanced cardiac imaging and diagnostic tools, multidisciplinary teams with niche expertise, and an ever-expanding arsenal of treatment options. A program without any one of these pieces would risk less-than-optimal care for these patients.

On page 9, we share a recently published journal article on the diagnostic utility of cardiac MRI when assessing recurrent chest pain after COVID-19. As we are all well aware, dealing with the acute consequences of the virus itself has required an unprecedented and rapid infrastructure build and



adaptation affecting nearly all aspects of our care delivery system. Now, as we now strive to manage the long-term cardiovascular effects of COVID, we rely on the "bricks" we've already laid—advanced imaging and subspecialist perspectives, among others.

We also see this metaphor play out in the astonishing story of Christopher Stanley, a 31-year-old who presented at MedStar Union Memorial Hospital with an acute aortic dissection. Within an hour of arrival, his legs were paralyzed, and his kidneys, intestines, and legs were ischemic. Compounding matters, he also tested positive for COVID. His road to recovery required eight procedures, seven weeks in the hospital, and two months of rehabilitation. Each member of Christopher's care team—from the emergency department clinicians, to the sophisticated surgeons, to the specialists at MedStar National Rehabilitation Hospital—played key roles in helping him achieve full recovery. See page 14 for his story.

In these stories and the others throughout this issue, I hope you will find evidence of diligence, perseverance, and commitment to our longstanding goal of building a program that can and will successfully support patients at all stages of their cardiovascular care. We will continue to foster growth in our talented team, innovation in our tools and services, and patient confidence in our care. Laying those "bricks" remains at the core of our commitment to excellence.

Infiltrative cardiomyopathies:

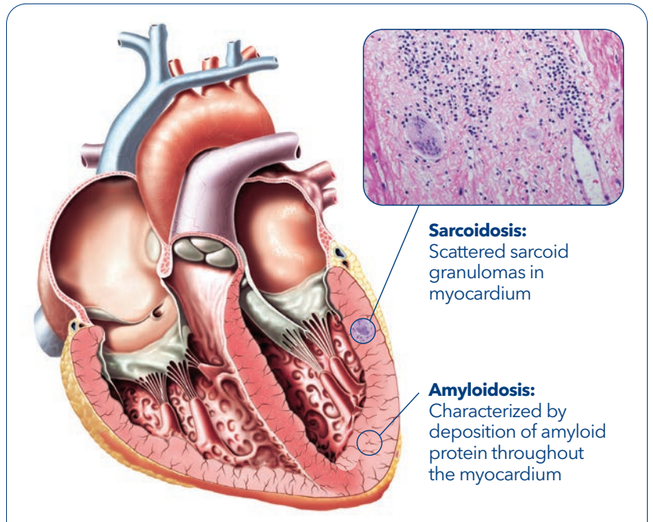
A new frontier in diagnosis and treatment.

Infiltrative cardiomyopathies, principally sarcoidosis and amyloidosis, are increasingly recognized as common causes of cardiovascular disease. Once thought to be rare, practitioners in all fields of medicine are seeing an increase in cases among their patients thanks to greater recognition of the signs and symptoms. Historically hard to identify—and even harder to treat—we finally have the tools to accelerate diagnosis and effective methods to manage patients well. At MedStar Health, we have built an infrastructure for our infiltrative cardiomyopathy program that brings together the technology, tools, and talent, to give patients the best chance for improved longevity and quality of life.

Increasingly common, yet still underdiagnosed.

Infiltrative cardiomyopathy represents specific acquired and inherited diseases characterized by the deposition of abnormal biological substances within the heart tissue that ultimately lead to cardiac dysfunction. **Sarcoidosis** is a multisystem disease characterized by the accumulation of inflammatory cells within various organs, resulting in the pathologic finding of non-caseating granulomas. While steroids remain the cornerstone immunosuppressive treatment, newer immunosuppressive therapies (steroid-sparing treatments) have been evaluated. In **amyloidosis,** the most common forms that infiltrate the heart are AL (light chain) and ATTR (transthyretin cardiac amyloidosis). The latter encompasses two distinct disease states: hereditary or wild-type. In patients with cardiac amyloidosis, abnormal proteins cause increased myocardial thickness and mass. Both diseases can lead to heart failure, arrhythmogenesis, and sudden cardiac death.

(continued on next page)



Tools, technologies, and talent positioned to make a difference.

A fairly common misconception is that these diseases are not treatable. But as Farooq H. Sheikh, MD (pictured page 5, top left), medical director of the Advanced Heart Failure Program in Washington, D.C. and director of the Infiltrative Cardiomyopathy Program explains. "The future has never been brighter when it comes to treatment. These diseases are indeed progressive, but with earlier recognition and detection they can be treated more successfully."

Fortunately, we now have the ability to diagnose these conditions more rapidly. At MedStar Health, we offer advanced imaging, which provides the most reliable method of confirming and staging the disease. Depending on which condition is suspected, our workup may include biopsy of affected organ(s), cardiac MRI, technetium pyrophosphate (PYP) imaging, and whole-body/cardiac FDG-PET imaging. Our imaging specialists have high-volume experience leading to exceptional expertise in interpretation, and positioned our program as the regional leader.

"Prompt diagnosis allows treatment to begin when it is most effective," says W. David Xu, MD (page 4, top right), lead for sarcoidosis in the Baltimore region. "Major evolutions in treatment have occurred over the last decade, with new therapies continuing to emerge."

"New drugs approved by the FDA just a few years ago are changing the trajectory of treatment and improving prognosis of hereditary and wild-type ATTR cardiomyopathy," explains Tolulope Agunbiade, MD (page 4, top left), lead for amyloidosis in the Baltimore region. "The development of phase III randomized clinical trials for ATTR cardiac amyloidosis—the HELIOS B and the CARDIO-TTRansform studies—offer the promise of additional therapies on the horizon."

Opportunities to pursue additional groundbreaking research abound, given our ability to identify patients earlier in the disease process, and thanks to multidisciplinary collaboration.

On top of efforts to directly treat the protein accumulation, inflammation, and other causes of the cardiomyopathy, our ability to treat heart failure-related symptoms has expanded. For example, our cardiac electrophysiology colleagues are engaged when necessary to determine eligibility for pacemaker and/or defibrillator (ICD) therapy. Some amyloidosis patients with aortic stenosis may be evaluated for transcatheter aortic valve replacement (TAVR) by our interventional cardiologists. For patients with advanced heart failure, cardiac transplantation and LVAD therapy may be considered by our advanced heart failure specialists and cardiac surgeons. Throughout the entire experience, we integrate the services of palliative medicine, which has been pioneering care in the heart failure space for many years. With genetic testing and cardiogenetic counseling, family members at risk can be tested, monitored, diagnosed, and treated.

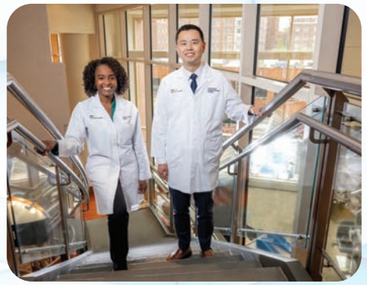
Common barriers to optimal care.

