

# PERCUTANEOUS SPLENIC EMBOLIZATION OF THE SPLENIC ARTERY IN THE TREATMENT OF HYPERSPLENISM

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## SUMMARY

Percutaneous splenectomy was performed in 6 patients with hypersplenism. Peripheral blood cell counts improved in 5 of the patients. The authors review the indications, technique and complications of percutaneous splenic embolization. It is concluded that medical splenectomy is an effective method particularly to alleviate symptoms of hypersplenism.

## RESUMO

**Embolização esplénica percutânea da artéria esplénica no tratamento de hiperesplenismo**

Efectuou-se esplenectomia percutânea em 6 doentes com hiperesplenismo. Faz-se uma revisão das indicações, técnica e complicações da embolização esplénica percutânea. A fórmula sanguínea melhorou em 5 dos doentes. Concluiu-se que a esplenectomia percutânea é uma forma de terapêutica eficaz particularmente no alívio dos sintomas do hiperesplenismo.

## INTRODUCTION

The first splenic embolization was performed by Maddison in 1973<sup>1</sup>. Splenic embolization has since been performed in the treatment of bleeding esophageal varices in patients with cirrhosis, patients with splenic vein thrombosis and variceal bleeding, and in hypersplenism associated with portal hypertension<sup>2,3</sup>.

Arterial embolization of the spleen may be performed with two purposes: the interruption of arterial flow to the splenic artery or to one of its branches, or the ablation of the splenic parenchyma.

Embolization of the splenic artery may be proximal to the hilum or at the level of the hilum. Embolization of the splenic artery proximal to the hilum is performed in portal hypertension with varices, in splenic trauma and splenic artery aneurysms. Patients with portal hypertension and splenomegaly may have hypersplenism with thrombocytopenia. Preoperative splenic artery embolization can decrease portal pressure and increase platelet counts therefore it decreases operative risk for portosystemic shunt. In spite of the definitive occlusion of the splenic artery, there is reconstitution of the distal branches through collaterals, therefore the splenic ablation is only temporary. However it is enough to produce improvement of the hematological formulae in patients with thrombocytopenia.

Embolization of the splenic artery at the level of the hilum is used only for decreasing of the spleen vascularization immediately before surgical splenectomy. This type of embolization is indicated in patients with huge splenomegaly, esophageal varices and thrombocytopenia<sup>4</sup>. Following embolization, the enlarged spleen will decrease in size therefore the surgical intervention will be easier. On the other hand there will be some auto-transfusion of pooled splenic blood into the general circulation and the variceal flow will be eliminated. Besides that, the splenic sequestration of platelets will be blocked, thus there will be increasing efficacy of preoperative platelet transfusions.

Selective branch embolization is performed in cases of intraparenchymal splenic aneurysm or arteriovenous fistula from a splenic artery branch<sup>4</sup>. Following catheterization of the involved branch, coil or Gelfoam will be released.

Ablation of the splenic parenchyma is obtained with partial splenic embolization. Such a procedure is performed for the

treatment of thrombocytopenia and leukopenia in patients with hyperplenism, for the treatment of anemia in patients with thalassemia major and also in painful splenomegaly. Splenic embolization is also useful in patients with portal hypertension, recurrent variceal bleeding and thrombocytopenia. Following splenic embolization, there is a reduction in portal pressure and an improvement in platelet levels<sup>6</sup>.

Spigos et al introduced the technique of partial splenic embolization. They used Gelfoam (absorbable gelatin) soaked in antibiotics<sup>4</sup>. With partial splenic embolization, about 30% of the splenic parenchyma remains intact, it probably provides protection from an overwhelming bacterial sepsis<sup>7</sup>.

Following partial splenic embolization, there is usually an increase in platelet and leucocyte counts within a week. When there is more than 50% of embolized parenchyma, complications such as splenic abscess, splenic rupture and bronchopneumonia can occur. On the other hand when the splenic parenchyma embolized is 30% or less, the major complications do not usually occur, but only the occasional abdominal pain or sympathetic pleural effusion<sup>6</sup>.

Splenectomy improves the hematological formulae of patients suffering from hypersplenism<sup>5</sup>. As splenic embolization results in definitive ablation of the infarcted splenic parenchyma, it represents an alternative therapy in some patients with hypersplenism. In comparison to splenectomy, splenic embolization has less morbidity and mortality.

## MATERIAL AND METHODS

Partial splenic embolization was performed in 6 patients with hypersplenism, aged between 17 and 62, mean 46 years, 4 men and 2 women. Four patients had hypersplenism associated with portal hypertension, one patient had shistosomiasis and another had cicle cell anemia. Five patients have been treated once and one patient twice.

