

[00:00:00] **Stephen Calabria:** From the Mount Sinai Health System in New York City, this is Road to Resilience, a podcast about facing adversity. I'm Stephen Calabria. In today's episode, we're delving into matters of the heart.

[00:00:13] We're joined by Marc Miller, MD, a pioneering cardiologist and electrophysiologist, as well as an associate professor of cardiology at the Icahn School of Medicine in Mount Sinai. Dr. Miller shares his experiences in treating heart attack and cardiac arrest victims, as well as his and his Mount Sinai colleagues' research into a heart disease that affects millions worldwide.

[00:00:34] Arrhythmic mitral valve prolapse is a disease in which the valve between the heart's left atrium and left ventricle functions abnormally and can lead to cardiac arrest, even in asymptomatic patients.

[00:00:44] The condition has received a lot of attention recently and has been the focus of national news programs in part because of a tragic, high profile case that spurred the nation's policymakers and scientists to action.

[00:00:57] Dr. Miller and his colleagues are at the forefront of clinical research, helping to identify the condition's most at-risk patients. We're happy to welcome Dr. Miller to the show.

[00:01:08] Dr. Marc Miller, welcome to Road to Resilience.

[00:01:12] **Marc Miller:** Thank you for the invitation.

[00:01:13] **Stephen Calabria:** Now, you are both a cardiologist and an electrophysiologist. What is the difference between a cardiologist and an electrophysiologist?

[00:01:22] **Marc Miller:** So a general cardiologist generally pays attention and treats cardiovascular disease such as cholesterol, high blood pressure, sometimes heart failure.

[00:01:33] A lot of preventative measures to prevent heart attacks in the future. A cardiac electrophysiologist is specifically focused on heart rhythm disorders. So, for example, we do our training in general cardiology, then we do an additional few years on heart rhythm disorders.

[00:01:51] And that basically encompasses therapies such as catheter ablation, as well as pacemaker implants and defibrillator implants.

[00:02:00] **Stephen Calabria:** What drew you to the work?

[00:02:02] **Marc Miller:** It was a new language for me. So after you finish general cardiology, some people further specialize, but to me it was a, a world I didn't understand and it was literally learning a complete new language and that was enticing for me.

[00:02:16] **Stephen Calabria:** What percentage of the population would you say suffers from cardiac rhythm disorders?

[00:02:22] **Marc Miller:** Actually quite a large percentage of the population. So The most common arrhythmia that we treat, which is something called atrial fibrillation, is present probably in 20 to 30 million Americans that know about it and probably another 10 to 20 million Americans who don't even know they have it yet.

[00:02:39] So it's a very common condition. So the patient population we assess is actually quite large.

[00:02:46] **Stephen Calabria:** Now, sir, as a cardiologist, you've had to contend a great deal, I imagine, with cardiac arrests, which are often conflated with heart attacks. Is there a difference between cardiac arrest and heart attack?

[00:03:00] **Marc Miller:** Yes, they're actually unrelated. A heart attack usually implies that there's been a blockage in the artery of a heart that causes damage to a portion of muscle of the heart. That is a heart attack.

[00:03:13] Cardiac arrest is an electrical phenomenon whereby the heart either stops in something called heart block, or more often, they go into something called ventricular tachycardia or ventricular fibrillation, which is the heart is beating so fast that it doesn't perfuse blood to the rest of the body.

[00:03:31] So, a heart attack is what you often think about when someone grabs their chest and says, I'm having chest pain, whereas cardiac arrest is, if you often, you've ever seen in videos or EMS, when someone suddenly collapses, and for example, they need to be defibrillated or shocked by one of those AEDs.

[00:03:50] Now, a heart attack can cause cardiac arrest, but cardiac arrest generally doesn't cause a heart attack.

[00:03:57] **Stephen Calabria:** From a bird's eye view. What are the causes and symptoms, most likely, of a heart attack?

