Good morning, I’m Dr. Makaroun and I am the Chief of Vascular Surgery at UPMC and the co-director of the Heart and Vascular Institute. I will be discussing with you today the current state of TEVAR or thoracic endovascular aortic repair and how it has impacted our treatment of thoracic aortic pathologies.

The first device to be approved for the use in the thoracic aortic was in March of 2005 and it was the TAG device that was developed by W.L. Gore and was approved by the FDA for the use in descending thoracic aneurysm repair. I was privileged to be the principal national investigator on this trial and since then two more devices have been approved for the same indication which is the treatment of thoracic aneurysms of the descending thoracic aorta. The one device is the TX2 from Cook and Talent from Medtronic. There have been several multi-centered trials for descending thoracic aneurysms that have met with the approval of these three devices and the last approval was in 2008 for the Talent and the TX2.

Two more investigational devices that are awaiting approval this year are the relay device from Bolton Medical and the Valiant device which is a modification of the Talent device from Medtronic. The end point of all of these devices is to exclude a descending thoracic aneurysm from circulation by providing a new channel and sealing above and below the aneurysm section.

This is a depiction of the first device that was approved in 2005, the TAG device and it is made of a PTFE tube with Nitinol support, this is constrained by a PTFE sleeve and actually remains somewhat
large with a profile of 20 to 24 French. The device is very flexible and simple to deploy, it comes in a variety of lengths and diameters. The deployment of this particular device is actually quite simple. The deployment knob at the proximal end of the catheter releases the constraining sleeve and allows the device to be deployed. A very interesting engineering peculiarity of this device is it deploys from the middle towards the periphery which prevents the wind socking effect of the thoracic aorta and its high flow rates. The device is introduced through a sheath that has a balloon that provides a good seal and because of the typical way of providing the seal it allows the introduction of more than one catheter through that valve.

That device has undergone revisions and it is now called the C-TAG or conformable TAG which has been released in Europe and several other countries and is finishing regulatory trials in the USA for several indications including dissection and trauma in addition to the aneurysmal indications. Currently it remains investigational in the United States.

The Talent device, it is similar to the abdominal Talent and had inlaid stents in a polyester fabric. The proximal end can be an open web or an uncovered stent. It also comes in a variety of diameters, the profile is also still somewhat large at 22 to 25 french. It is available in tapered configurations and initially was only offered in a short length of 120 sonometer which required the use of multiple stents. This device had been modified last year to be deployed through an Xcelerant system which is much smoother, it also provides for a controlled deployment through what is called the Captivia system that completely retains control of the proximal stent until the final stages of deployment.
and it is now available in longer lengths of 200 cm which reduces the number of grafts that have to be used for one patient.

A further modification of that device is called the Valiant device, it has increased the peaks from 5 to 8 to decrease the pressure of each of these peaks on the thoracic aorta and also comes with long lengths of 220 mm and will continue to have about the same French size of 20 to 24 French. Again, this device remains investigational and has not been approved yet as of the day of this talk.

The TX2 device is made of Z stents and Dacron. It has two components, the proximal and distal components are separate, it also comes in a variety of diameters. The profile is 20 to 22 and typically requires a longer landing zone. However, the TX2 is the only thoracic device that has active fixation on both ends designed to reduce any chances of migration. The deployment of the TX2 is very controlled and requires a multistage deployment which allows for very accurate placement of the device.

This particular device, the TX2 has been modified last year to allow for an apposition to the lower curve of the arch by allowing the first stent to telescope into the second stent and this device is called the Pro-form.

Now that we have discussed briefly the availability of these devices and what is in the immediate pipeline for later this year, let us go over the clinical results. The traditional method of treating
descending thoracic aneurysms by open thoracotomy involves a fairly large incision in the left chest with clamping of the aorta and a fairly substantial recovery and even in the best results that are reported continues to have a mortality of nearly 9 percent, renal failure rate requiring dialysis of about 5 percent and a significant paraplegia rate of about 4 percent. And these are the best results out there.