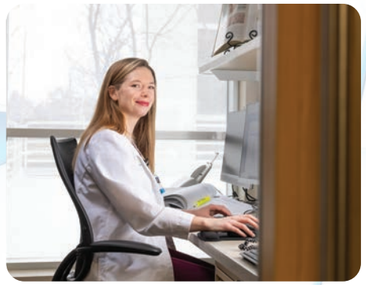
"Without a full, 'whole person' workup, it's not uncommon for patients to only receive treatment for their symptoms, rather than for the disease itself," explains Infiltrative Cardiomyopathy Program Director Johana R. Fajardo, DNP, ANP-BC, FHFSA, CHFN (page 5, top left).

Clinical presentation may be unspecific, since shortness of breath, fatigue, and palpitations can mimic other conditions. The recognition of "red-flag" signs and symptoms (such as bilateral carpal tunnel syndrome) may trigger a more detailed workup toward a confirmative diagnosis, such as cardiac amyloidosis.

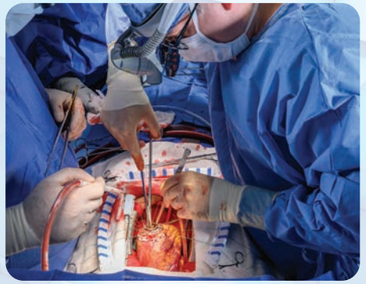
In addition, many geographic areas lack access to advanced imaging or nuclear radiology, making it difficult to obtain a clear diagnosis, even when the possibility is identified. Even if a diagnosis is confirmed, it can be difficult to assemble the appropriate care team. Since clinical presentation may vary, with different organs and systems affected, a patient needs access to a wide range of multidisciplinary clinicians with experience in managing infiltrative cardiomyopathies.

At our program, the infiltrative cardiomyopathy team helps patients overcome these common challenges by expediting diagnostic workup, reducing time from diagnosis to treatment, and managing their wide range of symptoms by providing specialized care within our multidisciplinary team.











A necessary infrastructure for effective treatment.

In order to effectively manage these progressive, multi-organ diseases, patients should be seen at a program with the infrastructure built around their unique needs. "Within our program, we have assembled the full complement of technologies and a multidisciplinary team of experts geared toward giving patients the opportunity of an improved quality of life and improved chance of survival," explains Dr. Sheikh.

Our team includes:

- Heart failure physicians, specialized in infiltrative cardiomyopathy
- Advanced practice providers
- Nurse navigators
- Advanced imaging specialists and technology
- Renowned cardiac electrophysiologists
- Interventional cardiologists on the forefront of all major devices and approaches
- Cardiac surgeons with high-volume expertise in LVADs and transplantation
- A cardiac genetic counselor
- Clinical pharmacists and financial counselors to expedite insurance coverage of new drugs
- Palliative care specialists
- Multidisciplinary teams assembled according to the disease state, and may include rheumatology, pulmonology, neurology, infectious disease, pathology, hematology/oncology, and radiology

Patient wellbeing and advocacy.

We take a comprehensive view of patients, evaluating quality of life and functional capacity. To that end, we host a number of programs for family members and patients with sarcoidosis, ATTR, and AL amyloidosis. As each condition is different, we provide a virtual support group for each, consisting of educators, expert panelists, and various wellness elements.

We also prioritize patient wellness and input through our Patient Advisory Group. As more is being learned about diagnosis and treatment, and patients are living longer with the diseases, we are seeking subjective input on how their acute and long-term care is tolerated.

Early diagnosis saves lives.

PCPs, cardiologists, neurologists, rheumatologists, dermatologists, pulmonologists, and other specialists are in the position to screen for symptoms and encourage a diagnostic workup.

If you suspect your patient may have infiltrative cardiomyopathy, we can work with you to diagnose and co-manage their care. Contact us at:

202-877-4698
(Washington region)

410-554-6550
(Baltimore region)

Washington D.C. providers
Farooq Sheikh, MD
Johana Fajardo, DNP
Nana Afari-Armah, MD
Richa Gupta, MD
Mark Hofmeyer, MD
Ajay Kadakkal, MD
Phillip Lam, MD
Sriram Rao, MD
Maria Rodrigo, MD

Baltimore, Md., providers
Tolu Agunbiade, MD
David Xu, MD
Erika Feller, MD
Sandeep Jani, MD
Mrinalini Krishnan, MD
Samer Najjar, MD

Piecing together the hypertrophic cardiomyopathy puzzle.

With Sandeep Jani, MD, director, HCM Clinic in the Baltimore region, and Andrew Ertel, MD, director, HCM Clinic in the Washington region
(pictured left to right)

Historically, hypertrophic cardiomyopathy (HCM) has been a very troubling diagnosis. Perhaps rightly so, as physicians had relatively few options for treatment in the early eras. Contemporary care is much improved, with diagnostic methods and treatments having evolved tremendously since the disease was initially studied in the 1960s.

Characterized by an abnormal thickening of the heart muscle, HCM can obstruct normal blood flow, causing dyspnea, angina, dizziness, and episodes of syncope. Some HCM patients are at risk for dangerous arrhythmias and sudden death. It is estimated that 1 in 500 people have HCM, but when accounting for silent carriers and asymptomatic patients, the frequency may be greater.

At MedStar Health, we offer a comprehensive approach to patients and families with HCM. Our clinics provide a streamlined pathway for patients that starts with the initial workup and continues for a lifetime. In this context, patients benefit from services, technology, and expertise that are not routinely offered in general practice.

Sophisticated imaging technology and diagnostic expertise.

Though increasingly recognized, HCM remains a challenging diagnosis in certain patients and can be confused with other disease entities. With sophisticated imaging, however, we can identify more subtle disease and less common variants, even in individuals with atypical symptoms.

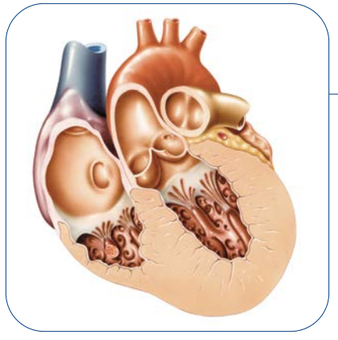
In addition to lab draws, event monitors, and EKGs, our rigorous diagnostic process includes:

- High-quality echocardiogram, which serves as the foundational assessment of cardiac structure and function, and evaluates resting and provocable gradients in cases of obstruction.
- Stress echo, to test for exercise-induced gradients in patients without resting obstruction.
- Cardiac MRI, which offers a more comprehensive assessment of cardiac morphology, can identify less-common variants, and can improve risk stratification for sudden cardiac death by revealing myocardial scarring and apical aneurysms.

It's also important to rule out other causes of LV hypertrophy, such as hard-to-identify amyloidosis and sarcoidosis—a process that requires substantial familiarity with these complex conditions. This is a critical element in managing HCM, and one that only a few very sophisticated programs can provide.

A toolbox of multidisciplinary treatment options.

