

# Ask the Experts:

## Is Coverage of the Celiac Artery Without Revascularization Acceptable?



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As more endovascular procedures involving the visceral aorta are being performed, management of the branch vessels is a necessity. Clearly, maintaining perfusion to the renal arteries is necessary to avoid lifelong hemodialysis. More importantly, loss of perfusion to the superior mesenteric artery (SMA) is not compatible with life. However, the necessity of celiac artery perfusion is unclear. Under circumstances where aberrant hepatic arteries do not arise from the celiac artery, revascularization is irrelevant, as there is rich, redundant, collateral circulation to the spleen and stomach. However, in normal anatomy, the question is whether the celiac artery can be covered without revascularization. Blood flow from the hepatic vein is prominent, but it is unclear how much oxygenated blood is delivered to the liver and whether it is sufficient to maintain this organ. As a result, it is best to ensure some arterial circulation to the liver.

The gastroduodenal artery serves as a collateral pathway between the SMA and celiac arteries. When present, patent, and robust, this provides adequate blood supply to the liver and allows for coverage of the celiac orifice. Maneuvers can be performed to test this pathway, such as balloon occlusion of the celiac artery with concomitant direct injection of the SMA. However, if the vessel is prominent on CT angiography, these maneuvers are not necessary. In many situations, the celiac artery already has a stenosis, which makes coverage more reasonable,

assuming the gastroduodenal artery is patent. Under circumstances in which the gastroduodenal artery is absent, small, or diseased, revascularization of the celiac artery should be more highly considered.

It is also important to remember that without stenting, the celiac artery can serve as a source of a type II endoleak. If the endograft abuts the orifice, occlusion is not needed. However, if the aorta is aneurysmal in this segment, the endograft will not cover the orifice, and the celiac artery needs to be occluded to prevent retrograde flow into the aneurysm.



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This question is not only at the heart of addressing the risks and benefits of celiac coverage during thoracic endovascular aortic repair (TEVAR), but also the evolution of techniques and technology in defining how to best limit patient morbidity and mortality. This question is relevant in nearly 10% of all patients undergoing TEVAR.

The evidence for or against celiac artery coverage during TEVAR is based on 20 single- and multicenter, retrospective case series collectively accounting for approximately 100 cases of celiac coverage during TEVAR. The

following is a breakdown of the evidence and issues surrounding celiac artery coverage during TEVAR to better understand when celiac artery coverage during TEVAR is an acceptable option.

### WHAT DO WE KNOW?

- A review of worldwide data on celiac coverage during TEVAR suggests that foregut ischemic complications occur in 8% of patients, foregut ischemia related-mortality occurs in 3%, and overall procedure-related 30-day mortality is 9%.
- Although there is a rich collateral network between the celiac artery and SMA, the existence of this network is variable and unpredictable. CT angiography and selective SMA angiography with celiac artery balloon occlusion testing might help identify these collaterals; however, both imaging techniques have limitations. Use of duplex ultrasound to evaluate hepatic blood flow with celiac artery balloon occlusion might overcome some of the limitations of angiography.
- Extensive thoracic aneurysmal disease is sometimes encountered, in which concomitant SMA coverage and revascularization is required during TEVAR, and coexisting SMA stenosis may require intervention.
- Surgical or endovascular celiac artery revascularization has its associated complications. Surgical celiac revascularization has a 10% morbidity rate, including bypass occlusion, and endovascular chimney/parallel/branch stent grafts have a 20% rate of associated endoleaks.
- Improvements in techniques and technology have enabled us to provide minimally invasive endovascular options for celiac artery revascularization during TEVAR with limited morbidity.

High-risk patients with complex thoracic aortic aneurysms that require lengthening of the distal stent graft landing zones beyond the celiac artery should be managed with a stepwise approach. This includes a careful analysis of a quality CT angiogram in identifying pancreaticoduodenal collaterals between the celiac and the SMA, as well as identification of celiac, SMA, or inferior mesenteric artery stenosis or occlusions. Furthermore, evaluation of thoracic arch anatomy and the feasibility and potential future implications of antegrade celiac chimney and/or retrograde celiac periscope are vital steps in optimizing patient outcomes. However, regardless of adequate workup and good intentions, one cannot disregard the unpredictable nature of foregut ischemia following celiac coverage during TEVAR.

There is no clear answer to the proposed question; one needs to tailor patient care to the patient's associ-

ated risk factors, the operative risks of celiac revascularization by endovascular or surgical means, and the physician's technical ability, as well as the implications of managing the associated complications of celiac coverage and revascularization. Patients with a replaced right hepatic artery originating from the SMA, well-developed and easily identified pancreaticoduodenal collaterals between the celiac and SMA, preexisting celiac artery stenosis, and a well-developed SMA without evidence of occlusive disease will tend to have a lower incidence of foregut ischemic complications following celiac coverage during TEVAR. Patients with inadequate celiac/SMA collaterals, preexisting occlusive disease in the SMA/inferior mesenteric artery, or independent common hepatic artery originating from the aorta will likely be at a higher risk of celiac coverage during TEVAR.



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There are multiple conflicting retrospective studies regarding routine coverage of the celiac artery during TEVAR. Because of the relatively low complication rates of routine TEVAR and the often-adequate collateral network from the superior mesenteric and gastroduodenal arteries, coverage of the celiac artery appears to be a reasonable compromise to ensure a good distal landing zone. Particularly in aneurysms or dissection pathology that usually extends past the oxbow and into the vertical portion of the distal thoracoabdominal aorta, the option to simply cover the celiac artery (with or without embolization) increases the simplicity and expediency of TEVAR. Certainly in an acute setting, such as malperfusion, rupture, or transection, TEVAR that covers the celiac artery in order to obtain an adequate seal and save the patient is acceptable. The more challenging scenario is in the elective setting, where some have argued that if an angiogram of the SMA shows a competent gastroduodenal artery and retrograde filling of the celiac artery, the likelihood of success of this strategy is high. Still, the fact that just because we can get away with it most of the time should not make celiac coverage during TEVAR completely acceptable.

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The challenging clinical problem is the fact that purpose-specific devices, namely branched or fenestrated thoracic endografts, are not routinely available for celiac arterial preservation during TEVAR. Custom devices that would potentially solve this clinical dilemma are likely years away from clinical trials or require a physician-sponsored investigational device exemption for access to industry-created or physician-modified endografts. The regulatory pathway for either of these options continues to prevent them from being mainstream. Open revascularization techniques, including debranching, defeat the purpose of the less invasive nature of TEVAR, leaving us with off-the-shelf creative solutions such as parallel endografts (the so-called periscope technique). Even this technique has potential issues, with gutter leaks and reliance on retrograde flow to perfuse the celiac artery, as well as uncertain long-term patency.

In summary, routine coverage of the celiac artery during TEVAR is a strategy that has been found by some groups to work most of the time with acceptable complication rates. I suspect this strategy really only exists due to the necessity of a better distal landing zone and the lack of appropriate endovascular grafts to revascularize visceral branch vessels. If we all had access to better devices or more durable alternative techniques, I believe celiac revascularization would be necessary during TEVAR involving the distal thoracoabdominal aorta. ■