[00:04:04] **Marc Miller:** Usually chest pain, shortness of breath, is the most common symptoms. And then it's diagnosed by EKG, and then there's blood enzyme levels, which are drawn to indicate if there's been any damage to the heart muscle.

[00:04:20] **Stephen Calabria:** What percentage of heart attacks are fatal?

[00:04:23] **Marc Miller:** Actually nowadays, a very small percentage of heart attacks that we know about are fatal. Those numbers were actually probably higher during COVID because people were having heart attacks and not going to the emergency room for treatment.

[00:04:36] But nowadays, because there's a system in place to quickly identify patients having a heart attack, and most major hospitals have catheterization labs that run 24 hours a day.

[00:04:47] On average, you can take someone from having a large heart attack to having the vessel opened in under 60 minutes, particularly here at Mount Sinai, where they have a very effective system for identifying and treatment patients in a very short period of time.

[00:05:01] **Stephen Calabria:** And that is certainly encouraging. What is discouraging and perhaps scary for patients is that heart attacks can happen at almost any time, often without warning. Are there warning signs other than chest pain, and are there environmental factors that make a heart attack more likely?

[00:05:20] **Marc Miller:** Well, there can always be hereditary causes, but a lot of the heart attacks nowadays are due to buildup of plaque in the arteries of the heart, which is obviously something relative to how we eat, uh, how we treat our bodies, determines how much plaque you're going to have in the arteries, and whether or not that plaque can burst open and cause a major blockage.

[00:05:41] **Stephen Calabria:** Is that something that can be tested beforehand? Like, could we look at a patient and their plaque buildup and say, Okay, you are X number of days or weeks away from a heart attack.

[00:05:52] **Marc Miller:** Days or weeks, no, but we can identify, on a population level, patients who are at higher risk, for example, of having a heart attack in the next five to 10 years.

[00:06:01] And that's done would be a variety of factors such as your comorbidities, uh, what your cholesterol levels are, what your blood pressure levels are.

[00:06:09] And also now there's pretty sophisticated imaging modalities that can identify patients who already have plaque buildup in the arteries, and you could then take steps to reduce the amount of plaque or at least stabilize it.

[00:06:23] **Stephen Calabria:** Having a heart attack must be one of the most terrifying things a person can be forced to face. What counsel do you give potential victims in how to face a heart attack if and when it happens?

[00:06:35] **Marc Miller:** So, after a heart attack, there's definitely a higher percentage of patients who have depression related to the heart attack.

[00:06:42] But I think, you know, frequent visits to your doctor, modifying your medication regimen, modifying your lifestyle and realizing that you survived a potentially fatal heart attack was really your eye opener for how to treat yourself in the future.

[00:06:57] But people can live, you know, normal lives after even pretty large heart attacks because of our ability to open the arteries so quickly nowadays.

[00:07:06] **Stephen Calabria:** What would you attribute that depression to? The two seem like two very separate things.

[00:07:13] **Marc Miller:** Well, I think the, the mind and the heart are actually interlinked quite intimately. And I think anyone who feels that mortality or feels like they almost had a fatal event, understandably can have a period of depression afterwards.

[00:07:28] And there's been a variety of attempted interventions such as antidepressants or therapy to try to pull patients out of that transient depression.

[00:07:39] **Stephen Calabria:** Resuscitating a patient following a heart attack often requires rapid decision making and effective teamwork, I imagine. What does that process look like and what are the challenges you have to overcome in the moment?

[00:07:54] **Marc Miller:** Well, so in in cities like New York City, where there is a, really an excellent system. In fact, there's even apps nowadays where EMS

can speak directly to the interventional cardiologist on call and they can actually send them a copy of the EKG to ask, is this a heart attack or not?

[00:08:12] And if it is, they can open the cath lab, for example, if it's in the middle of the night. Cath lab is where you do the intervention of opening the arteries. So the time from the patient having their first EKG to the time the artery has been opened with a balloon or a stent can be 30 to 40 minutes at the most, at least in New York City.

