Visceral Aneurysms: When to Watch, When to Intervene

An interview with Pierre Goffette, MD, on understanding the thresholds and treatment options for various types of visceral artery aneurysms.

What are your current thresholds for intervention in visceral aneurysms?

I divide this discussion between true aneurysms and pseudoaneurysms because the thresholds are completely different. For pseudoaneurysms due to inflammation or pancreatitis (eg, splenic, gastroduodenal [GDA], superior mesenteric artery [SMA], hepatic, or even renal aneurysms), trauma, or those occurring after surgery, the thresholds for treatment are very low. Even small aneurysms (2–5 mm) should be treated regardless of diameter because the risk of rupture for pseudoaneurysms is not related to their size. This type of aneurysm may (rarely) spontaneously heal, but in most cases, pseudoaneurysms will increase over time and eventually rupture. We should treat all of these aneurysms immediately after diagnosis, irrespective of their location or origin.

For true aneurysms, the treatment threshold is different and depends mainly on anatomic location. The threshold for most true splenic artery aneurysms is 2 cm in diameter at the largest axis. Even if peripheral thrombus is present, these aneurysms should be treated in cases of an overall diameter larger than 2 cm. Women of childbearing age should be treated regardless of the diameter because the risks increase significantly during pregnancy.

One of the vascular complications of portal hypertension, which could occur in cirrhotic patients, is the development of intrasplenic or extrasplicenic aneurysms. These lesions should not be treated systematically except in cases of aneurysms > 4 cm in diameter and in extrasplicenic locations. In most cases, multiple, diffuse, small aneurysms related to portal hypertension should be left untreated and followed by repeat CT or MRI examinations. Once the portal hypertension and underlying cirrhotic disease is treated (eg, via liver transplantation), the aneurysm may spontaneously decrease and completely disappear over time.

Other types of true aneurysms such as GDAs or those in the pancreaticoduodenal arcades, which can be caused by chronic hyperkinetic flow, should be treated as soon as they are diagnosed because they are at high risk of rupture, even when small in size. In such aneurysms associated with celiac trunk stenosis, inversion of the flow in the pancreaticoduodenal arcades to revascularize the liver or spleen needs to be preserved during the embolization procedure, which is sometimes a technical challenge.

For true hepatic or SMA aneurysms, the threshold for treatment is slightly lower than for splenic aneurysms. In most cases, we treat hepatic or SMA aneurysms when the large axis is > 1 to 1.5 cm.

The treatment of renal aneurysms is intended to prevent rupture either in the urinary tract or in the unclosed retroperitoneal space, as well as the development of systemic hypertension or renal failure in cases of intrarenal arteriovenous fistula development. Even small aneurysms could be the cause of changes to intrarenal hemodynamics and systemic hypertension and should, in this case, be treated endovascularly or surgically, depending on the type (saccular or fusiform) and location. In the case of isolated, nonsymptomatic aneurysms in the renal arteries, the treatment threshold is around 1 to 1.5 cm.

For both visceral and renal arteries, extraparenchymal aneurysms take priority over intraparenchymal aneurysms because the risks and severity of major rupture and hemorrhage seem significantly higher for proximal extraparenchymal lesions.

How have your thresholds evolved over the years that you’ve been in practice?

The threshold for aneurysm treatment due to pancreaticoduodenal arcade has evolved and is now very low. This was different 15 to 20 years ago. Considering this type of true aneurysm, the relationship between the celiac trunk or SMA stenosis and the development of hyperkinetic aneu-
Aneurysms was not well known. Only in the last 8 to 10 years has the relationship between these two conditions been established. The threshold for treatment of renal, hepatic, SMA, or splenic aneurysms has been established for 10 or 15 years, and it has not significantly changed. However, we actually can treat all of these types of aneurysms by endovascular approaches instead of a more aggressive, invasive surgical approach. It’s easier to treat these aneurysms now due to the evolution of endovascular techniques through a better understanding of peripheral conditions, as well as employment of neurovascular techniques. For the last 15 years, I have been performing peripheral and neuro interventions, applying neuro techniques for peripheral purposes with success. We know that the risks of rupture are very low in SMA or hepatic aneurysms < 1 cm, but we can treat these small aneurysms efficiently and safely with the endovascular approach. Most clinicians and patients prefer that these aneurysms are treated, because after treatment, the problem is solved. These patients, if left untreated, should have follow-up with CT scan, MRI, or ultrasonography each year or even every 6 months.

Are there different thresholds for patients with other underlying conditions?

Patients with vasculitis such as Ehlers-Danlos disease type IV who develop even very small, true aneurysms should be treated regardless of the size because the risk of rupture is very high due to intrinsic defects in the vascular wall. Aneurysms in patients with Ehlers-Danlos syndrome will invariably increase over time and should be treated as soon as the diagnosis has been established, preferentially by vascular reconstruction or segmental vascular exclusion instead of simple aneurysm coiling.