For embolization, a strict aseptic technique is important. The embolic material was soaked in an antibiotic solution prior to embolization. The solution consists of 100,000 units penicillin and 80 mg gentamycin in 100 ml of normal saline. Six hours before embolization all patients were begun on antibiotic pro-

phylaxis of penicillin 1.000.000 UI, and Gentamycin 3 mg/kg per 24 hours for a period of five days and continued with oral antibiotic.

The splenic artery was selectively catheterized from a femoral arterial approach and positioned under fluoroscopic control so that its tip lay in the distal part of the splenic artery distal to the major arteries supplying the pancreas. A preliminary splenic arteriogram was obtained to determine the exact splenic size and location of its pancreatic branches.

In one patient the embolization of the splenic artery at the level of the hilum was performed by placing the catheter well into the splenic artery and releasing 3 Gianturco coils of 3mm. With the blood stream they would be lodged at the hilar branches and proximal hilar bifurcation.

In the remaining five patients the partial splenic embolization was performed placing 4 to 6 pieces of 2x2x2 mm Gelfoam (Gelfoam) suspended in a gentamycin solution. With these small pieces of embolic material we managed the occlusion of small peripheral branches of the splenic artery and therefore partial splenic embolization. During embolization, small amounts of contrast material were injected through the catheter to fluoroscopically monitor the flow distribution within the spleen<sup>8</sup>. As fluoroscopy is not reliable enough to assess the degree of embolization, we injected four pieces of gelfoam and took an angiogram to check the degree of embolization. If necessary, a few more pieces would be injected and a second angiogram performed. The angiographic control of embolization was performed only 15 minutes after the embolic material was released. The embolization was stopped when approximately 30% of the splenic parenchyma was ablated.

A good result was not obtained in one patient and the embolization was repeated 3 weeks later<sup>4</sup>. The post embolization syndrome consists of fever, leucocytosis and abdominal pain. If the fever persists with leucocytosis an abscess should be suspected.

The patients did not eat for the next 6-8 hours after embolization, and they were on I.V. fluids. It is important to control the pain with meperidine 100 mg every 4 hours, for 72 hours.

## RESULTS

All of the patients, but one, showed some improvement of blood counts after splenic embolization.

The white blood cell counts rose from baselines of 1,400 – 5,100 to 13,000 – 23,000. Peak WPC counts occurred 2 weeks after embolization. Platelet counts increased after embolization and the peak was reached in one month. The red blood cells also increased in all patients. The spleen size decreased in all of the patients.

All patients were considered inoperable before splenectomy due to pancytopenia. After embolization, due to the increase in platelets, 5 of the patients were operated on.

All patients had post embolization syndrome with fever, leucocytosis and abdominal pain. In one patient, 70% of the spleen was embolized and he developed splenic abscess. In the remaining patients only 30% the spleen was embolized and this complication did not occur.

## REPRESENTATIVE CASES

### CASE 1

J.M.J.E. negro woman, 17 years of age with repetitive epistaxis and abdominal pain.

Hepatosplenomegaly, esophageal varices, portal hypertension due to shistosomiasis. Hypersplenism and pancytopenia, red blood cells 1.3000.00, WBC-3.500, platelets 33.000.

After splenic embolization with 3 coils, there was an increase in blood cells; red blood cells 3.5000.000, W.B.C. – 6.000, platelets 96.000. Following embolization the patient had strong pain in the upper left quadrant for 3 weeks and fever (38°) for 5 days.

A second embolization was performed. The blood cells increased again - red blood cells 3.800.000. WBC – 6.500, platelets – 170.000. The spleen size decreased.

As the blood formulae improved, splenectomy was performed (Fig. 1).