[00:08:32] And it's all about making sure that all the bureaucratic steps along the way have been pushed aside. And you basically have one healthcare provider talking to another healthcare provider who has the ability to mobilize the team very quickly.

[00:08:47] **Stephen Calabria:** Perhaps a textbook definition of resilience is how we handle the problems that life throws our way. In recovering from a heart attack, what are some useful things of which patients and their families should be mindful?

[00:09:02] **Marc Miller:** Well, I think you always have to be aware of compliance with medical therapy. I think sometimes there's definitely situations where the patient feels, well, I had a heart attack and yes, they prescribed me a bunch of these medications, but I don't feel like taking them because I already had the heart attack.

[00:09:17] It's quite the opposite. You can recover even if the muscle of the heart is severely injured because of a heart attack, in many, in fact, if not most, almost all patients, you can recover almost all of that function if you take your medications and if you have your routine follow up with your doctor, and if you take steps to prevent further cholesterol buildup in the future.

[00:09:40] **Stephen Calabria:** Is there any advice that you would also give to patients families? Like, is there a common set of things that they also have to contend with following a loved one's heart attack?

[00:09:50] **Marc Miller:** Yeah. I think it is important for follow ups that patients always bring, if they can, at least one family member, you know, when you're sitting there in the doctor's office and he's rattling off a whole bunch of new medications and what the next steps are, I think 95 percent of it kind of goes in one ear and out the other.

[00:10:06] It's just really difficult to process all that information. Having a family member that's there to help you process that information, take the appropriate notes, and then obviously create a calendar is actually quite useful for patients.

[00:10:21] **Stephen Calabria:** In that vein, there are patients who may feel a loss of autonomy when it comes with that, like always having to have a family member or loved one there after a catastrophic event like a heart attack could lead to feelings of loss of agency.

[00:10:41] Is that something that you've encountered in patients as well?

[00:10:44] **Marc Miller:** Absolutely. And you know, what I tell patients is you don't become a cardiac cripple because of, you know, your mind. And what I mean by that is that patients, for example, will often, months after a heart attack, they recovered completely, but they had their heart attack and now they have a stent.

[00:10:59] They'll ask, well, I wanted to go to Europe to see family. Can I go? And some people feel kind of like tied to their apartment or tied to their hospital. And it's quite the opposite. You have to resume your normal activities.

[00:11:10] You have to resume your normal life and if you're following your doctor's advice, you know, 95 percent if not higher percent of patients will not have a second heart attack in the future.

[00:11:21] **Stephen Calabria:** Before we move on, is there a case that comes to mind of a patient having a heart attack that was instructive for you, particularly in how you and your team handled it together?

[00:11:32] **Marc Miller:** Yeah. I mean, you know, early on when you're, a fellow in particular, like, I remember, I think I was like a second or third year fellow, so we're talking like 15 years back, where a patient was having a very large heart attack on a Sunday, and he was even a physician, in the emergency room.

[00:11:49] And we activated the cardiac catheterization lab, and actually Dr. Kinney was the doctor on call, she's one of the interventional cardiologists, she's outstanding, and we activated the cath lab.

[00:12:00] And in the elevator, and I still remember the floor it happened on, from the ER to the cath lab is up five floors, so it's only a few flights via the

elevator, the patient had cardiac arrest in the elevator, and you know, at that point it was just me alone with one of the transport people, and so basically I had to start doing CPR in an elevator.

[00:12:20] I remember the door would open up on the third floor, then people would be standing there waiting to come in. We'd have to close the door. And it seemed, even though it was only five floors, it seemed like it took 15 minutes, even though it only took about 30 seconds. And I just remember that patient arresting in the elevator.

[00:12:35] Thankfully, even though we were doing compressions on the way into the cardiac catheterization lab, they were quickly able to gain access, to open the artery, and all resolved, and to this day, he's not had another heart attack, he's never had cardiac arrest again, and his heart function is normal. And so that was, uh, a real eye opener for me.