I have summarized in the following few slides what can be expected from endovascular technology in reducing some of these complications. In the first column are the results of the FDA trial for the TAG device, in the second column the results of the TX2 and the third column the Talent device. In the fourth column I combined two control arms from the TX2 and the TAG to just give you a comparison of what can be expected from this endovascular technology and in the last column on the right side is a Eurostar data collection of multiple different pathologies and different devices which corresponds closer to what can be expected in real life rather than in a controlled trial for regulatory purposes.

You will immediately see that the technical success rate of these devices in the treatment of thoracic aneurysm is quite high and nearly 99 percent for all of the devices. The conduit here refers to an access to the common iliac artery in general, occasionally to the aorta which is higher than the femoral artery which is our usual access for the deployment of these devices and originally with the TAG device the patients required a conduit in about 15 percent of situations and this has remained
almost stable in most series about 1 in 10 or 1 in 8 patients will require a cutdown on the iliac artery to introduce these devices rather than on the femoral artery.

The issue of left subclavian artery revascularization is very variable. Initially with the TAG device which was approximately 12 years ago when we performed this particular study, every single subclavian artery that was covered was revascularized which resulted in a 20 percent incidence of revascularization. This has changed later on as more aggressive coverage of the subclavian artery has resulted and you can see it had dropped down to nearly 5 percent. This has now been changing again as more complications have been noticed and the incidence is going back up to 15 or 20 percent. The estimated blood loss is significantly lower in the TEVAR patients compared to the open procedure and the hospital stay is also markedly reduced in these patients.

The first major notable result that you can immediately see here is the mortality rate from TEVAR is significantly lower than those that can be expected from the open procedure for the treatment of the thoracic aneurysms. The paraplegia rate remains present and significant but is probably lower than the open repair procedure and it has been associated with several predicting factors. Probably the most notable of which is the presence of abdominal aortic aneurysms at the same time or in the distant past and in this paper from the University of Florida you can see that the risk of paraplegia can be quite high in patients with current abdominal aortic aneurysms. This has been also the same findings in a European collection of similar data.
Stroke rate remains present in these type of procedures and most likely is related to the manipulations of the thoracic arch with wires, balloons and introduction of these devices and is somewhere in the range of about 3 percent. The focal complication rates or major adverse event rates is significantly less than with the open procedure but continues to be quite significant.

The TAG results probably offer us the longest followup to give an idea of what can be expected over time and this is the 5 year paper that was presented in the Journal of Vascular Surgery 2008 and it actually shows that the aneurysm related survival after TEVAR continues to be significantly better than the open repair, mostly related to that initial drop off with the mortality of open procedures that is noted in the first 30 days.

The all cause mortality over the years quickly catches up as these patients start dying off from other conditions such as heart disease, cancer or other major problems. The freedom from reintervention is surprisingly better for the endovascular group which is slightly different than what has been the experience in the abdominal aorta with the abdominal endograft. And that is related to the magnitude of the operation that is carried out for the thoracotomy for the open alternative.

This survey which was actually carried out in 2006 gives you an idea of how quickly this technology was carried out from the treatment of abdominal aortic aneurysms into other pathologies. And as you can see from 2006 on the 2/3rds of the patients receiving endograft were actually being treated for aneurysms and quickly other pathologies were becoming the target of this type of intervention.
I will go briefly through several of these. I cannot address all of them but I will give you an idea about how things have progressed over the last several years. The first one that I will be discussing with you is the hybrid debranching. And that particularly refers to the involvement of branches both in the arch and in the viscera with the aneurysms and our inability to cover them without actually bypassing them first. This is an example of a patient who has a saccular aneurysm in the arch that is actually facing the left common carotid artery and the subclavian artery and to allow for the treatment of this with an endovascular repair without a complete thoracotomy, median sternotomy and hyperthermic arrest, we were able to do a carotid carotid bypass to the left subclavian completely debranching the area facing the aneurysm and use a stent graft to actually completely remove the aneurysm from circulation. And this is an arteriogram at the time of the implantation of the endograft showing the carotid carotid subclavian bypass and the exclusion of the aneurysm with an endograft.