Is there a relationship between the treatment threshold and the type of material used? Is there any difference based on your intended therapeutic approach?

The threshold to decide if we treat is never directly related to the material we use. For example, a proximal 3-cm-diameter splenic aneurysm can be treated with coiling, stent graft placement, segmental vascular exclusion, or even potentially a flow diverter.

Ten years ago, we only used coils or glue, because we didn’t have very smooth and flexible coils and microcoils. We also didn’t have flexible stent grafts or flow diverters, and we couldn’t use an imaging-guided direct percutaneous approach in cases of inaccessible lesions due to vascular sinuosity or proximal obstruction. With the tools and techniques we have today, by preserving vessel patency, we can conservatively treat even large-neck and fusiform aneurysms that could have only been treated by segmental vascular exclusion before. Now, we can exclude the entire aneurysm and preserve the afferent arteries in more than 90% to 95% of cases. It is particularly important for splenic and renal function that we can treat extraparenchymal or hilar aneurysms while preserving the parent arteries and distal flow.

What are some advancements in access technologies and techniques for the treatment of visceral aneurysms?

By performing neurointerventions, including cerebral aneurysm embolization, I have the opportunity to use neuroendovascular tools for peripheral aneurysm exclusion. Over the last 10 years, many neurological techniques have been developed into dedicated peripheral applications. For instance, the use of a balloon remodeling technique was created initially for neurointervention by Jacques Moret 15 years ago. Ten years ago, one main limiting factor in treating visceral aneurysms with large necks was the risk of coils protruding outside the aneurysm or occluding the parent arteries. The first use of a balloon remodeling technique to increase coil density and avoid protrusion of coils in the parent artery was performed by Dr. Moret in 1997. This technique is routinely used in some centers to overcome limitations due to broad neck, unstable microcatheter, or to treat complex renal/splenic/SMA aneurysms. The combination of Onyx (Covidien) as an embolic agent with Onyx-compatible remodeling balloon has been used by several physicians to treat hilar renal and superior mesenteric artery aneurysms. To preserve the parent artery, we can use bare stents and coiling through the mesh of the stent with a microcatheter and microcoils. Alternatively, we can use kissing stents in cases of aneurysms located at bifurcations, which is often the case with renal arteries. To preserve vascularization of the kidney, we use a double-kissing stent or kissing-balloon remodeling technique and detachable coils. Another great technical advancement is the use of detachable coils instead of pushable coils. For neurointerventions, 20 years ago, we started utilizing exclusively detachable coils for cerebral aneurysm embolization, and now there are many types of detachable coils for peripheral applications provided by various companies (eg, Terumo Interventional Systems, Boston Scientific Corporation, Cook Medical, and Covidien).

This is a significant advancement because it has increased the safety of treatment of even large-necked aneurysms by reducing the risk of periprocedural distal embolization of coils, especially for splenic and renal locations.

Hepatic artery aneurysms are probably the easiest to treat, as there is dual flow to the liver (arterial and portal), and we can completely exclude segmentally the parent artery that is responsible for the aneurysm without any risk...
of ischemia to the liver. Hepatic aneurysms can be treated by different methods including coil packing of the aneurysm, segmental coil trapping of the parent artery, placement of a covered stent in cases of proximal or relatively straight distal artery, or a combination of bare stent and microcoils through the mesh.

The main challenge is with the SMA and renal arteries because we must preserve distal flow and therefore maintain parent vessel patency by using remodeling coils/Onyx techniques, stent grafts, or a combination of bare stent and microcoils. Conversely, in cases of extrapancreatic splenic aneurysm, we use a different approach. The splenic artery is sometimes difficult to navigate, even with small and soft microcatheters. However, in most cases of splenic aneurysm, we can perform segmental splenic artery exclusion by deploying coils distally and proximally. Coil placement on both sides of the aneurysm is safe because there is enough collateralization through the gastric and pancreatic arteries, and this collateralization will revascularize the spleen at the ileum and help to preserve the intrasplenic blood flow.

I believe that the medial or proximal part of the splenic artery can be completely excluded without risk. It is probably the best treatment for splenic aneurysms, especially for pancreatitis-related pseudoaneurysm.

As mentioned previously, pseudoaneurysm due to inflammation, pancreatitis, trauma, and mycotic aneurysm should not be treated by packing the aneurysm alone. These pseudoaneurysms should be treated by segmental artery exclusion because the aneurysm is secondary to progressive regional arterial wall deterioration. If we only treat the aneurysm, the patient is at risk of aneurysm recurrence on both sides of the occluded neck because the wall is destroyed by the inflammatory process. In this case, the best and only efficient and safe treatment is to completely exclude the parent artery, distally and proximally, to be sure you’ve completely solved the regional problem. Placement of a covered stent with extensive proximal and distal landing zones could be an acceptable alternative.

