Splenic artery as a conduit to facilitate visceral arterial reconstruction

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Splenic-to-superior mesenteric artery transposition was used to treat proximal celiac in-stent occlusion in one patient and to prepare a landing zone for thoracic endograft treatment of a dissection in another. The proximal splenic artery was used as a conduit to facilitate visceral aortic debranching in four patients. Using the splenic artery as a conduit to preserve or restore celiac perfusion without interrupting liver perfusion is feasible. (J Vasc Surg Cases 2015;1:130-3.)

Proximal splenic artery ligation rarely results in splenic infarction.[1-4] The proximal splenic artery is readily palpated. Its redundant length and lack of branches facilitates mobilization up to the superior edge of the pancreas. Collateralization from the gastroepiploic, the gastric, and the five to seven short gastric arteries can be visualized angiographically.

The advantages of using the splenic artery as an autogenous conduit to the celiac include preservation of antegrade hepatic flow and the ease of this single anastomosis. As a precaution, patients are immunized 2 weeks preoperatively (or 2 weeks postoperatively if not elective) with pneumococcal, Haemophilus influenza B, and meningococcal vaccines. Our first experience dates to 1999, when an 85-year-old woman presented with symptomatic celiac in-stent occlusion and superior mesenteric artery (SMA) in-stent stenosis.

The SMA stent and adherent plaque were removed via a longitudinal SMA arteriotomy. The splenic artery was divided 7 to 8 cm from its origin and sewed end-to-side to the SMA arteriotomy. When antegrade SMA perfusion was restored, celiac flow was restored retrograde via the splenic artery. The patient consented to the publication of this report.

CASE REPORT

Splenic artery transposition onto the SMA. A 48-year-old man was transferred with chest pain and congestive heart failure. Computed tomography angiography (CTA) demonstrated a 6.3-cm-diameter thoracic aortic aneurysm arising from a 6-month-old Stanford B aortic dissection extending to the celiac artery. Also evident were a left pleural effusion, cardiomegaly, left lower-lobe atelectasis, and a 4.8-cm adrenal radiolucent mass. The aneurysm measured 4.5 cm on CTA 6 months earlier. His blood pressure (280/125 mm Hg) was controlled with esmolol and morphine. Pheochromocytoma was ruled out. An echocardiogram demonstrated an ejection fraction of 28%, diminished from 45% 6 months earlier.

Indications for surgery were aneurysm size and progression, recalcitrant hypertension, recurrent chest pain, cardiac deterioration from the outflow resistance from the coarctation of the true lumen, and noncompliance with outpatient medical therapy. Thoracic endograft treatment was feasible with coverage of the celiac artery orifice.

Via midline laparotomy, the adrenal tumor was resected with the harmonic scalpel, preserving the normal adrenal gland. Frozen section showed an adrenal pseudocyst. The pancreas was gently retracted inferiorly. The diaphragmatic crus and the celiac plexus were divided to expose the celiac artery and the proximal 4 cm of the SMA. The celiac branches were preserved. A brisk Doppler signal was present in the distal splenic artery after test occlusion. With this evidence of collateral flow, the mobilized proximal splenic artery was divided 7 cm from its origin as it neared the posterior superior edge of the pancreas (Fig 1, *A*). The 6-mm-diameter splenic artery was sewn end-to-side to the proximal SMA without tension (Fig 1, *B* and *C*). No tunneling was required, and the anastomosis lay posterior to the inferiorly retracted pancreas. Large hemoclips were then used to occlude the proximal celiac trunk.

One week later, two overlapping 34-mm-diameter thoracic aortic endografts (W. L. Gore, Flagstaff, Ariz) were implanted to exclude flow into the thoracic aneurysm and expand the true lumen. A spinal drainage catheter was placed preoperatively and removed on postoperative day 3. His discharge chest radiograph showed a reduction in the size of the heart shadow. He was discharged with a blood pressure of 150/78 mm Hg on a significantly improved antihypertensive regimen of oral amlodipine (10 mg daily), oral carvedilol (12.5 mg twice daily), and oral enalapril (20 mg twice daily). A surveillance CTA 11 months later (Fig 2) showed no endoleak, aortic diameter reduction to 4.9 cm from 6.3 cm, a normal spleen, and normal heart and lung.