[00:12:53] **Stephen Calabria:** How do you as the lone person in that situation not panic? I mean, was it just you kind of relying on your training and trusting the process?

[00:13:03] **Marc Miller:** Yeah, I think instinct just kicks in. I don't think there's a time to panic. It's perfectly fine to panic after it's all over when there's more support around.

[00:13:12] It's perfectly understandable, but I think in the moment, if it's not you, then it's nobody. And so it's weird. I mean, that event to happen in a, you know, eight by 10 space is quite unusual, but you have to be ready for that one in a million when it occurs.

[00:13:26] **Stephen Calabria:** Now one way of preventing problems like a heart attack is identifying risk factors, one of which happens to be a specialty of yours called arrhythmic mitral valve prolapse. Could you tell us a little bit about it?

[00:13:39] **Marc Miller:** Yeah, so mitral valve prolapse, and this is related more to cardiac arrest, but mitral valve prolapse is the most common valvular heart disease. It's estimated that about 3 percent of the population has mitral valve prolapse, and that's where you have thickened leaflets of the mitral valve.

[00:13:55] Mitral valve is one of the valves that connects the upper chamber to the bottom chamber. And very often the leaflets are floppy and about 3 percent of the population has it, which means about 7 to 10 million Americans have it.

And it is known to be a risk factor for cardiac arrest. So a sudden loss of consciousness and sometimes a fatal event can occur.

[00:14:17] Now, that may only occur in, you know, the highest estimate risk is about 2%, but 2 percent for an individual for a fatal event who's otherwise relatively young and healthy is obviously a catastrophic outcome.

[00:14:30] **Stephen Calabria:** Who is most at risk?

[00:14:32] **Marc Miller:** That's what we're trying to identify now. So we've known for years now, the compilation of general risk factors, which places patients at risk, certain features on the EKG, certain features on the echocardiogram, and sometimes on the MRI.

[00:14:50] What we don't know is, is each of those factors, risk factors necessary and how much they are weighted in the process. And this really came to light, or not light, but people working out for about five to seven years now, there's been a rapidly increasing interest in this field. It was first identified that there was an association about 40 plus years ago.

[00:15:12] And then for about 25 years, people knew it was out there, but no one really studied it. And then I would say in 2018, because of some new work that came out, it really started to come to the forefront.

[00:15:23] And then about two years ago, the way that the research community really got involved was, there was a congressman's wife, who I believe was 40 at the time, who had been told that she had mitral valve prolapse and she had one or two fainting episodes.

[00:15:40] And like a lot of people get told, unfortunately they say, don't worry about it. Mitral valve prolapse is overall a benign condition. And then a few months later, after she last saw her doctor, she was on a zoom call and at the end of the zoom call, she closed her microphone. She closed her camera, but she was still on the call while other people were speaking.

[00:16:01] And then she wasn't heard from again. And they kept trying to reach out to her. So then her husband, who is a sitting congressman, came home and found that she had passed away actually in the chair, on the Zoom call.

[00:16:12] And it turns out that likely she died of mitral valve prolapse. And so, as a consequence of that. They passed a law in Congress that directs the NIH,

which is the main funding institute for research in this country, to invest money in mitral valve prolapse and cardiac arrest research.

[00:16:33] **Stephen Calabria:** And what would you say have been the biggest strides in the field since then?

[00:16:38] **Marc Miller:** I would say probably advanced imaging. So we're starting to peel back the, what causes, for example, you have a thickened leaflet that for reasons that were unclear causes scar tissue in the heart to form.

[00:16:56] And what no one really understood is, they knew that it existed and they knew the prevalence of it. But no one really understood why it was occurring. It was just kind of taken as, as fact that yes, they get scar tissue.

