

[MUSIC PLAYING]

KRISHNA V We're going to get started on this very important topic of percutaneous coronary intervention in very elderly. I
TUMMALAPALLI: do not have any conflicts of interest for this presentation. I will be talking various studies in this aspect and also focus on the study results pertaining to the very elderly. I will also be showing some of the cases that I have performed right here at Shadyside Hospital. So we will make some important points based on the case presentations plus the literature review.

So the obvious question comes, who is the elderly and who is very elderly? And there is a lot of debate on that one. But I'm going to go with the American College of Cardiology definition of elderly. So if someone is more than 65 years of age and less than 80, they are considered elderly. And people who are over the age of 80, they are considered very elderly. So we're going to discuss our topic mostly over the age of 80.

However, some of the trials included people over the age of 70. So we may be also talking about some of those patients as well. So I think we all know that the age itself is a risk factor. The older you are and if you are admitted with a cardiac event, the higher the mortality. So we are trying to figure out how we can impact that mortality.

The coronary artery disease is still the most common cause of death in elderly. And there is always-- there is a knowledge gap in this aspect, because many of the previous cardiovascular trials, they have excluded patients over the age of 75. So we don't know really what happens in octogenarians and nonagenarians when we perform these invasive procedures.

And these patients do come in with various types of presentations. As you could see, they can commit with-- come in with STEMI, merely go on to cardiogenic shock, or non-STEMI, again, can proceed to cardiogenic shock, and stable ischemic heart disease. And the more elderly you are, your chance of presenting with the non-STEMI is higher. Actually, the octogenarians and nonagenarians, they don't come in with STEMI, but they mostly come in with non-STEMI, and which is also a significant morbidity and associated with higher chance of death.

In addition to that, there is always selection bias in this age group. And the Swiss STEMI Registry have-- has shown that the older you are, the interventional cardiologists are less likely to offer you the PCI. So that is something we need to keep in mind. And today's discussion, we will not discuss medical therapy for coronary artery disease in this age group, except to say that all people should get guideline directed medical therapy first before the PCI. So we will focus on the PCI and the elderly.

So why are we discussing this? Because as you can see, people over the age of 65 years is it is the fastest growing sector of population. In 2018, people over the age of 65-- we have 52 million in this country-- have the estimated projection of people 65 will be 80 million by 2040. And even if you include greater than 75 years, we will have 46 million people by 2050. So this is a growing concern that unlike the-- a couple of decades ago, the elderly-- the elderly now are much more active. They are functional. They like to do things. So we have to help this group of population.

And interestingly, as the age increases, our elderly population can manifest two types of problems. Some have increased bleeding, because of the high tPA and low platelet activity as age encroaches. And some have actually increased thrombosis, because the plasminogen activator inhibitor will increase, and the blood also has a high viscosity. And in addition to these, there will be some other histological changes. The endothelial dysfunction is much more common among elderly. So all these things will play a factor when we encounter these patients.

In addition, the elderly have much more complex coronary artery disease. So in a study of people greater than 75 years of age, 55% had triple vessel disease. There is also a high prevalence of left main coronary artery disease. And these lesions are much more advanced. Tortuosity is quite common in elderly. Calcification, diffuse nature of the disease, lung lesions, a multivessel disease-- in invasive cardiology, these are referred as class C lesions. We rarely see class A and Class B type of lesions in these elderly people.

In addition, the older you are, you are associated with multiple comorbid conditions, such as history of congestive heart failure or myocardial infarction, atrial fib, diabetes, stroke, COPD, renal failure. All of these, again, compound the clinical complexity of these patients as we get older.

So that creates some of these challenges. The older you are, there is atypical presentation. They don't come in with classic chest pain. They may have nausea. They may say I'm not feeling well. They may have epigastric pains, even with acute myocardial infarction. So that causes delay in recognition and diagnosis of STEMI or non-STEMI.

Most of them have LV dysfunction. They also have valvular disease. More common is, as we get older, calcific aortic stenosis and mitral incompetence. They are very common among elderly. They also have musculoskeletal and cognitive dysfunction. They have poor functional status.