There are various types of HCM, and therefore various pathways used to attack the problem. Once HCM is confirmed, we take a multi-pronged approach.



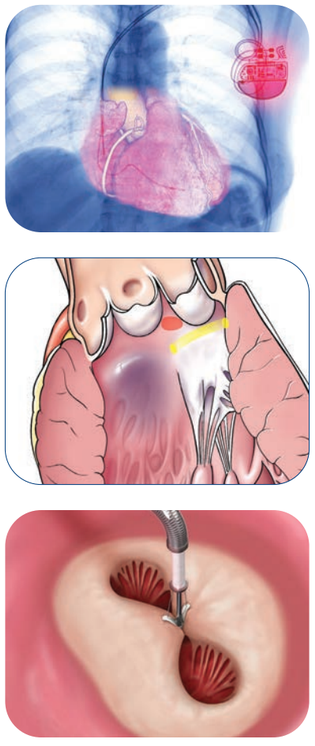
We typically:

- Adjudicate the risk of sudden cardiac death—a continual process as we assess activity levels and moderate intensity in the context of evolving guidelines.
- Start medical therapy. Mainstay treatments (such as beta blockers, calcium channel blockers, and disopyramide) are still effective, but new therapeutics are also emerging.

We now have novel oral medications that specifically target HCM. A new class of myosin inhibitors has been shown to be highly effective in improving symptoms. As of this spring, the FDA has approved mavacamten for adults with symptomatic obstructive hypertrophic cardiomyopathy to help reduce symptoms. Another therapy is currently in trial (we are a participating site), and both options provide a lot of hope for dramatically improved symptoms with fewer side effects, as well as the possibility of changing the trajectory of the disease process.

- Up-titrate according to symptoms, EKGs, blood pressure, and heart rate. We follow this very closely, sometimes every two weeks, to ensure optimal dose is prescribed promptly.
- Evaluate holistically. We assess the patient's comorbidities, such as hypertension and obstructive sleep apnea, and help them access primary care services, nutrition education, and CV disease prevention programming.

Using a model of shared decision-making, we continue to modify the course of treatment. Most patients are successfully managed with beta blockers and calcium channel blockers, along with adjuvant treatment for symptoms, but up to 10 percent may need further interventions. In these cases, we partner with our colleagues from cardiac electrophysiology, interventional cardiology, and cardiac surgery to discuss options and potentially refer patients for:



- Pacemakers and defibrillators
- Interventional options, such as alcohol septal ablations
- Surgical options, such as a MitraClip or myectomy

Cardiogenetic testing and counseling.

Genetic testing is incredibly advantageous for patients and families—in terms of diagnostics and of treatment. Sometimes, it can be helpful in diagnosing the patient or finding other rare conditions that mimic HCM. The largest benefit really sits with the families. In patients with a genetic mutation causing HCM, there is a 50 percent chance of passing it to offspring, and usually a slew of family members are affected. Our patients are encouraged to take advantage of our simple at-home testing process and are always connected with our cardiogenetic counselor for comprehensive explanation and result interpretation. Family members should start to undergo clinical screening in early adolescence, with a visit to their cardiologist that includes a simple history and physical, as well as an EKG and echocardiogram. Although the inception of cardiac hypertrophy tends to occur in young adulthood, patients typically don't present until their 50s or 60s. The earlier we can find the condition, the better the outcomes—genetic testing is one critical key to doing this.

(continued on next page)

Nuanced care for "athletic" hearts.
Our Sports Cardiology Program, one of only a few in the United States, offers a unique element for HCM management. Since athletic hearts may bear some similarities to pathologic hearts and need nuanced care, we frequently draw on the niche skillset of Ankit B. Shah, MD (pictured above), director of MedStar Health Sports & Performance Cardiology, whose expertise is in co-managing the activities of athletic patients.

Renowned heart failure program.
Since some patients with HCM progress to the point of heart failure—usually with preserved ejection fraction (HFpEF), though some may develop a reduced EF—our advanced heart failure specialists are integrated in the care plan, as needed. The severity of heart failure symptoms may vacillate, so these specialists continue to follow the patients and co-manage care throughout their lives.

Robust resources to support a lifetime of patient care.
Even after interventional or surgical treatment, patients still have HCM and need to be followed for the rest of their lives. Constant optimization of medical therapy, consideration of symptoms, and repeat imaging must persist. We also take care of AFib, apical aneurysms, or other risks of stroke that require anticoagulation. New guidelines are refined regularly, so we must be nimble and responsive to improvements in therapeutic options.

An optimistic outlook.
With comprehensive management and surveillance by a program like ours, life expectancy for a person with HCM can be normal. With early intervention, the risk of dangerous arrhythmias can be mitigated and other symptoms managed successfully.

Key practice takeaways.

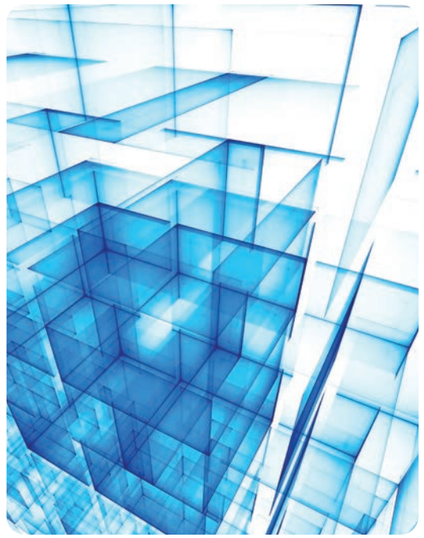
HCM is more common than traditionally thought.

Along with assessing family history, be alert for symptoms including dyspnea, angina, syncope episodes, palpitations, or dizziness.

If your evaluation is suggestive of HCM, please contact us for a diagnostic workup.

Baltimore:
410-554-6550

Washington:
202-877-7777



Norma Flores, DNP, CRNP, AGACNP, serves as the lead nurse practitioner for the Hypertrophic Cardiomyopathy Clinic. She manages patient care, from initial diagnosis through long-term follow up. In addition, she recently received the distinguished appointment of regional educator for the HCM Academy. In this role, she works to increase awareness and knowledge of the disease among clinicians. For more information or to request education materials, please contact her at **norma.flores@medstar.net.**

Case Study

Recurrent chest pain after COVID-19:
Diagnostic utility of cardiac MRI.

Singh M, Mehta N, Hayat F, Soria CE, Hashim H, Satler LF, Barac A.
CJC Open. 2022 Jan;4(1):100-104. doi: 10.1016/j.cjco.2021.08.003.

A collaboration, in part, among our MedStar Health cardiologists, this recently published article reports a case of myocarditis in an adult patient with recent coronavirus disease 2019 (COVID-19) infection presenting as recurrent ST-segment elevation, mimicking coronary vasospasm. This case highlights the wide range of presentations of COVID-19-related myocarditis. The novel teaching point is that COVID-19 myocarditis can present with acute manifestations such as chest pain and transient ST-segment elevation even several weeks after complete recovery from the initial infection. Cardiac magnetic resonance imaging should be considered in patients with chest pain syndromes and angiographically normal coronary arteries, as the presence of late gadolinium enhancement and a high T2 signal can be diagnostic. Follow-up cardiac magnetic resonance imaging may be used to assess resolution.

