

# Partial Splenic Artery Embolization

Paired with careful planning, this alternative procedure is a viable consideration for hypersplenism and portal hypertension complications.

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Partial splenic artery embolization (PSE) has been used for a wide range of indications, including the control of bleeding in blunt splenic injuries, portal hypertension complications, and hypersplenism due to various etiologies.<sup>1</sup> The higher incidence of complications, including septic shock, abscess formation, and postembolization syndrome, made PSE less popular compared to transjugular intrahepatic portosystemic shunt (TIPS) for portal hypertension.<sup>1-3</sup> Many of these complications were due to near-complete embolization of the spleen and not using adequate antibiotics. The complication rates are significantly decreased with antibiotic prophylaxis, adequate pain control, and limited volume embolization.<sup>4</sup> We discuss the indications, relevant anatomy, preprocedure evaluation, techniques, complications, and postprocedure care of PSE for hypersplenism and other portal hypertension complications in this article.

## INDICATIONS FOR TREATMENT

PSE can be used in portal hypertension complications such as hypersplenism, hepatic encephalopathy, and variceal bleeding.

*Hypersplenism* refers to a clinical syndrome characterized by splenomegaly, a variable combination of anemia, leucopenia and/or thrombocytopenia, compensatory bone marrow hyperplasia, and improvement after splenectomy.<sup>5</sup> Thrombocytopenia in portal hypertension is

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Partial splenic artery embolization may be a better choice than splenectomy, particularly in severe hypersplenism.

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due to the dual mechanism of splenic sequestration of platelets and reduced hepatocellular function. TIPS treats portal hypertension but does not improve liver synthetic function and has not been found effective in hypersplenism.<sup>6</sup> On the other hand, PSE has a direct effect on the spleen and may cause improved hepatic function.<sup>1</sup> The improvement may be due to an immunologic mechanism, or because of decreased splenic venous flow, leading to compensatory increase in flow in the hepatic artery and superior mesenteric and vein, which may result in more nutritious flow of blood to the liver.<sup>1</sup> PSE may be a better choice than splenectomy, particularly in patients with severe hypersplenism—defined as a platelet count of < 75,000/ $\mu$ L and/or white cell count < 2,000/ $\mu$ L in conjunction with splenomegaly.<sup>7,8</sup>

Hepatic encephalopathy is a known complication of both portal hypertension and creation of TIPS. PSE has been used to control hepatic encephalopathy in patients with splenomegaly and spontaneous splenorenal shunts.<sup>9</sup>

PSE, in combination with balloon occlusion retrograde alcohol embolization, can be useful in cases such as splenic vein thrombosis where TIPS may not be effective.

PSE can be especially beneficial if hepatic encephalopathy is not responding to conservative measures and surgical options including liver transplantation are not readily available.

In general, TIPS is the preferred technique over PSE for variceal hemorrhage secondary to portal hypertension. However, PSE in combination with balloon occlusion retrograde alcohol embolization can be particularly useful in cases such as splenic vein thrombosis where TIPS may not be effective.<sup>10</sup> It can also be used as an alternative to TIPS if the portal and hepatic venous anatomy is so distorted that TIPS becomes technically difficult.

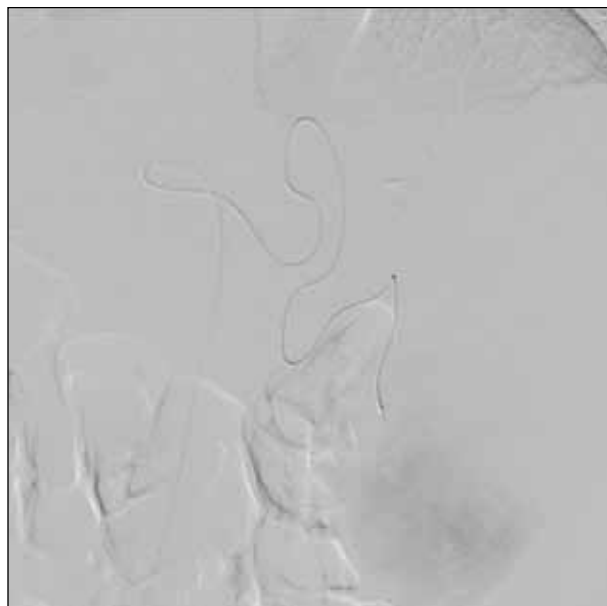
PSE has also been used for other portal hypertension complications, such as portal hypertensive enteropathy or impaired hepatic function.<sup>1,10</sup>

## CONTRAINDICATIONS

PSE causes decreased portal venous flow, which, in combination with an increase in platelet count, can cause portal or splenic vein thrombosis.<sup>11,12</sup> Hepatofugal flow should be considered a contraindication to PSE. Other relative contraindications include severe infection, abnormal coagulation status, and decompensated liver disease in its terminal stage.