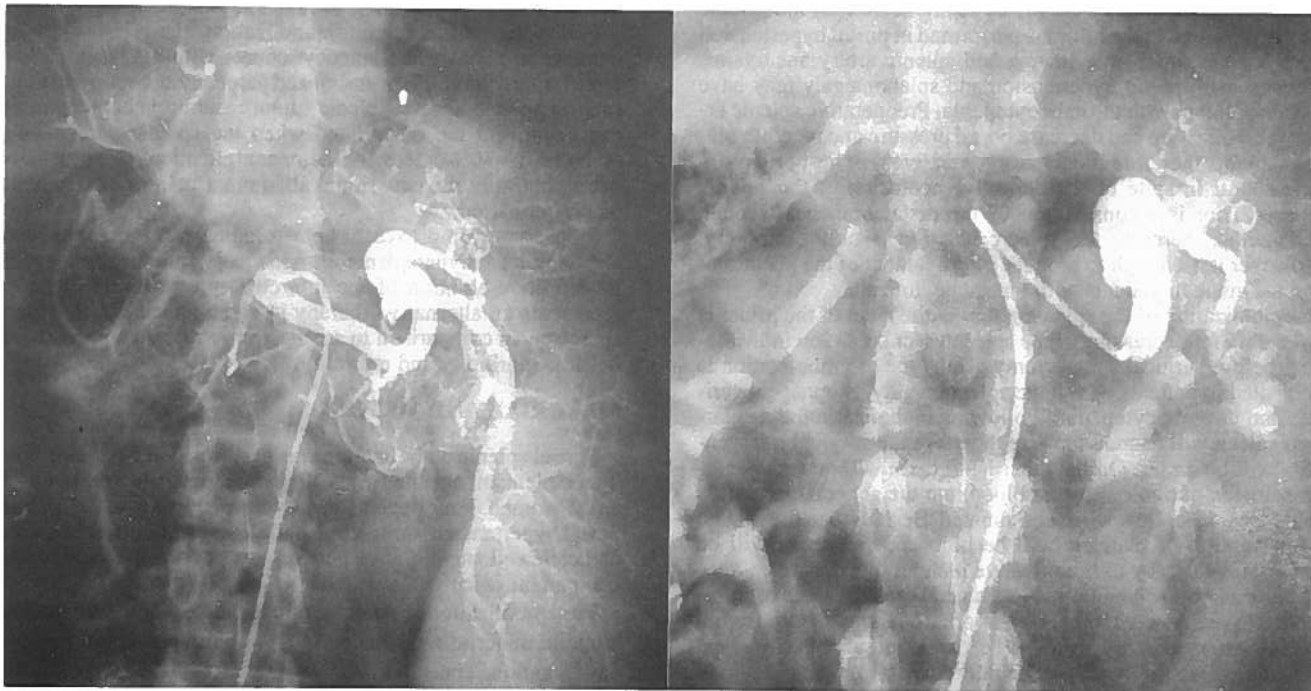


Fig. 1-a) Splenic arteriogram – Splenomegaly. b) After embolization with microcoils – some of the intrasplenic branches of the splenic artery are not shown.

**CASE 2**

A.M.A.M. white woman, 43 years of age. Lack of strength of the lower limb muscles, headaches. Splenomegaly. Pancytopenia due to sickle cell anemia with a glucose

deficiency – 6 – fosfate desidrogenase (Fig. 2). After splenic embolization with gelfoam, there was slight improvement of platelets from 80.000 to 140.000 and splenectomy was performed.



Fig. 2-a) – Splenic arteriogram – splenomegaly, two intrasplenic aneurysms of a splenic artery branch, one large and one small. b) After embolization with Gelfoam – the aneurysms are not shown.

**CASE 3**

B.A.O.L. – 52 year old white man. Hematemeses due to esophageal varices by portal hypertension, hepatosplenomegaly, pancytopenia. Following splenic embolization with gelfoam, the platelets increased from 101.000 to 282.000, the white blood

cells from 2.300 to 10.200 and the red blood cells from 1.860.000 to 2.320.000 (Fig. 3). There was slight abdominal upper left quadrant pain for 4 weeks and fever for 10 days. The spleen decreased in size following embolization. As the blood cell count improved the splenectomy was performed.