This has also been carried out to the abdominal aorta, this is an example of the patient who has a previous surgical graft for the treatment of a descending thoracic aneurysm and developed an additional type IV thoracoabdominal aneurysm that starts below the old surgical graft and involves the visceral arteries, most notably the celiac, SMA and renal and as you can see a bypass was performed from the iliac arteries to reperfuse the renal, SMA and the celiac arteries followed by the placement of a thoracic endograft all the way in the abdominal aorta coupled with an abdominal
endograft totally excluded the thoracoabdominal aneurysm and allowing this patient to undergo a less morbid procedure than reopening the chest on somebody who had a previous thoracic repair.

In short, hybrid procedures with debranching had been used successfully to expand the applicability of recurrent endograft to patients who are older and could not undergo the open procedures or can actually now undergo the procedures with less mortality and morbidity. However, the relative safety of combining the open and endovascular procedures together is not very well demonstrated and will probably need further evaluation.

So far it appears that the arch debranching of the carotid and the subclavian can actually be worth the effort and the visceral debranching may actually be quite an involved procedure that still carries a significant morbidity and mortality and may not be as valuable as initially thought.

Once we go beyond the aneurysmal pathologies I will first describe to you the use of endograft as we currently understand them for the thoracic aortic dissection. As you know the thoracic aortic dissections are probably the most common aortic emergencies that we have to deal with as vascular specialists and can be a very large spectrum from a full blown aortic dissection or a very simple intramural hematoma that can progress to the dissection or vice versa.

This is a natural history and treatment algorithm that has been collected through the IRAD registry which includes several U.S. and European centers and it shows a very high mortality in the first two
weeks for Type A dissection which are the dissections involving the ascending aorta if these patients are treated medically. Half of these patients have expired by 2 weeks. That is why Type A dissection is considered a surgical emergency and the ascending aorta is treated typically surgically and that can reduce the mortality to about 20 percent. The Type B dissection which is the dissection distal to the left subclavian artery involving the descending thoracic aorta, if it is not complicated and treated medically has an acceptable mortality of less than 10 percent by two weeks. However, when complications develop the mortality can be very high unless the patient is treated surgically and the current management of dissection involves surgery for all acute Type A dissections, medical management for acute Type B that is not complicated although there is some evidence that maybe thoracic endovascular repair in these patients may over the long term decrease the complication rate of dissection. And the most important role of TEVAR has been now documented in the acute Type B that is complicated and we will go through this in a second.

The chronic stable Type B dissection without any aneurysmal degeneration is still best managed medically and the chronic Type B dissection that develops an aneurysm over time typically has been managed by surgery over the years although TEVAR has started to make some form of inroads in the treatment of these patients.

The complicated type B dissection typically is those who have end organ ischemia and malperfusion by involvement of the visceral vessels or have a rupture or suspected leak or those who have an
unrelenting back pain despite adequate medical treatment. Those who have refractory hypertension and rapid enlargement of the false lumen are also considered as complicated type B dissections.

How do you treat those patients with TEVAR relies on a very simple concept that if we can cover the entry tear where the connection between the true lumen of the aorta and the false lumen, is started typically distal to the left subclavian artery, we will improve the flow into the true lumen and induce the thrombosis of the false lumen thereby achieving our treatment without a major thoracotomy and replacement of this very fragile aorta and we can decrease the morbidity and the mortality of the treatment hopefully preventing late complications.