## PREPROCEDURE PREPARATION

PSE, like splenectomy, can theoretically increase the risk of infection by encapsulated organisms including *Streptococcus pneumoniae*, *Haemophilus influenza* type B, and *Neisseria meningitidis*. Consideration should be given to vaccines such as 23-valent pneumococcal polysaccharide vaccine (PPV-23), H influenza type B conjugate vaccine and meningococcal vaccine, which are used in patients at risk of overwhelming postsplenectomy infections. PPV-23 is recommended for adults or children older than 5 years who are scheduled for elective splenectomy. It must be given at least 2 weeks before splenectomy or, in the event of emergency splenectomy, 2 weeks after splenectomy.<sup>13</sup> Similar guidelines can also be used for PSE. All patients should be given proper information to reduce infectious complications. Preprocedure broad-spectrum antibiotics may be administered, although it



**Figure 1.** Microcatheter advanced into the inferior splenic artery.

is not evidence based. Preprocedure imaging such as computed tomography (CT) or MR, if available, could be helpful for planning.

## TECHNIQUE

After arterial access is achieved, a 5-F, 10-cm sheath is placed using the standard Seldinger technique. A 4- or 5-F catheter with cobra head configuration is generally used to access the splenic artery. Other catheters, like a Sos or Simmons, can be used in technically difficult cases to access the splenic artery. A high-quality diagnostic splenic artery angiogram should be obtained to identify the branches to the pancreas like the dorsal pancreatic artery and greater pancreatic artery.<sup>14</sup> The catheter is advanced beyond the last major pancreatic branch. The catheter can be further supported with sheaths such as the Destination sheath (Terumo Interventional Systems, Somerset, NJ), which can be placed in the celiac or proximal splenic artery. The splenic artery usually divides into superior and inferior terminal branches near the hilum.<sup>14</sup> Microcatheters can be used to further subselect the terminal branches (Figure 1). The middle or lower pole splenic branches are usually subselected due to lower risk of pulmonary complications such as atelectasis, pneumonia and pleural effusion, or pain, which are more common with upper lobe embolization.<sup>10</sup>

We use Embospheres (Merit Medical Systems, Inc., South Jordan, UT), specifically 300- to 500- and 500- to 700-  $\mu$ m size for embolization. It may be mixed with 80 mg of gentamycin and injected slowly. Other embolization agents, such



Figure 2. Postprocedure CT showing infarction of lower third of the spleen.

as Gelfoam, gelatin sponge, polyvinyl alcohol, cyanoacrylate, and coils, have also been used.<sup>1,14</sup> Embolization should stop when an estimated 30% to 40% of the spleen has been devascularized to reduce complications.<sup>15</sup> A second embolization can be performed after 1 month if adequate therapeutic response has not been achieved. Embolization of more than 70% of splenic parenchyma is generally not recommended.<sup>16</sup> Nonselective partial embolization is an alternate technique with the catheter more proximally in the main splenic artery but beyond the origin of major pancreatic branches, and embolic particles are injected until the parenchymal blush is reduced. With the availability of microcatheters, we prefer to be as selective as possible. Performing portal pressure evaluation via a transjugular route is not recommended because it may give variable results.<sup>1</sup>

## POSTPROCEDURE CARE

All patients should be admitted to the hospital for postprocedure care. Postembolization syndrome of fever, left upper abdominal pain, nausea, and anorexia are extremely common after splenic artery embolization. All patients should be given patient-controlled analgesia (PCA) for pain control. Antibiotic prophylaxis with 250 to 500 mg per day of amoxicillin or 500 mg per day of phenoxymethylpenicillin, or other alternatives such as cotrimoxazole or erythromycin are given after splenec-

tomy.<sup>13</sup> Similar prophylaxis could be considered after PSE, particularly in high-risk patients. CT of the abdomen and pelvis with contrast can be performed after 1 day to evaluate the extent of splenic infarction (Figure 2). There should be a low threshold to repeat CT of the abdomen if there is any concern for splenic abscess.

## CONCLUSION

PSE is an alternative endovascular procedure for patients with various portal hypertension complications such as hypersplenism, variceal hemorrhage, hepatic encephalopathy, and portal hypertensive enteropathy. Adequate planning can significantly reduce the risk of postprocedure complications. It should be considered an important alternative to TIPS, particularly in patients with hepatic encephalopathy, severely impaired liver function, or unsuitable venous anatomy. ■

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