And when they undergo any invasive procedures, they have a higher vascular complications, higher chance of acute tubular-- ATN, and also a higher chance of cerebrovascular accident, stroke, because they may have atheromatous debris in the aorta and due to the catheterization, that may get lost and cause stroke. Atheroembolism is quite common as we proceed in the age.

And this is very important fact also. When elderly patients come in with STEMI or non-STEMI, they have inherently they have a high mortality compared to the younger population. So it's one way to look at is this gives us, actually, an opportunity that if you provide invasive workup and revascularization on these patients, in fact, the absolute benefit we can actually provide more to the elderly compared to the younger population.

And interestingly, the activity of daily living, another way of looking at this is the frailty score. The more frail individual is, the less active patients are. That itself is associated with higher mortality in patients 85 years or older. So when we offer invasive procedures, we have to consider this fact as well. And a lot of times, these elderly people, after the successful intervention, they may have to go to a nursing home and rehabilitation. And that itself causes some problems on its own.

So let's just start with the STEMI patient. So we're going to use our case examples in the aspect of STEMI, non-STEMI, and stable ischemic heart disease. So we're going to start with a 69-year-old female. She already had a history of STEMI eight months earlier. And she underwent stenting of the right coronary artery, emergent at the time. Patient also has history of diabetes, dyslipidemia, obesity. And she continues to smoke. And she was also noncompliant with medicines.

So she stopped all her cardiovascular medicines including dual antiplatelet therapy. And as a sidebar, one of the common reasons why STEMI happens eight months after previous intervention would be most common cause is non-compliance with the dual antiplatelet therapy. So when asked why did you stop medicine, she said they are not doing anything. So she stopped all her medicines.

She came in with severe chest pain, slumped over from her chair. And 911 call, paramedics came. And this is the EKG that was taken actually at her place. As you can see, you have significant ST elevations in II, III, AVF, also V3 through V6. And you have significant ST depressions in I and AVL. So this is the classic STEMI. And when we see STEMI, actually, the decision making would be easier.

So anytime we have a STEMI patient, the quicker we open the artery and quicker we maintain TIMI 3 flow, the better for the prognosis for this patient. And here, I had to give a lot of credit to the paramedics, because they had-- they have done the EKG at patient's place. And they have actually activated the cath lab from the patient's place. And it also happened on a weekday during the daytime. So by the time the patient came, we were all quite ready.

So let's talk about the role of primary PCI in acute MI. Also, the other option we have is, if the patient happens to be at a non-PCI center, the thrombolytic therapy. So what are the teaching points that we could make? So if we look at the earlier trials, the landmark trials PAMI and DANAMI-2, these trials have clearly showed that primary PCI for STEMI is superior to fibrinolysis.

So since we are focusing on the elderly patients, they also did a subgroup analysis. So even in elderly people, people who are older than 70, this stands true. PCI is superior to fibrinolysis. So whenever there is opportunity, we like to perform the PCI even in elderly with a STEMI, because STEMI mortality in elderly with a closed infarct vessel is much more higher than the open vessel. So we have to establish the flow and open the artery.

So if you look at the GRACE Registry, I think all of us are familiar with GRACE score. If somebody comes in with non-STEMI or unstable angina, we do this score. We assess the risk of this patient. So in this GRACE Registry, nearly 3,000 older patients, they have documented that the PCI was associated with reduced death and reinfarction, compared to thrombolytic therapy.

So we must always aim for PCI-- primary PCI for STEMI patient. So here is if you happen to be at a PCI center like we have, those-- PCI is always preferable. And along the same lines, I would like to drive four really important teaching points.

The primary PCI should be performed in patients with STEMI and the ischemic symptoms of less than 12 hour duration. And if the patient has contraindications to fibrinolytic therapy, definitely PCI should be performed, irrespective of the time delay from the first medical contact.

And let's say the patient goes into cardiogenic shock after STEMI. PCI, primary PCI, should be performed, irrespective of the time delay from the onset of the MI. The sooner we do it, the better. But we should not withhold the PCI, thinking that OK, patient is too late already. Then, patient is in shock. That should not be done.