A 25-year-old man with a history of mild coronavirus disease-2019 (COVID-19) infection, characterized by a low-grade fever and malaise for several days, with complete recovery 6 weeks prior, presented to the emergency room with intermittent episodes of substernal chest pain, with radiation to both arms. He denied diaphoresis and shortness of breath. On initial evaluation, the patient was awake and conversant, with a heart rate of 82 beats per minute, blood pressure of 131/73 mm Hg, a temperature of 36.4°C, and an oxygen saturation of 100% on room air. While in the emergency room, he experienced another episode of similar chest pain. An electrocardiogram (ECG) performed during the episode demonstrated normal sinus rhythm with 1-mm ST-segment elevations in leads II, III, and aVF, without reciprocal changes **(Fig. 1a).** Initial laboratory workup was significant for a positive COVID-19 polymerase chain reaction test, elevated high-sensitivity troponin (hs-troponin) level of 10,739 ng/L (normal: < 34 ng/L), and an elevated high-sensitivity C-reactive protein (CRP) level of 27.1 mg/L (normal: < 3 mg/L). A repeat ECG a few minutes after the initial ECG showed normal sinus rhythm with resolution of the ST-segment changes **(Fig. 1b).**

Etiologies of chest pain with ST-segment elevation and elevated troponin level include ST elevation myocardial infarction (STEMI), myocarditis, perimyocarditis, coronary vasospasm (such as that secondary to illicit drug use), and stress cardiomyopathy. The patient was treated with aspirin at 325 mg, ticagrelor at 180 mg, and intravenous heparin, and he underwent emergent left heart catheterization (LHC), which demonstrated angiographically normal coronary arteries, with subsequent transfer to the intensive care unit for observation. Dihydropyridine calcium-channel blocker was started for suspicion of coronary vasospasm.

Further tests, including a urine drug screen, were negative. His hs-troponin levels were serially followed and peaked at 14,122 ng/L without chest pain recurrence. An echocardiogram demonstrated a normal left ventricular ejection fraction of 55%-60%, without wall-motion abnormalities. Within 30 hours, the patient developed another episode of chest pain, with ECG demonstrating recurrent ST-segment elevations in leads II, III, and avF **(Fig. 1c).** The hs-troponin level rose to

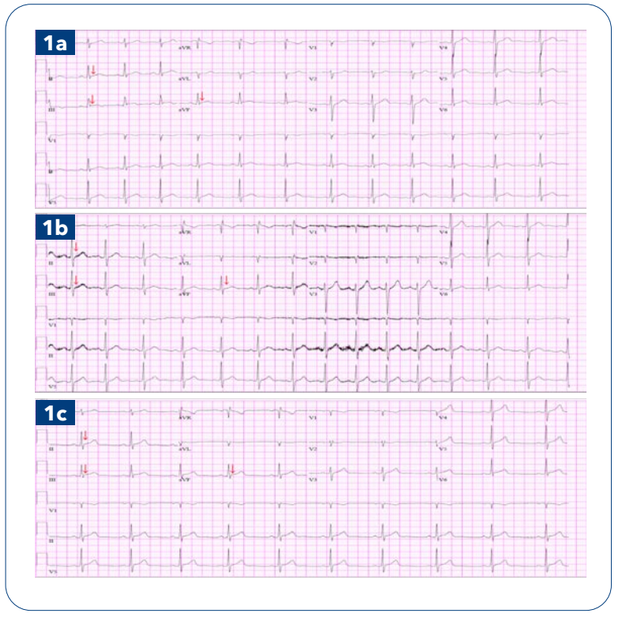


Figure 1: (1a) Electrocardiogram (ECG) results demonstrate ST-segment elevation in the II, III, and aVF leads on presentation. (1b) Repeat ECG demonstrates resolution of ST-segment elevation. (1c) ECG at time of recurrence of chest pain shows ST-segment elevation in the II, III, and aVF leads.

18,235 ng/L. A repeat LHC was performed along with optical coherence tomography (OCT; Abbott, Abbott Park, IL) and combined near-infrared spectroscopy and intravascular ultrasound (NIRS-IVUS; Abbott, Abbott Park, IL). Both NIRS-IVUS **(Fig. 1d)** and OCT **(Fig. 1e)** of right coronary artery

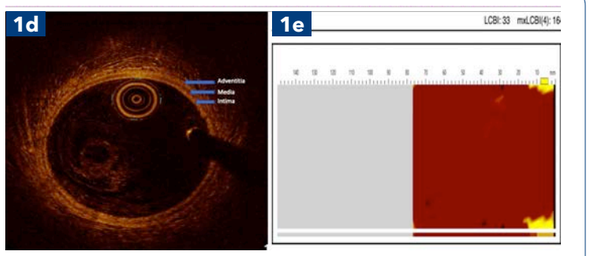


Figure 1: (1d) Combined near-infrared spectroscopy and intravascular ultrasound demonstrates minimal lipid burden. (1e) Optical coherence tomography shows normal right coronary artery.

showed normal intravascular morphology with minimal lipid burden. Cardiac magnetic resonance (CMR) imaging demonstrated predominantly subepicardial enhancement of the basal to mid inferolateral wall and the apical lateral wall **(Fig. 2, A and B)**, suggestive of myocarditis. The enhancement also included pericardium adjacent to the affected myocardium, suggestive of concomitant pericardial involvement and myopericarditis. The T2 signal **(Fig. 2, C and D)** was increased to 77 ms (for our clinical reference range, the value of 45 ± 6 ms is used for abnormal values, consistent with the Society for Cardiovascular Magnetic Resonance recommendation[1] in the lateral wall, indicating presence of edema and acute inflammation. There was mild left ventricular systolic dysfunction (left ventricular ejection fraction: 52%) with mild hypokinesis of the lateral wall of the left ventricle, corresponding to the late gadolinium enhancement (LGE) and increased T2 signal. Serial hs-troponin levels continued to downtrend, and the patient remained free of chest pain. The patient was discharged with a recommendation to refrain from high-level physical activity and to follow-up in an outpatient clinic for a repeat CMR. At a 6-week follow-up clinic visit, the patient denied any recurrence of symptoms, with laboratory work showing an hs-troponin level of 10 ng/L. A repeat CMR performed at that time showed interval resolution of the T2 signal **(Fig. 2, E and F)** and a minimal qualitative decrease in the extent of LGE **(Fig. 2, G and H)** in the involved segments, suggesting resolution of the acute/subacute phase of myocarditis, with residual fibrosis.