This is a quick panel in the top part of the slide that shows the false lumen and the true lumen in the thoracic dissection that is a Type B in this case and post treatment that shows an expansion of the true lumen by the thoracic endograft and the thrombosis of the false lumen on the outside. This is a recent case that presented to us last week of a relatively young gentleman who has an extension of his dissection into the superior mesenteric artery nearly causing a complete thrombosis of that artery and the patient had visceral ischemia and on this arteriogram you can see that the superior mesenteric artery is not filling from the true lumen and the left renal artery is also not filling so this patient also had very left renal perfusion and the creatinine was going up and as soon as we placed a thoracic endograft you can see on the bottom of this third panel the superior mesenteric artery starting to fill. Typically additional interventions can be done to improve the flow to all these visceral vessels and here you can see an approach from the true lumen through the false lumen to the left renal artery that
was stented and shows now filling of the left renal artery and SMA was also stented to improve the flow to the viscera and typically these patients can do very well and this whole procedure took less than 40 minutes to restore the flow to all these vessels but unfortunately this gentleman passed away because he had a prolonged period of ischemia before we got to him.

There has been some new investigational devices that have been studied lately to improve the treatment of the distal segment that’s typically not covered by a thoracic endograft and that’s with the use of an uncovered stent to expand it through lumen further and the results of this trial are not yet available and this is still not approved in the United States.

So what are the results of the use of TEVAR for aortic dissection. This is a meta-analysis that was presented in 2006 in the European Heart Journal and you can see that there’s a fairly high technical success rate but the hospital mortality is still appreciable at 5 percent with a complication rate of 14 to 18 percent but this is still significantly lower than the alternative of an open procedure. The surgical conversion rate is rather small at 2 percent and occasionally require adjunctive endovascular procedures to treat these patients.

The net effect is to actually reduce the complication rate of the complicated patients to that of those uncomplicated patients and you can see here in the solid line the mortality rate at 30 days of the stent graft is now closer to those of those treated medically and are uncomplicated than those who are treated surgically for severe complications.
This is a report on the results of these TEVARs that was published by the subcommittee of the Society for Vascular Surgery Outcome Committee and this reviewed five IDE studies including 85 patients and as you can see the mortality rate at 30 days is still about 10 percent but that is significantly lower than the open surgical alternative. As you can see also the complication rate remains quite significant as these are very sick patients.

This is a report on a review of the nationwide inpatient sample in the United States which is a database that reports on all the discharges from non-VA hospitals in the United States and as you can see the mortality rate with TEVAR has been reduced significantly in the treatment of these Type B aortic dissections.

The TEVAR can also – have been used in the hope of preventing future complications in this type of situation. So if the TEVAR is good to treat the complications can we use it in uncomplicated dissections to actually prevent the late aneurysmal degeneration. This hypothesis was tested by the INSTEAD trial which is a multi-center European and U.S. trial and unfortunately it included a lot of chronic patients but this was the report in circulation of 2009 that showed that at 2 years there is really no significant advantage of having used a TEVAR in the terms of improving the mortality over time. However, what was noticed is there was significant aortic remodeling around the endograft with a collapse of the false lumen around the endograft. This was something that was not completely expected because in these chronic patients the lamella between the true and the false lumen can be
quite thick and the expectation was that it would not expand but actually what the INSTEAD trial has taught us is that it actually still expands even if it is a chronic dissection.

The biggest problem with the INSTEAD trial is the randomization involved a fairly chronic group of patients and a new trial called the ADSORB trial is currently running in Europe to try and test the hypothesis, whether the early treatment in less than 14 days even in uncomplicated patients will actually provide long term benefits in these patients.

This is an example from our patients here to show how the treatment in chronic dissection or subacute dissections can actually be quite beneficial and improve on the open repair. This is a middle-aged gentleman who is a US Airways baggage handler who presented with severe back pain, has been found to have a dissection in his thoracic aorta in 2006 and as you can see over a two month period he progressed to a very severe enlargement of the false lumen that was quite rapid. This led us to treat him with an endovascular graft and as you can see this was performed in January of 2007 resulting in an exclusion of that segment of the thoracic aorta that was enlarging and by the following year the entire thoracic aorta has remodeled around the graft and the patient currently is completely free of any dissections and doing quite well. That is an image from 2010 showing the complete healing of the thoracic dissections.