And what about if the duration is 12 hours to 24 hours? PCI is reasonable if the patient is continuously having chest pain and if the patient is continuously having ST segment elevations. Yes, PCI even after 12 hours up to 24 hours seems reasonable to perform. So whenever possible, we have to do PCI for the STEMI patients.

So then, how about if we are in a non-PCI center? So let's look at some of the important trials. STREAM trial, that is strategic reperfusion in elderly patients early after myocardial infarction. So tenecteplase followed by transfer to a PCI hospital. Because sometimes the thrombolytic might fail and the infarct related vessel may still be closed, so if we transfer the patient to the PCI hospital and perform the rescue PCI, that is beneficial than keeping the artery closed.

So in this STREAM trial, there was comparable efficacy noted among patients less than 75 years versus more than 75 years. Very important. So if you're in a non-PCI center, this strategy should be considered. The composite end point of death, shock, congestive heart failure, and reinfarction at 30 days were similar to primary PCI. But one caution we have to exercise especially in elderly, they have increased risk of intracranial bleeding. So that has to be taken into account. And when we talk to the patient getting the informed consent for fibrinolysis, this has to be clearly spelled out to the patient.

Look at another trial, the REACT trial. This is after fibrinolysis. Patients who are sent to a PCI center for rescue PCI, they did better than conservative therapy. So if we are in a non-PCI center, the best thing to do is do fibrinolytic therapy. If we cannot transfer the patient and get the primary PCI done within 120 minutes, then we give fibrinolytic therapy and immediately transfer the patient to a PCI center. In case if there is no perfusion, then there is an opportunity for PCI.

But always be cautious with the contraindications for fibrinolysis. They are all listed here. And this is very important, because if any of these contraindications are present, and we give fibrinolysis, that could result in fatality.

So very important ones are the any prior intracranial hemorrhage, cerebrovascular like AV malformation, known malignancy, ischemic stroke within three months. So all these are very important contraindications. So you might ask, what do we do with the very elderly, 80 plus years old? And some authorities have suggested instead of giving full thrombolysis, give half dose thrombo-- fibrinolysis and then transfer the patient to a PCI center. So that strategy also has been utilized in very elderly.

So coming back to our patient, we did a radial catheterization on our 69-year-old with STEMI. So the reason we do radial preferably for STEMI patients is there is mortality benefit in several studies. And also, the radial catheterization is associated with less chance of bleeding. And any bleeding after a PCI or a STEMI leads to much higher complication rate.

So here, patient's LAD is here, the circumflex here, marginal branch. The LAD itself looks good. And we have the right coronary artery totally occluded. Passed the wire, and put the balloon, and then subsequently stent. I want to bring the attention that the door to balloon time was 17 minutes in this patient. And this is after stent placement. We have a nice result for the right coronary artery. And all the credit really goes to the great teamwork starting from the paramedics to the availability of the cath lab, the ER physicians, and the transfer of the patient in timely fashion.

So by looking at the-- if you look at only the STEMI, there's really no upper age limit for primary PCI for STEMI as long as there is no contraindications. So every patient with a STEMI must be considered, regardless of their age, for primary PCI. So this patient did very well and went home with a normal LV function.

Now, let's turn our attention to non-STEMI. So non-STEMI is really like a tip of the iceberg. These people are, even though they may look good with the non-STEMI, but they are associated with higher morbidity and mortality. And they may progress to STEMI. Or they may have progress to even cardiogenic shock and just to heart failure, arrhythmias.

And now, we are-- we have a patient that an 89-year-old retired physician. Patient has a history of hypertension, dyslipidemia, chronic renal failure, and has hypercoagulable state, admitted with chest tightness and shortness of breath. EKG showed normal sinus rhythm, right bundle branch block, nonspecific ST T abnormalities, and PVCs. We will look at the EKG in a minute.

Three months earlier, patient had an echocardiogram, which showed good left ventricular function. So troponin was 6. So non-STEMI was diagnosed. And his creatinine was 1.8. So this retired physician came on a Friday. So we thought we will stabilize the patient, make sure the creatine improves, and maybe perform non-- Because non-STEMI patient is stable, we will perform the catheterization 48 hours later.