Discussion

Cardiac catheterization of COVID-19 patients presenting with ST-segment elevation has shown a variety of findings, ranging from obstructive coronary artery disease to angiographically normal coronary arteries.[2] This is, to our knowledge, the first reported case in the literature of COVID-19 myocarditis presenting late after initial COVID-19 infection with transient and recurrent ST-segment elevation. Our patient was young, without cardiovascular risk factors, and had a history of complete recovery from mild COVID-19 infection 6 weeks prior to presentation. LHC demonstrated normal coronary arteries; OCT and NIRS-IVUS excluded occult plaque/coronary artery dissection and confirmed normal coronary arteries, including the right coronary artery. In this setting, he was referred for CMR imaging for further evaluation of the myocardial injury. Of note, the diagnostic algorithm used in this patient has been used in a published trial that

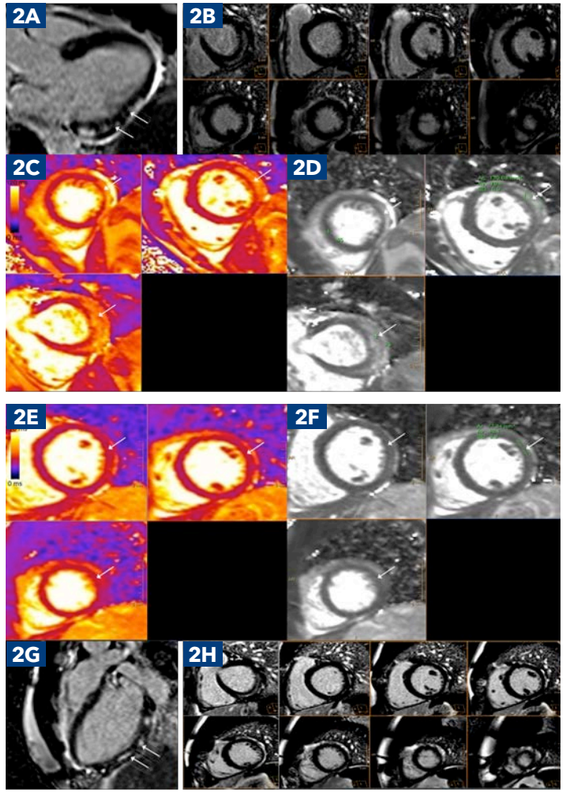


Figure 2: Cardiac magnetic resonance (CMR) imaging on 1.5T. (A, B) Late gadolinium enhancement imaging in (A) 3-chamber view and (B) short-axis view shows areas of patchy, mid to epicardial enhancement in the basal, mid, and apical lateral and inferolateral wall. (C, D) T2 maps in the short-axis projection show prolonged T2 relaxation times in the anterolateral and lateral wall, consistent with edema. For our clinical reference range, the value of 45 ± 6 ms is used for abnormal values consistent with the Society for Cardiovascular Magnetic Resonance recommendation.[1] Follow-up cardiac magnetic resonance on 1.5T. (E, F) Late gadolinium enhancement imaging in 3-chamber- and short-axis view shows small interval decrease in late gadolinium enhancement. (G, H) T2 maps in the short-axis projection show resolution of the previously increased T2 signal. For our clinical reference range, the value of 45 ± 6 ms is used for abnormal values, consistent with the Society for Cardiovascular Magnetic Resonance recommendation.

demonstrated the utility of sequential OCT and CMR in patients with myocardial infarction with normal coronary arteries (MINOCA).[3] Parametric imaging (myocardial mapping) is of particular interest in the diagnosis of myocarditis, and elevated T2 values, in addition to T1 parameters, are part of the CMR consensus criteria for nonischemic myocardial inflammation.[4] In our patient, the abnormal T2 signal indicating myocardial edema of the inferolateral wall, and LGE with subendocardial sparing, pointed to acute myocarditis as the underlying mechanism. In absence of other known causes of myocarditis, including vaccination, COVID-19 infection remained the most likely etiology.

Most reported cases of COVID-19 myocarditis describe myocarditis at the time of active infection[5]; however, in our case, the patient presented 6 weeks after recovering from mild COVID-19 infection. The treatment for COVID-19 myocarditis remains uncertain, with options including corticosteroids, interleukin-6 inhibitors, and antivirals. Given his clinical improvement and the lack of data on the use of immunosuppressive therapy, our patient was treated supportively with plans for follow-up CMR imaging as an outpatient. He was additionally advised to restrict physical activity for 3 to 6 months, a recommendation consistent with the American Heart Association/American College of Cardiology scientific statement on myocarditis.[6] Our findings of residual LGE on follow-up CMR imaging, several months after the acute myocarditis have been previously described in non-COVID-19 myocarditis.[7] Although baseline LGE represents a known predictor of cardiac mortality, the long-term impact of persistent LGE on cardiac events during follow-up remains uncertain.[8] Further study is needed to determine whether COVID-19 myocarditis has similar outcomes, compared with myocarditis from other causes.

Conclusion

COVID-19 myocarditis is highly variable in presentation. We report a case of COVID-19 myocarditis developing 6 weeks after initial COVID-19 infection and presenting with transient and recurrent inferior ST-segment elevation, mimicking coronary vasospasm. This case demonstrates the clinical utility of CMR imaging in the diagnosis of myocarditis in the setting of an atypical presentation. The clinical course in this case was mild, and the patient improved with supportive management.

References

1. Wiesmueller M., Wuest W., Heiss R.,et al. **Cardiac T2 mapping: robustness and homogeneity of standardized in-line analysis.** *J Cardiovasc Magn Reson.* 2020; **22**: 39
2. Bangalore S., Sharma A., Slotwiner A., et al. **ST-segment elevation in patients with covid-19–a case series.** *N Engl J Med.* 2020; **382**: 2478-2480
3. Reynolds H.R., Maehara A., Kwong R.Y., et al. **Coronary optical coherence tomography and cardiac magnetic resonance imaging to determine underlying causes of myocardial infarction with nonobstructive coronary arteries in women.** *Circulation.* 2021; **143**: 624-640
4. Ferreira V.M., Schulz-Menger J., Holmvang G., et al. **Cardiovascular magnetic resonance in nonischemic myocardial inflammation: expert recommendations.** *J Am Coll Cardiol.* 2018; **72**: 3158-3176
5. Siripanthong B., Nazarian S., Muser D., et al. **Recognizing COVID-19-related myocarditis: the possible pathophysiology and proposed guideline for diagnosis and management.** *Heart Rhythm.* 2020; **17**: 1463-1471
6. Maron B.J., Udelson J.E., Bonow R.O., et al. **Eligibility and disqualification recommendations for competitive athletes with cardiovascular abnormalities: task force 3: hypertrophic cardiomyopathy, arrhythmogenic right ventricular cardiomyopathy and other cardiomyopathies, and myocarditis: a scientific statement from the American Heart Association and American College of Cardiology.** *Circulation.* 2015; **132**: e273-e280
7. Berg J., Kottwitz J., Baltensperger N., et al. **Cardiac magnetic resonance imaging in myocarditis reveals persistent disease activity despite normalization of cardiac enzymes and inflammatory parameters at 3-month follow-up.** *Circ Heart Fail.* 2017; **10**: e004262
8. Grün S., Schumm J., Greulich S., et al. **Long-term follow-up of biopsy-proven viral myocarditis: predictors of mortality and incomplete recovery.** *J Am Coll Cardiol.* 2012; **59**: 1604-1615


Manavotam Singh, MD


Neil Mehta, MD


Fatima Hayat, MD


Cesar Soria, MD


Hayder Hashim, MD


Lowell Satler, MD


Ana Barac, MD

Diagnosing coronary microvascular dysfunction (CMD):

A new solution to an old problem.