Multivisceral aortic debranching. Four-vessel visceral aortic debranching (SMA, celiac, and bilateral renal arteries), using up to four grafts originating from the distal aorta or the iliac arteries, enables visceral aortic endograft placement. Long-term graft

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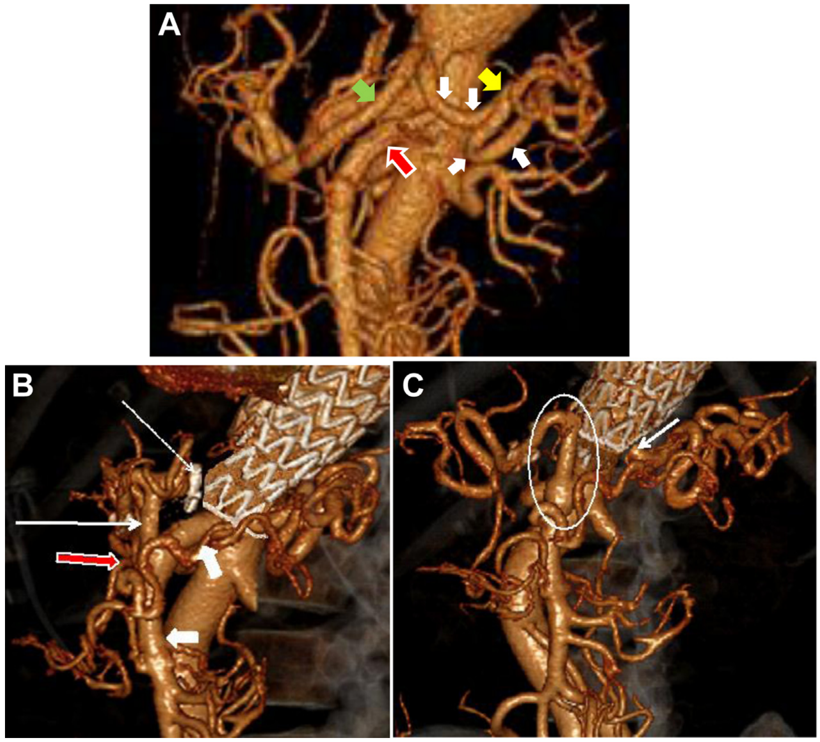

Fig 1. **A,** Visceral aorta before splenic artery transposition. The splenic artery (*white arrows*) is divided at the *yellow arrow* and is sewn end-to-side to the superior mesenteric artery (SMA) at the *red arrow*. The common hepatic artery is the *green arrow*. **B** and **C,** Computed tomography angiography (CTA) 11 months after transposition of the proximal splenic artery onto the SMA. **B,** Lateral CTA. The *thin solid white arrow* points to the transposed splenic artery. Its SMA anastomosis is at the *red arrow*. The *dotted arrow* points to the large hemoclips on the proximal celiac artery. The two *solid wide white arrows* point to the SMA. **C,** Anteroposterior CTA shows the transposed splenic artery onto the SMA within the *white ellipse*. The *white arrow* points to the ligated end of the distal two thirds of the splenic artery, which remains patent.

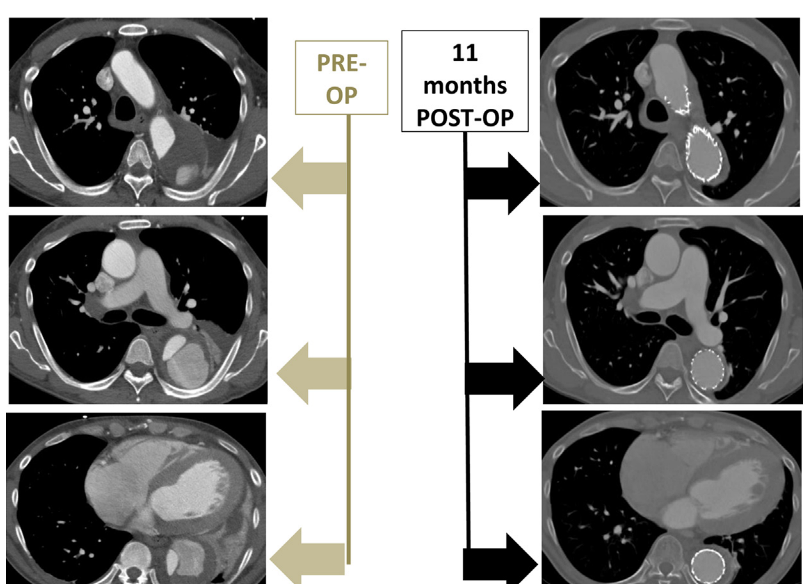

Fig 2. Preoperative and 11-month postoperative computed tomography angiography (CTA). Note at 11 months, significant reduction in aneurysm diameter, expansion of true lumen, disappearance of most of the false lumen, and resolution of left lower collapse and left pleural effusion.