So that night-- Before we do that, we looked at the electrocardiogram. Clearly, no ST segment elevation. He does have frequent PVCs. Normal sinus rhythm with first degree AV block. So that night, this gentleman went into rapid atrial fibrillation with recurrent chest pains, also became progressively and severely hypotensive.

Blood pressure went as low as 78/60 millimeters of mercury. We did a STAT echo. It showed LV ejection fraction 35%. Patient had worsening heart failure and went into respiratory insufficiency. Did not require intubation, but he was requiring high oxygen, and became cold and clammy and was going into cardiogenic shock.

So now, we have an 89-year-old, very elderly by any definition, and came in with non-STEMI, chronic renal failure, and now going into cardiogenic shock. So what should we do? Should we do emergency cath, because he's 89? Should we just continue conservative therapy? Is age a factor in cardiogenic shock? Should we be doing any invasive procedures at this age with a cardiogenic shock? So all these questions come into mind. And what data do we have? Or what evidence do we have to guide us in this aspect? So let's examine.

So the one trial that was still quoted today is the SHOCK trial that was published in the Journal of American College of Cardiology in 2003. So this hypothesis has been tested in this. Should we immediately revascularize patients in STEMI and cardiogenic shock? Whereas, should we conservatively manage and late revascularization if indicated? So that theory was tested in the SHOCK.

So if we do not do anything, if the-- in fact, vessel left closed and patient is in cardiogenic shock, the mortality approaches 80%. So really, the question was, can we alter this by offering early revascularization? So I'd like to point out one thing that in this SHOCK trial, when they were trying to enroll the patients, they have actually screened close to 2,000 patients, but they were only able to enroll 302 patients for randomization.

So the SHOCK trial results were they have divided the patients into less than 75 years and greater than 75 years. In fact, there was actually harm was noted in the SHOCK trial for people who are greater than 75 years. So indicating that to-- something to consider that when we are dealing with very, very elderly people.

But one of the criticisms for this trial was only 56 patients over the age of 75 were recruited in this trial. So can we actually take this result as a value result? So that is the question. And as we said, there were 2,000 people who were screened and only 300 people were in the randomization. So the rest of the patients were put in a SHOCK Registry.

And in this SHOCK Registry-- As a contrast to the SHOCK trial, the SHOCK Registry actually showed mortality benefit if we do early revascularization for people 75 years and older. So their mortality actually reduced from 79% to 48%. Although high, but it's much better than 79%. So the registry included 232 patients for people of greater than 75 years of age.

So based on this registry data, 2013 STEMI guidelines, they have actually advocated that no age limit was placed for early revascularization for patients who are in cardiogenic shock. So for that reason, we elected to proceed with the cardiac catheterization on our 89-year-old patient with shock. So here is the representative picture of the left vein is here and the LAD showed tight 99% stenosis. Circumflex is patent.

And one more look at the LAD right behind with very critical stenosis. And we are looking at the right coronary. Right coronary artery is patent. So any time we have a very high grade stenosis, we do our intervention, balloon dilatation followed by drug-eluting stent and post-dilatation. And this patient has very good result and good flow into the left ante descending artery.

So then, what happened to this patient? So the next day, the hemodynamics have improved. Intra-aortic balloon was removed. And patient was converted to normal sinus rhythm with IV amiodarone. He was in congestive heart failure for a few days in the hospital. And actually, renal function deteriorated but stabilized at the time of discharge to 2.1 from his baseline 1.8. Oxygenation improved. And patient was discharged with life vest.

Patient did very well. And three months later, the LV ejection fraction improved to 50% to 55%. Patient is clinically very stable. Now, one and a half years later has been very stable and has been followed by us every six months. So in this case, the PCI in cardiogenic shock, non-STEMI, had made a difference.

So what data do we have? Or do we have any important trials indicating that yes, we should be performing invasive procedures in octogenarians? So some of the important trials I would like to go through. TACTICS-TIMI 18, so they have looked back to people greater than 75 years. The benefits are better with early invasive therapy. And death and myocardial infarction was reduced. The risk reduction was 56% compared to the conservative therapy, again, indicating that we should offer the PCI.