Nearly 10 million Americans have angina pectoris, with approximately 500,000 new cases diagnosed each year. Like the proverbial canary in the coal mine, the condition is often a warning sign of worse troubles ahead—heart failure, stroke, myocardial infarction, and death.

While many cases of angina have a common cause—atherosclerosis—a surprising number do not, leading to repeated testing, ineffective therapy, and, in the absence of a definitive diagnosis and care plan, patient distress and dissatisfaction.

The culprit is often coronary microvascular dysfunction (CMD), a condition that is not yet fully understood, although an estimated 50 percent of all angina cases are now attributed to it. Women account for the majority of incidences (see sidebar). Yet differentiating CMD has remained elusive.

MedStar Heart & Vascular Institute recently became one of only a few programs in the nation to acquire the Coroventis CoroFlow™ Cardiovascular System: an advanced, software-based platform that, along with a special companion guidewire, can effectively measure the workings of the heart's tiniest blood vessels—a feat beyond the capabilities of standard CT and coronary angiogram.

"For the first time, we now have the ability to correctly diagnosis and then treat coronary microvascular dysfunction," says Hayder Hashim, MD, an interventional cardiologist at MedStar Washington Hospital Center. "As such, this innovative approach has the potential to help us prevent subsequent damage, improve quality of life, and reduce mortality."

A patient presenting with severe angina typically first has a stress test and then, if results are abnormal, a cardiac catheterization. If obstructed coronary arteries are found, the problem can be resolved, fully or partially, by stenting or coronary artery bypass grafting.

In the absence of significant atherosclerosis, however, therapeutic options are not as clear.

"Long-acting nitrates and vasodilators have been the medical mainstay for chronic or unspecified angina for decades," explains Dr. Hashim. "Yet new evidence suggests that they may not work on the heart's microvascular system the same way they do on larger vessels. As a result, CMD patients still experience angina, even after following a medical regimen."

(l to r) Interventional cardiologists Itsik Ben-Dor, MD, Brian Case, MD, and Hayder Hashim, MD, are using new technology to diagnose and treat coronary microvascular dysfunction.

That lack of resolution prompts a cycle of more visits to the emergency department, more hospitalizations, more testing, and—in the end—the same inconclusive results, frustrating physicians and patients alike.

"When multiple studies repeatedly return the same negative results, patients with coronary microvascular dysfunction often feel dismissed by their doctor, like it's 'all in their head,'" says Brian Case, MD, an interventional cardiologist at MedStar Southern Maryland Hospital Center. "Yet they know their pain is real, regardless of the lack of medical evidence. And that leaves them worried, unhappy, and even distrustful of the medical system."

For their part, physicians are frustrated by their inability to provide optimal care for their patients.

The new CoroFlow platform should help both parties get the answers they seek.

The assessment begins with a coronary angiogram, followed by threading the platform's PressureWire™ X through the left anterior descending artery. Once in place, the wire can measure a variety of physiologic indices, which the CoroFlow software then translates into measurements of coronary flow reserve and microcirculatory resistance. The CMD assessment can be applied to anyone undergoing a cardiac catheterization or coronary angiogram.

After a diagnosis, CMD patients are returned to their referring physician for ongoing management.

The CoroFlow system is a young technology, with optimal results dependent upon the skill and experience of the operators. Drs. Hashim, Case, and interventional cardiologist Itsik Ben-Dor, MD, are the only specialists in the area to offer the approach, performing 120 of the novel, comprehensive procedures since its MedStar Health debut in August 2021. They are also creating a CMD registry to follow patients long-term and further advance understanding of the disease.

"We are now able to deliver referring physicians the evidence they need to provide optimal care, and to give CMD patients the reassurance and validation they deserve," concludes Dr. Case.

CMD presents unique risks for women.

For reasons that remain unclear, up to half of all women with severe angina have coronary microvascular dysfunction (CMD). But this much is clear: CMD in women is more often a precursor to myocardial infarction, stroke, congestive heart failure, and coronary death than it is in men, who only account for an estimated 30 percent of all CMD diagnoses in the United States.

To advance clinical understanding of the condition and how it affects women, MedStar Georgetown University Hospital recently became one of 80 sites to participate in the nationwide WARRIOR trial. M. Barbara Srichai-Parsia, MD (pictured above), vice chair of Cardiology and director of the Non-Invasive Cardiology Lab at MedStar Georgetown, serves as the site's principal investigator.

"Through this study, we hope to gather enough data to inform the development of evidence-based guidelines for treating ischemia in women with non-obstructive CAD," says Dr. Srichai-Parsia, who is also medical director for MedStar Health's Women's Heart Health Program. "The ultimate goal is to reduce the incidence and severity of CMD and improve quality of life."

Dr. Srichai-Parsia is currently recruiting women with unexplained ischemia and non-obstructive CAD blockage for the study.

For more information, contact Deja Bell at 202-444-6619.

Eight procedures and seven weeks of treatment restore full function to man with acute aortic dissection while positive for COVID-19.

At 31 years old, Baltimore native Christopher Stanley was still young, strong, and healthy, holding down two full-time jobs to help support his teenage daughter and mother. So on November 18, 2020, Christopher followed his usual routine, squeezing in a short nap between finishing his job at a nearby casino and starting his shift at the docks. But that day turned out to be anything but routine.

"At home, I felt a tightness in my chest and back, then a bad tingling in my legs," the former college football player says. "I just knew something was wrong, so I called 911."

Christopher was rushed to MedStar Union Memorial Hospital where he would remain for the next seven weeks.

A ticking time bomb.

"Christopher's legs were weak and getting worse by the minute, without any apparent cause," says Raghuveer Vallabhaneni, MD, director of Vascular Surgery in the Baltimore region. "His blood pressure was 228/102; his kidney values were off. Given his chest and back pain, and decreased pulses in his legs, I was quite concerned that he might have an aortic dissection."

A CT angiogram confirmed Dr. Vallabhaneni's suspicions. Christopher, indeed, had an aortic dissection that was cutting off blood flow to his lower body. Compounding matters, he also tested positive for COVID-19.

"Within an hour of his arrival, Christopher's legs were paralyzed, and his kidneys, intestines, and legs were ischemic," says Dr. Vallabhaneni, an expert in the treatment of complex aortic disease. "He was going downhill fast, right in front of our eyes."

Armed with a clear diagnosis and faced with an emergent situation, Dr. Vallabhaneni first placed a thoracic stent in Christopher's aorta, covering his left subclavian artery and vertebral artery. With the entry tear of the dissection now sealed down to the level of the celiac artery, blood flow returned to Christopher's compromised kidneys, mesenteric vasculature, and aorta.

But blood flow to Christopher's left leg, the more severely affected, was still cut off, requiring another stent in his left common iliac artery. Given the prolonged ischemia to the legs and subsequent swelling, Dr. Vallabhaneni also performed bilateral lower leg fasciotomies to prevent further muscle death from the development of compartment syndrome.