Stent grafts may be useful to preserve the distal vascularization. We have used coronary stent grafts because of their high flexibility; they can be navigated through tortuous arteries. These balloon-expandable stent grafts are mounted on very thin microcatheters and can reach distal aneurysms. Coronary stent grafts are limited by the length and diameters available, which range between 9 and 22 mm and 2 and 4.5 mm, respectively.

Inaccessible small aneurysms or pseudoaneurysms in the gastroduodenal or pancreaticoduodenal arcades may also be treated with liquid embolics, such as N-butyl cyanoacrylate glue or Onyx instead of coils. If we cannot reach a distal aneurysm due to a tortuous access, we place a small catheter as close as possible to the aneurysm and inject a mixture of glue diluted by lipiodol in variable ratios depending on the flow and distance between the point of injection and the target. We can inject the glue slowly, moving distally to exclude both the aneurysm and the arterial segments beyond and behind the aneurysm. This is the so-called front-and-back-door occlusion.

In the same way, for inaccessible aneurysms, we can use liquids embolics injected through collaterals when the main artery has been occluded for another reason and the aneurysm still grows or after previous artery occlusion, or if coils have been placed but were not sufficiently packed. The aneurysm remains open because collaterals revascularize the aneurysm, requiring navigation of very thin neuro microcatheters through tortuous collaterals to occlude the aneurysm using Onyx or glue.

In cases when the aneurysms cannot be accessed by an endovascular approach or if proximal injection of liquid embolic agents is considered too dangerous, we can use a direct percutaneous ultrasound/CT-guided approach. This method could be used not only for intraparenchymal aneurysms in the spleen, liver, kidney, and pancreas, but also for extraparenchymal aneurysms, especially for SMA, GDA, or pancreaticoduodenal aneurysms that we cannot access safely.

Using Dyna CT imaging guidance or conventional spiral CT, an 18-G guiding needle is first placed from the abdominal or back entry site to the target to stiffen the tract, and a microcatheter is navigated through the external needle into the aneurysm. Thrombin or even glue is slowly injected to get an immediate occlusion. Sometimes, you can fill the aneurysm with microcoils. If the lesion is clearly visible by ultrasonography, it’s easy to place the needle through the splenic/renal or hepatic parenchyma into the aneurysm. The needle tip is clearly visible in the aneurysm by using color duplex ultrasonography. This is a major improvement in the treatment of visceral aneurysms inaccessible by an endovascular approach.

Are there any other devices or techniques that you like to use?

In cases of small aneurysms, there is a risk of perforation when you place the first coils. If this occurs, the coils should be completely placed and detached as quickly as possible to stop the bleeding. When using the balloon technique, inflation of the balloon stops the flow or the bleeding if it occurs and helps to solve the problem. During placement of the first coil in a small aneurysm, the remodeling balloon technique is very useful to avoid or address bleeding complications.

Another interesting technical approach to treat pseudoaneurysms with liquids while avoiding distal untargeted
embolization is to inject liquid embolic or glue though the microcatheter just in front of the aneurysm. The exact volume of contrast media necessary to fill the aneurysmal cavity and segmental arteries in front and back is estimated. Before injecting the glue, epinephrine, a vasoconstrictor, is injected to induce occlusive spasm of the artery distal to the aneurysm. Using this technique, there is no risk of glue migration far into the distal arteries and parenchyma.

Are there any clinical scenarios in which you prefer to use a surgical approach?

The remaining indications for a surgical approach for visceral aneurysms are few, even for the less common types of fusiform aneurysms. These aneurysms are normally not treated if the dilatation is less than two times the normal diameter of the artery. These may be treated with a combination of stents and coils, stents grafts (often too rigid), as well as new devices used for neurointervention, such as flow diverters or multilayer uncovered metallic stents. Due to vascular intima remodeling combined with modification of the hemodynamic flow leading to progressive thrombotic phenomena inside the aneurysm, the placement of such a new device leads to complete aneurysm occlusion in most cases while the arterial lumen is kept patent. Flow diverter stents are more and more often used to treat aneurysms with very large necks or that cannot be managed by a remodeling technique or covered stent placement because of insufficient safe landing zone. When using a covered stent, especially for renal aneurysms, we often do not have sufficient landing zones on both sides of the aneurysm. This angiographic condition seems to be a good indication to use a flow diverter stent because there is no need for a landing zone with flow diverter implantation. Flow diverters keep the side branches patent, which is the main advantage of these devices compared to stent grafts.

Physicians from Italy and France have used multilayer stents to treat fusiform renal artery aneurysms or visceral aneurysms that cannot be coiled for technical reasons. Preliminary results of the use of multilayer intra-arterial stents for peripheral applications are very promising. However, flow diverter placement requires dual-antiplatelet therapy for a minimum of 4 to 6 months because of the thrombotic risk of the aneurysm. This angiographic condition seems to be a good motivation to use a flow diverter stent because there is no need for a landing zone with flow diverter implantation. Flow diverters keep the side branches patent, which is the main advantage of these devices compared to stent grafts.

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