But there is also another trial, After Eighty trial. Only people over the age of 80 were included in this trial, published in Lancet 2016. It is a randomized prospective trial. 457 patients, who are followed for 1.5 years, so one and a half years. The composite endpoint, death, myocardial infarction, stroke, and urgent revascularization were lower in the invasive ARM, again, supporting that even octogenarians get benefit with PCI.

Also, some of the other studies like GRACE Registry. GRACE Registry had 16% of the 18,000 plus patients that were octogenarian. So the octogenarians, they had improved outcomes in all age groups, particularly also octogenarians with PCI compared to conservative therapy. So these are non-STEMI patients.

And if you look at the CRUSADE Registry, the PCI was better in ages 75 to 90. And the registry also showed benefit in people who are 90 years of age. From octogenarians, now we are contemplating invasive procedures, PCI, in people who are 90 years of age. So Denmark study also showed that the five year survival in nonagenarians is as similar as the octogenarian. So even in 90, we should be thinking of offering PCI.

So that brings to our next patient, who is 94-year-old lady. She came in with non-STEMI. She is very independent. She has history of hypertension, hyperlipidemia. She was admitted with dyspnea on exertion. She lives by herself. She swims almost daily. No previous history of myocardial infarction. Clinical exam was unremarkable. EKG showed lateral wall T wave inversion. And troponin was 1.45. And she has a DNR/DNI wish.

So baseline echocardiogram showed big anterior wall defect. The whole anterior septum, apex, anterior lateral wall are hypokinetic. It's a contrast echo showing dilated LV. LVEF is only 25%. And she was very much involved with her care. She wanted to know what's going on with her heart. She agreed for cardiac cath. So [AUDIO OUT] performed the cardiac cath, which showed total occlusion of the RCA, very mild disease in the left main. The left anterior descending artery is the culprit, has a long lesion, which is heavily calcified and long lesion.

As we said, as we grow older, the complexity of the coronary anatomy also increases-- long lesions, calcified lesions, multivessel disease. So this patient has all of those. So we, again, performed the radial arterial approach. And showing this again, long lesion. So after the catheterization, we paused because she told us that under any circumstances, she would not want bypass surgery.

The reason the older you are we prefer the radial artery, again, because of the bleeding issue. If you look at the bleeding, as the complexity of the patient clinical situation increases, from stable angina to non-STEMI to STEMI, the incidence of bleeding also increases here from 2.1% to 12.7%.

Why are we concerned about bleeding? Because anytime a patient with STEMI, and non-STEMI, or even stable ischemic heart disease undergoes PCI, if they have bleeding after the PCI, their mortality goes up, as shown in the next slide. But I want to show you this complication that we never want to see is the retroperitoneal bleeding from the puncture site from the femoral artery. This is a reconstructed CT angio showing this is the anterior side here, posterior retroperitoneal hematoma, which could be serious, and at times it could be fatal.

So if you have bleeding after PCI, so as you can see in this slide from three different studies-- REPLACE-2, ACUITY, and HORIZONS-- and people who are interested can look up these studies-- it showed that any bleeding after PCI, they are associated with higher mortality rate. So we tend to do radial arterial approach in these patients, because the bleeding risk would be much less compared to femoral arterial approach.

So coming back to our patient, as we saw there's long lesion, calcified, LAD stenosis. There's moderate disease in the circumflex, and the right coronary artery is totally occluded. So what should we do? Should we do bypass, multivessel PCI, LAD stent only? Or because she is 94, should we just treat medically? So these are all the questions that come up. And also remember, this patient has DNR/DNI. And she also said under any circumstances, she would not want bypass surgery.

So the idea of showing this case is that as the patient's age grows-- goes up, the other social and ethical factors also play into our decision making. So the patient says that under any circumstances, that I [AUDIO OUT] surgery. Are we ethically able to perform a PCI? What if there's a complication? What if the LAD closes? What if there's a perforation? Is it ethical to let the patient die on the cath table? So all these issues come.