How about in those patients with chronic aneurysmal degeneration? The results are not really very solid. This is a study from China that was published in 2010 on 84 patients and shows a very low
surgical mortality but unfortunately continues to have some late complications such as retrograde dissections, second TEVAR that required for endoleaks and some late deaths from rupture. Nonetheless, these are actually very good results in this type of patient population.

This is another publication for 2010 that evaluated the midterm results of TEVAR in Type B dissections in the chronic phase and had essentially no mortality in 14 patients with a clinical success rate of 86 percent, this is a very small series but it does show that the treatment of these chronic aneurysmal degenerations with thoracic dissections can actually be approached with TEVAR and endovascular treatment.

This is the remodeling curve and it shows that actually with TEVAR you have a large number of patients who had a complete remodeling even in the abdominal aorta while some have only in the thoracic aorta. Now the use of endograft has gone beyond thoracic dissections and aneurysms and has been used extensively for acute trauma and aortic transection which is a significant problem since the vast majority of these patients die even at the scene before they reach the hospital. We still get about 1500 patients that reach the hospital alive with an aortic transection. In the panel on the right you see a chronic degeneration of this in a very unusual patient who doesn’t die in the acute phase because at least 30 percent of these patients die in the hospital from the aortic injury. The typical site of injury is shown in that chronic pseudoaneurysm degeneration which is just distal to the left subclavian artery and the majority of these patients have a lot of other injuries including
intracranial, long bone and abdominal injuries. The non-fatal ones which are very few can present with false aneurysms over time.

The standard treatment in the past used to be a left thoracotomy with single lung ventilations, systemic anticoagulation which can be quite hazardous in these patients with intracranial injuries, with required aortic cross clamping and a possible left heart bypass to decrease the problem. The endovascular repair clearly can be done in a more expeditious way with less magnitude of the procedure, it can be done under local anesthesia with no cross clamping, it is a much faster procedure with a fast recovery and minimal anticoagulation can be used and occasionally we have done several of those patients without any anticoagulation. However, I have to caution you that this is still not approved for the use of these type of devices.

Just to give you a few examples, this is a 45-year old gentleman who had a motor vehicle accident and had a transection of the aorta that you can see in the panel on the left hand side in the descending thoracic aorta, slightly more distal than the usual location and on arteriography you can appreciate the area of the injury and this was easily treated with a thoracic endograft.

One of the problems is the fact that the thoracic aorta in these patients can be quite small, this is a 29-year old female who hit a tree while riding her all terrain vehicle and had both head, abdomen, pulmonary, spine injuries in addition to a thoracic transection as you can see pointed out by the arrow in the panel in the CT scan. And unfortunately, the aorta was quite small in this situation and
instead of using a very large thoracic endograft we used a collection of abdominal aortic cuffs in that location and that resulted in a complete sealing of the thoracic injury and avoiding a thoracotomy in these patients.

So the potential drawback of TEVAR is that we may not be able to seal it completely and the patient may continue to bleed or the device may migrate and it may form a new bleeding site or you can form a fistula to the esophagus and other injured structures in the neighborhood. The other problem is that these are young patients with long life span hopefully in front of them and we still don’t have a long term durability data on these type of devices in these young patients. We don’t have a graft that are specifically designed for these aortas that are hyperdynamic and the graft can occasionally not behave in that area the same way that we would like it to. Some instances of graft collapse have occurred due to oversizing and poor apposition.