"Because of Christopher's COVID diagnosis, the initial surgery was expedited to get him to the ICU as soon as possible to recover," Dr. Vallabhaneni explains. "Once there, we placed a spinal drain to reduce spinal cord swelling."

Then Dr. Vallabhaneni and his team closely monitored their patient for function to return to his legs. Four days later, when Christopher was awake enough to follow commands, he could only slightly move his right toes. His left arm was also ischemic from covering the subclavian artery.

"Given the amount of aorta that needed to be covered to repair his dissection, I thought the only way to give him a chance to recover neurologic function was to optimize collateral blood supply," says Dr. Vallabhaneni.

"But there was another twist: Christopher's vertebral artery came off his aortic arch instead of subclavian artery, an anomaly that only affects about eight percent of the population. As a result, I had to perform both a carotid-subclavian bypass and a vertebral artery transposition to augment blood flow to his spine."

Slowly, Christopher started to regain motor function in his right leg and minor motion in his left foot. However, he still had to undergo multiple debridements, followed by skin grafts to close his leg wounds. Because of the injury to his kidneys, he required dialysis as well.

Director of Vascular Surgery, Baltimore region, Raghuveer Vallabhaneni, MD

A full recovery against the odds.

All in all, Christopher underwent eight different operations during his stay at MedStar Union Memorial Hospital. He was discharged on January 8, 2021, and transferred to MedStar National Rehabilitation Hospital where he underwent two additional months of rehabilitation regaining strength and relearning ambulation.

Today, Christopher is back home, walking unaided, swimming, jogging, and even sparring with an old buddy. His hypertension is now controlled, his kidney function improved, and he is no longer on dialysis. He has given up cigarettes and alcohol, and is being worked up for connective tissue disorder. While he plans to return to work, his days of holding down two full-time, physically demanding jobs are gone.

"I can't do a lot of standing like I did before," Christopher says. "Basically, I'm still getting my sea-legs back. But I'm making progress day by day. And I'm so grateful to be alive, thanks to God, Dr. V., and the whole team at MedStar Union Memorial. No one ever gave up on me."

Adds Dr. Vallabhaneni, "Christopher was so, so sick, that I honestly thought his chance of full recovery of his legs was only one to two percent. Had he gone to another facility without the experience and ability to handle such a complex case, he may not be alive today…particularly if there was a long delay in transfer. But through his own perseverance and the team's expertise, he's living his life again."

THE 25TH ANNIVERSARY CRT22

Join us next year!
Feb. 25-28, 2023
Omni Shoreham Hotel
Washington, DC

After nearly two years of virtual medical meetings, Cardiovascular Research Technologies (CRT) became the first major cardiology meeting to resume a fully in-person format since the pandemic began. The Omni Shoreham Hotel, a familiar venue to which the meeting returned, provided a vibrant setting for learning, sharing, training, and connecting with colleagues from around the globe.

The annual meeting features focused educational and training sessions that discuss new clinical trial data, explore evidence-based research, and demonstrate the most up-to-date techniques that can be directly applied to clinical and academic practice. Concurrent meetings are conducted in six main areas of interest—coronary, valve and structural, endovascular, technology and innovation, atherosclerosis and research, and nurses and technologists.

Keynote speaker Benjamin Carson, MD, (left) former U.S. Housing and Urban Development Secretary, touched on several subjects in a wide-ranging interview with CRT 2022 Course Chairman Ron Waksman, MD, including the need for more diversity in medical education.

Keynote speaker Deborah L. Birx, MD, former White House Coronavirus Response Coordinator, shared details about her time in the role, as well as her perspective on the current state of COVID-19.

Remarks by keynote speaker Stephen Hahn, MD, former U.S. Commissioner of Food and Drugs, included an extensive discussion of the global spread of COVID-19 and the development of tests, therapeutics, and vaccines.

Attendees enjoyed the return of the popular Women and Heart Disease Symposium, during which Rosanna Chan, PhD, the recently retired chief physicist in the Radiation Oncology Department at MedStar Washington Hospital Center, received the CRT Lifetime Achievement Award.

As part of the coverage of late-breaking trial results, David E. Kandzari, MD, presented 5-year results of the BIOFLOW-V trial.

The Chronic Total Occlusion (CTO) Academy started with a live case of a patient with CTO and heart failure from MedStar Washington. Later, several presenters described a number of techniques for the antegrade approach to treating CTOs.

Azeem Latib, MD, of Montefiore Medical Center, won the Best Innovation Competition for the NeoChord Transcatheter NeXuS System, a device designed for transfemoral mitral valve repair.

For the first time, the longstanding FDA Town Hall, with participation by the U.S. Food and Drug Administration and Centers for Medicare and Medicaid Services, was held virtually.

Please visit CRTmeeting.org for full coverage of the event.

Welcome new physicians.

Aiman Alassar, MD, PhD, is a board-certified cardiothoracic surgeon at MedStarWashington Hospital Center and serves as the associate director of the heart transplant program.

Dr. Alassar's clinical focus encompasses the full spectrum of cardiothoracic conditions and treatment approaches, including: heart transplantation; left ventricular assist device implants; extracorporeal membrane oxygenation; complex CABG, including total arterial and coronary revascularization; aortic valve replacement; major aortic surgery, including aortic root replacement, valve-sparing aortic root replacement, ascending aorta and arch replacement; mitral valve repair/replacement; minimally invasive surgery; and complex reoperative cardiac surgery. Just prior to joining MedStar Health, Dr. Alassar practiced at Stanford University Hospital.

Education and training:

- **PhD:** University of London, London, UK
- **Fellowships:**
  Cardiothoracic Transplantation and Mechanical Circulatory Support, Royal Papworth Hospital, Cambridge, UK;
  Minimally Invasive Surgery, St Antonius Hospital, Utrecht, Netherlands
- **FRCS:** Fellow of the Royal College of Surgeons of England, UK
- **Clinical training:** Wessex Deanery Hospitals, UK
  Diploma in Surgical Sciences: University of Edinburgh, UK
- **Medical school:** Tishreen University, Syria

Salman M. Malik, MD, is a cardiologist practicing at MedStar Health in Glen Burnie, Maryland. He is board certified in cardiovascular disease.

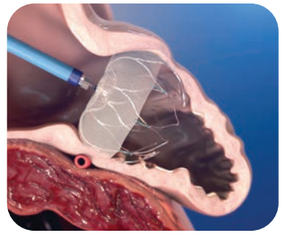
Dr. Malik commonly sees patients with the full range of cardiovascular conditions, and offers diagnostic and imaging expertise with the use of echocardiography and nuclear stress testing. He has a special interest and advanced training in arrhythmia evaluation and management. His clinic provides support for patients with pacemakers and implantable cardioverter defibrillators.

Education and training:

- **Fellowships:**
  Clinical Cardiac Electrophysiology, Drexel University College of Medicine, Philadelphia, Pennsylvania
  Cardiovascular Disease, Drexel University College of Medicine
- **Residency:** Internal Medicine, Drexel University College of Medicine
- **Medical School:** Ross University School of Medicine, Miramar, Florida

News and notes.