And the DNR/DNI status also becomes very important in these very, very elderly patients. Sometimes, the patients do not distinguish between a seriously ill condition to a terminally ill condition. So a lot of times, if they are severely sick, even though it's reversible, they think they are terminally ill. And they'll say, don't resuscitate me. So we explained the situation to her that this could be a temporary situation. And if we do a PCI of the LAD, she may get better. So for that reason, after explaining, she had reversed her DNR/DNI status and agreed for PCI.

And also interestingly, she has this right next to her bed in her patient room. The older you get, the thicker it is to navigate the health care system, which is very true. The book cover also says that treat me, not my age. So because she is functional, she is able to live by herself and swim. So we thought we should offer the PCI.

So while we are getting ready for the next day, PCI, she deteriorated with increasing shortness of breath. She did not have chest pain. But blood pressure was falling. She was having increased oxygen requirements. She required IV Lasix. And we discussed further. And she agreed for emergency procedure.

So this is her LAD. So we did atherectomy, to debulk the calcium in order for us to insert the stent. And the stent was placed. And we have good result. Stent was post-dilated. Because her hemodynamic situation was precarious, we were able to support her with intra-aortic balloon and a temporary pacemaker. And she did well. She actually became clinically stable.

And two months echocardiogram showed LV cavity became less in size. The LV ejection fraction has improved to 45%. She was going to cardiac rehab for three times a week, no angina, no shortness of breath. Blood pressure was high. However, we adjusted the medicines. And now, it's over two years of follow up. And she's still living independently. And she is doing very well.

So then, you might ask, it's nice-- a nice example of a good success story. But should we be doing these invasive procedures on nonagenarians? What kind of data do we have? Do we have any literature to support that yes, we should be doing these invasive procedures?

In the National Inpatient Sample, so what they have done was based on the discharge diagnosis of coronary artery disease and PCI, from 2003 to 2014, they have compiled all the data on patients who are nonagenarians, 90 plus, who have had PCI, and the temporal trends, and what were the reasons, what was happening. These patients, 90 plus years old, in three categories-- STEMI, non-STEMI, and stable ischemic heart disease.

So this is published in JACC September 2018, very important analysis. Granted, this is not a prospective randomized trial, but it still performs-- or gives us many important concepts. So this is a US study, United States. Nearly about 70,000 patients during this timeframe, nonagenarians, all 90 plus years old, had PCI.

So let's look at what was observed. A proportion of cardiogenic shock patients increased during this time, 2003 to 2014. PCI reduced in hospital mortality for above 75 years and also 90 years. So if the patient had STEMI, the baseline risk profile increased, which we talked about that, because they have many comorbid conditions, there is a slight increase in hospital mortality. Sure, that is reasonable, because the older you are, higher the inpatient mortality. But when they risk adjusted this mortality, the mortality was acceptable.

Another important thing is in hospital, stroke rate was also increased. The bleeding and vascular complications have been-- have decreased. That is because the improvement in technology and their knowledge awareness from the invasive cardiologist's point of view. So we are able to reduce the bleeding and vascular complications.

So the incidence of a STEMI PCI-- that means offering PCI for STEMI patients who are 90 plus years old-- the incidence increased from 23% to 30%. So yes, 90-plus-year-old patients are also getting PCI for STEMI. The STEMI mortality-- If you look at this, very, very impressive. The STEMI mortality 16% if the patient had PCI versus 33% without PCI, again, making a-- making a case for continuation of PCI in STEMI patients who are 90 plus.

What happens in non-STEMI patients? Interestingly, most PCIs are performed for non-STEMI. In nonagenarians, the incidence increased from 49% to 53% of the people who were having these PCIs. If a 90-plus-year-old comes with non-STEMI, there is a favorable mortality trend with PCI. Bleeding and stroke, in this analysis, unchanged. And vascular complications have decreased. So the summary of the experts in looking at this data is that in non-STEMI, PCI should not be withheld in nonagenarians.