So the potential drawback of TEVAR include the possible residual endoleak and bleeding that may result if the area of injury is not completed excluded or the graft can occasionally migrate and on some occasions have formed a fistula of the neighboring structures that are also injured by the blunt trauma. In addition, these are young patients that have a long life span in front of them and we still don’t have long term durability for these patients. As you can see this, in 2008 a patient that I treated all the way back in 1999 and these patients are going to live a long time and we need these devices to last a long time. We still don’t have grafts that are available specifically designed for these types of aortas and situations and as you can see on the right hand side these small aortas sometimes do not
allow the graft deployed as intended and the graft may protrude into the arch and this has resulted in graft collapse as you can see in this particular example which can be due to both graft oversizing and poor apposition to the thoracic arch in the areas of tortuosity.

However, despite all the actual and theoretical shortcomings of the use of these endografts in trauma in young patients, what are the results? These are studies – the one from Von Oppel was actually a review of the literature that included 87 studies and nearly 1500 patients and you can see that the mortality of open repair of the aortic transection can be actually quite prohibitive, about 15-16 percent no matter what the technique was used and the paraplegia rate can actually be very significant with the clamp and sew technique of nearly 20 percent and even with the use of distal reperfusion we are talking about 6 percent rate of paraplegia.

Even more concerning from the early 70’s to the early 2000’s, there has been no significant improvement in the results with open procedures with a very high operative mortality and a high paraplegia rate. This is a very long series from a very large center in Texas that showed that we are not making a whole lot of headway with our open treatment of these lesions.

This is a review that the American Association for Trauma commissioned in 1997 and included 274 patients from 50 centers and it showed that there’s a mortality of 31 percent related to the aortic source with a significant paraplegia with standard open repair. So this was not limited to one area
but these are the major trauma centers in the United States not able to achieve a very good outcome of these injured patients.

The reports of using endovascular technology in this pathology started coming out in 2006 and this is a collection of multiple small reports that first indicated that we can a very high technical success rate, a low mortality and essentially no paraplegia in these patients and this is our review until 2010 of our own series and it shows something that is now been duplicated around the country and the world that with open repair you still have a very significant mortality and paraplegia rate and with TEVAR and endovascular technology you can reduce the mortality and the paraplegia rate significantly. This has not been updated recently but we have had one case of stroke and weakness in the lower extremities since then but essentially since 2007 we no longer perform open repairs on aortic transections and all such patients are treated initially by TEVAR.

Now this is not to say that there are no complications with TEVAR over time and in the bottom part of this slide I mention to you the complications that we have encountered. But in general these days we still believe that this is the primary form of treatment for these patients. In general, we don’t have to cover the subclavian artery all that often and there’s only an occasional stroke from the manipulation of the arch. But in this particular case that is reported here, it was from an associated anonymous trauma.
This is a review that the American Association of Trauma did in 2007 and notice that the practice in
the United States has shifted dramatically over the previous three years and by 2007 two-thirds of all
transections in the United States are now managed by endovascular repair. And this is the
conclusion of that review that was published in the Journal of Trauma in 2008 – is that endovascular
repair has replaced open repair to a great extent resulting in a reduction in mortality and paraplegia
but also an increase in the graft related complications. This is a couple of examples from our series
of some of the type of complications. This is a young woman who was treated for a thoracic
transection and when she returned approximately 27 months later, she was complaining of
amaurosis and lightheadedness and on Duplex Ultrasound it appeared that there was a to and fro
motion in the common carotid artery and when we did an arteriogram there was clearly an
impingement of the collapsed endograft on the left common carotid artery. This also resulted in a
decrease in a pressure in the left carotid artery compared to the systemic pressure that’s causing the
transient ischemic attack. This patient had a conversion and did very well subsequent to that. Now
the conversions are usually not a major problem since they are done electively when the patient is
not as sick as the original transection.

This has led several companies to try and develop either modifications of current devices or new
devices specifically designed to handle these young hyperdynamic aortas that are smaller in size and
this is a picture of the C tag that has undergone clinical trials but is not yet approved in the United
States for use.
So in summary even the devices that are not designed for traumatic transections, the results of TEVAR are still superior to the emergency open repairs and although conversion may be required it can be done safely at a later date if needed. And hopefully the new modified devices will decrease the late graft complications.