MedStar Health performs more than 700 WATCHMAN™ procedures, becoming the first in the Greater Washington-Baltimore region to achieve the milestone.



Cardiac Electrophysiologist Manish Shah, MD, performing a WATCHMAN™ procedure.

MedStar Health physicians have performed more than 700 implantations of the WATCHMAN™ device, which reduces stroke risk in patients with atrial fibrillation (AFib). Both MedStar Washington Hospital Center in Washington, D.C., and MedStar Union Memorial Hospital in Baltimore, Md., offer WATCHMAN therapy.

"WATCHMAN technology has been shown to be a safe and effective alternative to blood-thinning medications in patients with AFib that is not caused by a heart valve problem. It is particularly valuable to patients who have a reason to avoid blood thinners," said Cardiac Electrophysiologist Manish Shah, MD, director of the Cardiac Electrophysiology Fellowship Training Program at MedStar Washington Hospital Center.

John Wang, MD, chief of the Cardiac Catheterization Laboratory at MedStar Union Memorial, adds, "When we started implanting the WATCHMAN, there were certain criteria that had to be met to qualify a patient for the procedure. The technology has continued to improve since then, with five sizes available now, allowing us to treat very small and very large left atrial appendages."

The WATCHMAN implant blocks the left atrial appendage (LAA), an area of the heart where thrombus forms in patients with AFib. The device prevents clots from forming and/or entering the bloodstream, thereby reducing stroke risk and enabling patients to stop anticoagulants. WATCHMAN devices have been implanted in more than 150,000 patients worldwide. The procedure is performed in about an hour under general anesthesia. Patients spend one night in the hospital and are typically discharged the next morning.

The field is advancing rapidly. The new generation WATCHMAN FLX™ device is an updated design accomodating different-sized orifices, promoting the best long-term outcomes. In 2015, MedStar Washington was the first hospital in the national capital region to implant the WATCHMAN device successfully.

To refer a patient, call 202-877-7685 (Washington) or 410-554-2332 (Baltimore).

Cardiac surgeon finishes a half marathon with his heart transplant patient.

Following her heart transplant surgery in early 2020, Jayde Kelly, an avid runner, asked her surgeon, Ezequiel Molina, MD, to run a half marathon with her. Dr. Molina, surgical director of the VAD and Heart Transplantation program, had never run 13.1 miles before but accepted the challenge. Jayde and Dr. "Zeke" spent several months training, and finished their half marathon together last November, crossing the finish line hand-in-hand.

Dr. Michael Fiocco retires after 24 years of dedicated service.

Michael Fiocco, MD, former chief of cardiac surgery at MedStar Union Memorial Hospital, has retired after more than 24 years of exceptional service. He was both highly respected by his peers for his collegiality and expertise, and greatly beloved by his patients for his kindness. Under his steady and dependable guidance, the cardiac surgery program earned a coveted three-star rating for coronary artery bypass grafting (CABG) and CABG + AVR procedures from the Society of Thoracic Surgeons, positioning the cardiac surgery team in the top seven percent of high-performing hospitals nationwide.

"We are grateful to Dr. Fiocco for his unwavering focus and commitment to his patients and colleagues at MedStar Union Memorial Hospital, as well as his significant contributions to the field of cardiac surgery," says Stuart F. Seides, MD, physician executive director, MedStar Heart & Vascular Institute. "Throughout his time in leadership, Mike was truly a rock of stability within our program, and he leaves a legacy of compassionate, high-quality care upon which we continue to build."

Dr. Fiocco's wide range of surgical skills were instrumental in treating many patients with complex pathology, particularly those with aortic and valvular heart disease. Over his tenure, he served as a primary or secondary investigator on several research studies, including those that evaluated the usage of coronary artery stents versus bypass surgery for obstruction of the left main coronary artery. His collaborative work also facilitated the expansion of transcatheter aortic valve replacement (TAVR) use from high-risk to lower-risk patient populations.

MedStar Health

110 Irving St., NW
Washington, DC 20010

Non-Profit
Organization
U.S.Postage
PAID
MedStar
Washington
Hospital Center

Cardiovascular Physician is a publication of MedStar Health. It is a forum to share clinical, research, and teaching information in cardiology, cardiac surgery, and vascular care.

Please submit any comments to Managing Editor Karoline Hutson, at **karoline.m.hutson@medstar.net.**

Department of Continuing Professional Education

Please visit **MedStar.Cloud-CME.com** for updated conference information, or call **202-780-1655.** CE transcripts are available online. You can download, print or e-mail your CE transcript. Visit **CME.MedStarHealth.org** and click on **"View Your CE Transcript"** for complete instructions.

Upcoming conferences and courses

DMV Cath Lab Case Review

Second Thursday of each month
7:15 p.m., Virtual

Colleagues from hospitals in D.C., Maryland, and Virginia engage in thought-provoking conversation regarding unique, interventional cardiology case reviews.

To request an invitation, please email **lowell.f.satler@medstar.net.**

CRTvirtual Fellows Course

Saturdays, July 9 through 30
9 a.m. to noon, Virtual

This 4-week interactive course will highlight live cases and hands-on demonstrations of topics including access closure, stent management, atherectomy, and in-depth imaging and physiology.

Register at CRTVirtual.org.

Mastering Cardiac and Vascular Complications (MCVC)

August 5 and 6
Yours Truly Hotel, Washington, DC

This case-based course will provide a venue for fellows to review challenging complications in cases of coronary, structural heart, and endovascular procedures. Participants can engage with experts to acquire the knowledge set needed in the rescue and "bailout" of complications resulting from cardiac and vascular procedures. This course will consist of didactic lectures, case presentations, and panel discussions, as well as simulation sessions to allow fellows the opportunity for hands-on experience with the equipment needed.

Register at MCVCMeeting.org.

Regularly scheduled series–*AMA PRA Category 1 Credit(s)™*

Cardiac Catheterization Conference
Weekly, Wednesdays, 7:30 a.m.
1 AMA PRA Category 1 Credit™
202-877-7808

Cardiac Surgery Grand Rounds
Weekly, Tuesdays, 7:15 a.m.
2 AMA PRA Category 1 Credits™
202-877-3510

Cardiology Grand Rounds
Weekly, Tuesdays, 12:30 p.m.
1 AMA PRA Category 1 Credit™
202-877-9090

Cardiac Ultrasound and Advanced Imaging Conference
Weekly, Thursdays, 7:30 a.m.
1.25 AMA PRA Category 1 Credits™
202-877-6264

Electrophysiology Core Curriculum Conference
Weekly, Tuesdays, 7 a.m.
1 AMA PRA Category 1 Credit™
202-877-3951

Visit us at **MedStarHealth.org/Services/Heart-and-Vascular.**

Some of the photos in this publication were taken prior to the COVID-19 pandemic. Photo editing techniques were used to create some group photos. All patients and providers are expected to follow the current MedStar Health guidelines for safety including proper masking and physical distancing where appropriate. Learn more at **MedStarHealth.org/Safe.**