So nonagenarians with stable ischemic heart disease, so in this one group, the PCI incidence has decreased, because there is an increase trend in hospital mortality. PCI decreased from 27% to 16%. And stable ischemic heart disease, they had higher vascular and procedural complications. They actually noted increased mortality, 3.9% versus 1.2%.

So this indicates that if your patient is a nonagenarian and with stable ischemia heart disease, we should be very cautious in performing PCIs, because if they get into any complication, their margin of reserve is small. So they get into more complications. So we should not be looking for coronary [AUDIO OUT] nonagenarians to offer PCI. We should only offer PCI if they actually fail medical therapy and come in with a STEMI or non-STEMI. That's the important take from this analysis, from National Inpatient Sample.

So now, we have shown that PCI can offer advantages to octogenarians and nonagenarians. Then, you might ask, when is the time that you would not consider PCI in STEMI or non-STEMI in cardiogenic shock-- cardiogenic shock patients? So if they have very limited life expectancy, we should not offer. If they are actually actively bleeding, we should not offer PCI. If they have end stage disease process, such as metastatic malignancy, life expectancy is very poor, we should not be offering invasive procedures.

And if they have severe cognitive decline, they cannot make a decision by themselves. We should not be offering. If there is a patient's preference of not to get PCI, and if they already have an advance directive. In other words, in octogenarians and nonagenarians, we should not be talking them into doing something that they are not comfortable, and if they cannot understand the risks and benefits and agree for these procedures, because all these procedures in this age group have inherently have a higher complication rates.

So if we can do PCI for 90s, then what happens if the patient is 100 years old and comes to us? This happened to me a few months ago. I was consulted on a 100-year-old lady. Patient has hypertension, dyslipidemia, arthritis, and GERD. Patient had chest pain on exertion for a few weeks. And then, she had pain at rest, requiring hospitalization.

EKG showed sinus rhythm, lateral wall T changes. And the troponin was already elevated at 2.63. So 100-year-old lady with non-STEMI. Echo showed LVEF 55% or 60% with inferior lateral wall hypokinesis. They continued the medical therapy. But during the whole night, chest pain continued in spite of IV heparin and IV nitroglycerin.

So now, the question comes to should we be offering a 100-year-old patients do PCI? So if you ask me, do we have any literature supporting 100 year old with PCI, no, there is no study or no analysis that I can come up with, other than some anecdotal case reports. There are several case reports on 100-plus-year-olds with PCI for STEMI, non-STEMI. But there's no randomized or even observational studies.

So this, again, gives us an opportunity to learn. As we said, the population is getting older. So some of these patients may have to be enrolled in some kind of prospective study to answer these types of questions. So when we don't have any literature to guide us, then we have to rely on our clinical judgment. So whether to offer a PCI on this patient depends on the overall functional status of the patient. So let's examine that.

So what is a functional status? So this patient lives by herself, is self-sufficient, cooks, cleans, et cetera. She had similar chest pains few months ago, treated conservatively, meaning she has already failed medical therapy. So at age 99, she visited Italy. And according to the daughter, she just walked everywhere without any problem. So she wants to be independent. She lives where the daughter lives across the street. When you have this good functional status, we thought it was reasonable to offer PCI for this patient.

So we did the radial cardiac cath. So again, patient has triple vessel disease, moderate LAD. The culprit is the circumflex, very tight, 99% stenosis. Even the right coronary had a couple of tight high grade stenosis. But based on the EKG and the echocardiogram and looking at the angiogram, the culprit vessel is the circumflex. And we went ahead and intervened on the circumflex, so here with a stent.

And this is also raises another important concept. The older you are, just because we see coronary lesions, we should not be stenting them, because the more lesions that we stent, higher chance of complication, especially if the patient is not having any problem with the lesion, because patient has been having these coronary lesions for a long time. The only time probably some-- because of some plaque rupture, the circumflex caused the problem. So if we take [AUDIO OUT] vessel, then patients do very well.

So we stented the circumflex, very nice nice result on the circumflex. And following the stent placement, patient did very well, symptom free. She was ambulating. We were able to wean the nitroglycerin. Heparin was weaned off. She was discharged home on aspirin, carvedilol, amlodipine, and Plavix. And she is clinically stable. Now, it's about six months. She's doing really well, asymptomatic.