[00:17:07] And we know that scar tissue in the heart is, predisposes patients to developing life threatening arrhythmias. And so a few years ago here at Mount Sinai, because we're lucky enough to have really a fantastic group of advanced imaging and cardiology, as well as cardiac surgeons, as well as general cardiology, we decided to do a study looking at whether or not there was an inflammation that was playing a role in the development of scar tissue.

[00:17:36] And what we determined was that there was almost all the patients who had scar tissue had inflammation around the areas of scar tissue, that likely predisposed them to that development.

[00:17:49] And so we're finally starting to understand that there is this inflammatory component to the disease, which no one really appreciated before. And since that time, people have validated that work and demonstrated that there are actually inflammatory cells in the heart tissue in patients with mitral valve prolapse who develop scar tissue.

[00:18:10] And the key is, so what we're doing now, is we have a five year study that's funded by the NIH, about four to 500 patients that we're going to follow prospectively over the course of five years, and they're going to go really under detailed assessments to try to identify the patients at high risk, intermediate risk, and low risk.

[00:18:29] And the hope is at the end of five years, when we have all this information, we're going to be able to assign a score and say that this patient has a score of, just to make up an example, three. And therefore they are low risk, whereas this patient who has a score of nine is high risk and something needs to be done to mitigate that risk.

[00:18:49] **Stephen Calabria:** Are there any interventions, either on the part of you, the doctor, or the patients themselves that can help prevent or at least mitigate mitral valve prolapse?

[00:18:59] **Marc Miller:** So, I think that for mitral valve prolapse, since it's a condition that you basically are born predisposed to and develops slowly over the course of many years. Like, most patients with mitral valve prolapse in their 40s probably had it in their 20s, it just starts to get worse over time.

[00:19:17] And there's definitely some interventions, which I think across the board, everyone agrees in. For example, certain medications such as beta blockers, if they have enough like abnormal beats would be warranted.

[00:19:28] And then in the most significant examples, we'll even put in a defibrillator because the defibrillator is basically a device, like a pacemaker that treats cardiac arrest if it occurs. And the way I explain it to patients is they should think of their defibrillator like a seatbelt.

[00:19:44] You wear a seatbelt every time you drive for that one in a thousand chance you get into a car crash, the seatbelt will save your life and you won't go through the windshield. And the other 999 times you wore it, you don't look at it like you wasted your time because you never know when that event can occur.

[00:20:02] And a defibrillator is the same way. Someone might have a defibrillator put in because they were at high risk for cardiac arrest. And then at year number five, when they went to bed at night, they woke up in the morning because the defibrillator let them out of cardiac arrest without even them knowing about it.

[00:20:18] Like, they go into cardiac arrest. Had they not had the defibrillator, they would not have woken up. And because of the defibrillator, they woke up and went about their normal day.

[00:20:25] And that happens, probably, I would say weekly. We have a very large clinic full of defibrillator patients or patients with defibrillators. And at least once or twice a week, we have a patient who has what would otherwise be a fatal event happening in the middle of the night.

[00:20:40] And they were not even aware they had it. So defibrillators do save lives in the right patient population.

[00:20:47] **Stephen Calabria:** You touched, sir, on the many team members that play a role in researching mitral valve prolapse. Could you talk a little bit about that?

[00:20:56] **Marc Miller:** So it's not possible to perform a large research study that's so comprehensive without a lot of team members. So for example, I'm an electrophysiologist. I can interpret and diagnose arrhythmias based on monitors, but I don't read or interpret MRI scans of the heart.

[00:21:16] So you need someone in the imaging department who is trustworthy and understands this disease to participate in the performance and interpretation of cardiac MRIs and PET scans. You also need a group of great surgeons who have expertise in mitral valve prolapse.

[00:21:32] So, should the patient require some kind of surgical intervention, which is sometimes necessary if the valve is very leaky, that surgeon needs to be involved in either the recruitment for the study or more importantly for performing the necessary surgery.

[00:21:47] And then there are a lot of people who are involved in ensuring, for example, that the patient consent is done, that the imaging, that the testing is done in a timely fashion, that follow up is performed on time.