I would like to discuss with you just one last example of the expanded use of thoracic endografts. Of course, I will not be able to discuss everything and this is one that sometimes we find ourselves at a complete loss of how to treat these patients with embolizing lesions that present with either blue toes or diffused embolizations to the feet that occasionally do not heal very well and may require toe amputations and occasional limb loss. The major problem with these is they also result in renal failure because of emboli to the kidneys. And this is an old report about what can be expected with these patients. The majority of the sources of these emboli is typically from the thoracic aorta and they have a very high recurrence rate, a very high mortality rate of about 60 percent over the period of followup in this study and a very high amputation rate.

So these are very difficult patients to manage, they have a very high mortality and morbidity if they are left alone and this is an example of a patient that we saw a few years ago who was a 62-year old truck driver who presented with blue toes on the left side and as usually also noted in these patients had a creatinine of 1.6 which is elevated and this is a patient who had a documented normal creatinine shortly before that episode and clearly that is related to the embolization to the kidney and
the CT scan showed a large atheroma in the thoracic aorta that was embolizing to the kidneys and to the feet.

This is an example of another section of the CT scan showing the extent of disease in the thoracic aorta. The patient refused our recommended treatment of the stent graft in March ’06 but he returned only 2 months later with a new episode of blue toes to the right and this time his creatinine had climbed to 2.4 and at this time he agreed to the stent graft coverage which we performed under intravascular ultrasound control without any contrast used. We identified where the plaque was and covered it with a thoracic endograft and this is his followup since.

He has had no recurrence and his creatinine gradually started to improve. He did not have any new renal infarcts and the luminal surface of the aorta is now much cleaner and as you can see here this is the area where the endograft was placed and the last followup actually is a little bit more recent then ’09 but the patient currently has had no recurrence with an excellent improvement in his kidney function.

So the sources of these embolizing lesions can be multiple. We should try to treat all of them if possible. This is another patient who had a repeated episodes with left blue toes and had weak but palpable left pedal pulses and as you can see the patient has also an abdominal aortic thrombus and a thoracic aortic thrombus and in these type of situations the IVUS tells us exactly which are the ones
that are embolizing and which are the ones that we need to treat. In the left panel you can see an IVUS picture showing the mobile plaque in the aorta and after it is covered with the endograft.

So these types of problems can be from different pathologies but however the consequences can be similar and we treat them all the same way. This is a 44-year old female who had abdominal and flank pain and was noted to have a three clogged endothoraic aorta, had splenic infarcts, renal infarcts and an SMA embolus. And this patient was also treated with a stent graft and typically we use again the IVUS for the control, the right side panel shows how angiography can be almost useless as it will miss the lesion almost entirely. So this patient had an SMA embolectomy and a stent graft coverage of the mobile thrombus with no complications and no recurrence.

This is a final case that I show you in a patient who had a very large mobile thrombus in the arch and you can see it here on a TEE and this again was covered very easily with an endograft and the patient had no further problem. So this was a quick status of the TEVAR as we currently practice it in 2010-2011. However, the future is even brighter since a lot of new devices are being developed and tested, that will have branches that will allow us to expand our treatment options all the way to the ascending aorta and the arch. We have been involved in the development of the single branch device on the left hand side and have already tested it in animals and hopefully the trials for the use of these in patients will start in 2012 or early 2013. The branch flap on the right hand side has been used in patients in Australia and in Europe and in one or two centers in the United States and again, we’ll
start entering more widespread clinical trials in the near future. These will offer a significant improvement to the treatment of pathology we have not been treating so far.

So in summary TEVAR has reduced the mortality and morbidity for the treatment of many thoracic pathologies and the role of thoracic endografts, so the treatment of these pathologies continues to expand and we are looking forward to improvements on the horizon that will increase the applicability to more patients, more anatomies and more pathologies allowing us to treat most of these patients with minimally invasive approaches. Thank you for your attention and we will try to update you in the future with another one of these talks.