So that with some cases and also with some literature review, I have convinced that the overall success rates have improved in very, very elderly. Mortality and complications rates are down. So in STEMI in very elderly, PCI is better. Cardiogenic shock elderly, PCI is better. Non-STEMI, PCI is better.

Then what about stable ischemic heart disease? We touched upon nonagenarians in the National Inpatient Sample. But what about if the patients are a little younger, like 80s? So just to show you another example of an 82-year-old with a stable coronary artery disease. Patient is very functional, has stable hypertension, hyperlipidemia, deep vein thrombosis. Then, had remote bypass surgery. And already had multiple PCIs.

The reason I chose this case is to illustrate the point that the older population in the 80s and 90s, a lot of them already have previous bypass surgery. And the bypass disease is that itself presents difficult challenges for interventional cardiologists. So in this patient, the EKG showed no changes. Troponin is negative. And LV ejection fraction was 50%.

So here is the coronary angiogram. The right coronary artery is totally occluded. The right graft, if we look at it, in stent 80% restenosis right here in the graft itself. And if you also look at the graft of the marginal branch of the circumflex has a very tight stenosis. Looking at a different view, look at how critical 99% stenosis in the graft of the marginal branch, nothing much to see on the native vessels. And the LIMA to LAD was patent.

So this patient has two graft disease, graft to the right coronary artery, in stent restenosis, and graft the marginal branch, thrombotic-looking high grade 90% stenosis. So we intervened, put stent in the right coronary artery. Nice result. And also intervened on the graft to the marginal branch stent. Nice results.

So the uniqueness of these people who already have bypass is this is also a growing population, with a previous bypass. The PCI should be performed only if medical--

MALE SPEAKER: [INAUDIBLE]

KRISHNA V -- medical therapy fails, because these patients who have-- elderly patients with stable ischemic heart disease, **TUMMALAPALLI:**we may not increase their survival. So we're not doing this for survival. We will improve their quality of life.

MALE SPEAKER: She is a 72-year-old woman with a history of hypertension, obesity, and obstructive sleep apnea.

MALE SPEAKER: Let me ask everybody in the audience to please mute their microphones right now. Thank you.

KRISHNA V So the PCI in stable ischemic heart disease patients who already have previous bypass, we should be doing this **TUMMALAPALLI:**for not to prolong their life, but perhaps to improve their quality of life, because there is no data to suggest that any redo bypass is any better than PCI in post-bypass patients.

And also, bypass, this is itself is a very different disease than native coronary arteries. And it is associated with higher procedural complications such as MI, vascular complications, bleeding, no reflow phenomenon. And sometimes, if there is big clot [INAUDIBLE] in the graft and procedurally, if we are not careful, we may dislodge some of the thrombus and can cause CVA as well. So again, in this also, this is one area where we have a lot of knowledge gap, whether should we be considering redo bypass in very elderly who already have bypass or should we just treat them with PCI if they need PCI.

So based on all of this, some of the statements that we can make are this is, again, from the American College of Cardiology, AHA, and American Geriatric Association scientific statement. The management decisions for older patients with non-STEMI ACS should be patient centered. And we should consider patient preferences, goals, comorbidities, functional and cognitive status, as well as life expectancy.

The potential benefits of aggressive treatment in older adults with non-STEMI ACS are often equal, but in fact greater than those in the younger people. The reasons that we mentioned. The older you are, you are admitted with non-STEMI and STEMI, your mortality is already high. So if we intervene, they actually get higher absolute benefit compared to the younger patients, because the younger patients' mortality is low to start with. So we should take that also very much into consideration.

So the older patients are at increased risk of adverse outcomes and vascular complications. And always consider radial approach. And it is emphasized that therapies should not be withheld solely based on age alone. So age is only one [AUDIO OUT]. So more prospective randomized trials are needed in this age group, as the population of nonagenarians and centenarians is increasing, not only in USA but also across the world. So I would stop there and entertain any questions. Thank you.