[00:22:00] So it takes on average, you know, 15 to 20 people just for one research study to be done effectively, or at least a research study like this.

[00:22:10] **Stephen Calabria:** Let's talk for a moment about the singular researcher, you. As we heard from Dr. Brian Brown on a recent episode of our show, scientific research can be slow moving and frustrating, meeting dead ends or outright opposition or resistance to your ideas, skepticism from other medical professionals, et cetera.

[00:22:31] How do you prevent yourself from getting burned out and cynical about things and instead soldiering ahead with your work?

[00:22:38] **Marc Miller:** Oh, I think, I think science is full of inaccurate assumptions and that you have to. to break some eggs, obviously, in the process. And there's, you know, there's no researcher out there who hasn't made an inaccurate assumption that was then disproven by either their research or somebody else's research.

[00:22:58] You come up with hypothesis, and then you perform the necessary study to prove or disprove that hypothesis. And, you know, just to your point, when we first came up with the hypothesis about four years ago that inflammation played a role in this disease, the first journal that we submitted our article on, the reviewers thought that was absolutely crazy.

[00:23:19] Now since then, obviously the research got published in a high impact journal and it's almost become, I think, accepted at this point that there is an inflammatory component, but it was a lot of walking uphill to get to that point, but I'm glad that we persevere because if you don't persevere, then I think good ideas can inadvertently be tossed to the wayside, but you should put them through the rigors of scientific research. Can't make assumptions on something as complex as mitral valve prolapse.

[00:23:47] **Stephen Calabria:** If someone believes themselves to be at risk of mitral valve prolapse or even a heart attack, what should they do?

[00:23:54] **Marc Miller:** Mitral valve prolapse is an echocardiographic diagnosis. So if you have symptoms suggestive of mitral valve prolapse, sometimes there are absolutely no symptoms, but if you have, for example, symptoms of palpitations or if you have an abnormal EKG, the diagnosis is actually made by trans thoracic echocardiography, which is basically an ultrasound of the heart.

[00:24:15] It's like a 15 minute test. That is the diagnostic modality of choice. Thankfully, you can get an echocardiogram at basically any cardiologist's office nowadays or any hospital clinic. They're widely available and very quick, and they carry no risk because it's just an ultrasound.

[00:24:33] **Stephen Calabria:** Last question. There are likely listeners here who have struggled with heart health or have a family member who has. What do you say to patients who may be struggling to give them realistic optimism for the future?

[00:24:46] **Marc Miller:** I think you have to look at the life down the road. It's very easy, all of us do, when you're in discomfort or pain now, you assume that it will never get any better. But the reality is that it does.

[00:25:01] I mean, there are people, like I've said, who've had heart attacks 20 years ago, who have since run the New York city marathon. And if you treat your body right and you, you know, you treat yourself right, 99.9 percent of diseases in our field can be effectively treated.

[00:25:18] And you can go back to a normal quality of life.

[00:25:21] **Stephen Calabria:** Well, doctor, that was it for my questions. Was there anything else you wanted to say?

[00:25:25] **Marc Miller:** No, that was great. Thank you for the invitation.

[00:25:27] **Stephen Calabria:** Dr. Marc Miller, thank you so much for coming on Road to Resilience.

[00:25:31] **Marc Miller:** Thank you.

[00:25:31] **Stephen Calabria:** Dr. Mark Miller is a cardiologist and an electrophysiologist, as well as an associate professor of cardiology at the Icahn School of Medicine at Mount Sinai.

[00:25:40] That's all for this episode of Road to Resilience. If you enjoyed it, please rate, review, and subscribe to our podcast on your favorite podcast platform.

[00:25:48] Road to Resilience is a production of the Mount Sinai Health System. It's produced by me, Stephen Calabria, and our executive producer, Lucia Lee. From all of us here at Mount Sinai, thanks for listening, and we'll catch you next time.