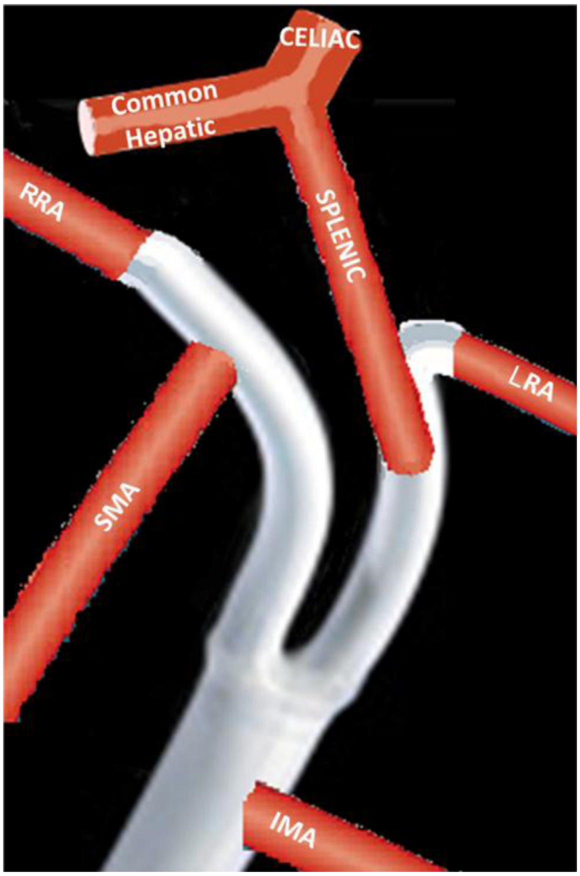

Fig 3. Illustration of visceral debranching. A single bifurcated graft anastomosis originates from the infrarenal aorta or from the common iliac artery. The inferior mesenteric artery (*IMA*) can be implanted on the proximal graft, if necessary. The splenic artery is sewn end-to-side to the left graft limb. The left renal artery (*LRA*) is sewn to the end of this graft limb. The transected proximal superior mesenteric artery (*SMA*) is sewn end-to-side to the right graft limb. The right renal artery (*RRA*) is sewn to the end of this graft limb. The proximal celiac artery is ligated.

patency data are limited by the small size of individual series, survivability of the operation, the spectrum of symptoms associated with single graft occlusion, and life expectancy.[5-10]

In four patients, a single bifurcated graft was implanted (Fig 3) that uses the low resistance of the renal artery circulation to improve graft rheology. The proximal splenic artery was used to facilitate this procedure. Via a midline laparotomy, the planned inflow site (terminal aorta or iliac), the splenic, proximal celiac, SMA, and renal arteries are mobilized. The aorta or iliac inflow anastomosis is completed. The inferior mesenteric artery is implanted, if patent, on the graft proximally. The SMA is transected near its aortic origin and sewn end-to-side to the right limb of the bifurcated graft. SMA perfusion is restored.

The right renal artery is then divided and sewn to the terminus of the right graft limb. The splenic artery is divided before passing behind the pancreas and sewn to the side of the left limb of the bifurcated graft. Its 7-cm length permits the left graft limb to gently arc toward the left renal artery. The left renal artery is then sewn end-to-end to the terminus of the left graft limb. The celiac artery origin is then occluded. The low outflow resistance of the renal circulation at the end of each prosthetic graft limb leads to a high steady graft flow rate independent of the increased resistance observed in the visceral circulation between meals.

DISCUSSION

Endovascular techniques are evolving to reduce the historic morbidity and mortality from visceral aortic surgery. Using the splenic artery as a conduit offers another opportunity to reduce the duration and complexity of visceral aortic surgery. Hepatic or gallbladder complications from ischemia associated with aortic debranching is reportedly uncommon, although limited follow-up is available. One series of 46 patients[11] reported a dismal 1-year survival of 45%; 13 were alive and had patent hepatic/celiac perfusion out to 5 years. The paucity of patients hinders meaningful determination of the incidence of ischemic complications or their relationship to clamp time, conduit choice, graft conformation, or baseline hepatic function.

When the splenic artery is used as an autogenous conduit leading to the celiac trunk, there is no hepatic or gallbladder ischemia time, no dissection near the porta hepatis, and only one anastomosis. This approach should reduce liver and gallbladder complications (as uncommon as they may be) both acutely and over the long-term. For those performing celiac trunk revascularization by transposing the gastroduodenal artery onto the right renal artery, splenic artery transposition may be useful if the gastroduodenal artery is small or aberrant or the renal function is marginal.

CONCLUSIONS

Using the proximal splenic artery as a conduit leading to the celiac artery does not interrupt hepatic or aortic perfusion and facilitates visceral aortic debranching procedures for endograft and celiac revascularization strategies.

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