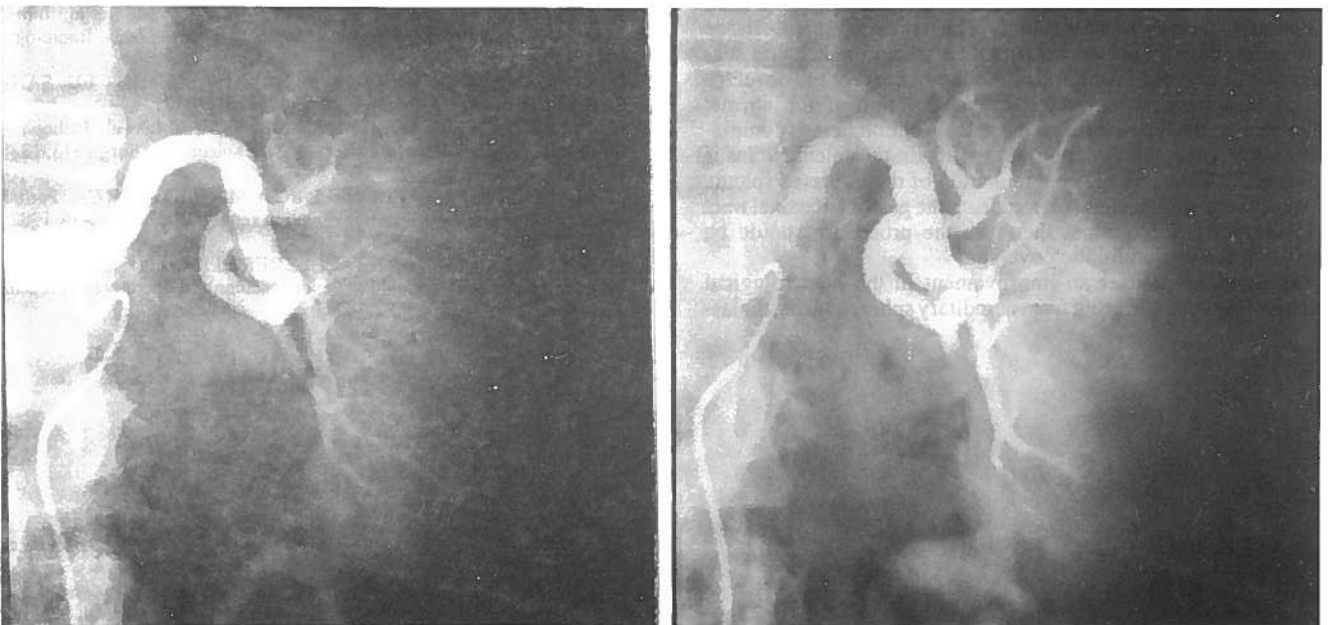


Fig. 3-a – Splenic angiography – splenomegaly. b) After embolization with gelfoam – some of the intrasplenic branches are not shown.

## DISCUSSION

With embolization of intrasplenic branches, the platelet counts increase more and the complications last longer than with splenic artery trunk embolization<sup>9</sup>. The increase in platelet counts and the duration of complications correlated with the size of splenic infarction after embolization. Our case n° 3, in which the platelets rose from 101.000 to 282.000, was the one with pain that lasted for a longer period of time.

On the other hand, when embolization is in the proximal splenic artery of the splenic hilum, the platelet counts increase less and the incidence of splenic infarction is lower. In this type of embolization the blood flow in the intrasplenic branches is preserved via collaterals. There are some factors involved in the increase in platelet counts after splenic embolization: decrease in blood flow to the spleen caused by splenic artery trunk embolization and splenic infarction. The last factor is the most important<sup>9</sup>.

When the splenic artery is occluded, the distal segment receives blood from the celiac axis through three major collaterals; the left gastric to short gastrics, the gastroduodenal to right gastroepiploic to left gastroepiploic, and dorsal pancreatic to transverse pancreatic to caudal pancreatic artery. The pancreatic magna may also be a collateral through the small pancreatic branches if the splenic artery is occluded distally<sup>6</sup>. The collateral can still be opened beyond the hilum, which will result in the infarction of the zone supplied by that branch because there are practically no anastomoses within the splenic parenchyma<sup>6</sup>. Thus, small liquid agents, small particles and powders are not used because they can cause infarction pancreatitis or opening necrosis.

Progressive anemia is the most common clinical abnormality produced by enlarged spleen in patients with cirrhosis. As splenectomy will eliminate the possibility of a selective distal splenorenal shunt in case the patient should bleed from varices, it is preferable to retain the spleen and yet reduce the anemia secondary to the spleen by partial splenectomy<sup>10</sup>.

Due to serious complications that may occur, such as splenic abscesses, septicemia, pneumonia and splenic rupture, splenic artery embolization was performed only preoperatively in patients with thrombocytopenia in order to improve the hematologic status<sup>11</sup>. With partial splenic embolization performed under aseptic technique and antibiotic profilaxis, the complication rate is low and acceptable<sup>3</sup>. Thus partial splenic embolization is an alternative therapy to splenectomy. The remaining splenic tissue probably provides protection from overwhelming bacteria sepsis. In addition partial embolization might prevent the development of splenic abscesses by the preservation of the normal direction of the blood through the splenic circulation. If completely interrupted, the direction of the flow in the splenic veins is reversed<sup>12</sup>. Thus there is contamination of the infarcted splenic parenchyma with bacteria carried from the gastro-intestinal tract via the portal circulation, therefore the procedure should be performed under antibiotic coverage.

Splenectomy causes an improvement in the hematological status of patients suffering from hereditary spherocytosis, thalas-

semia, idiopathic thrombocytopenic purpura, congestive splenomegaly and in renal transplant recipients<sup>3</sup>. Partial splenic embolization can be performed as an alternative in these situations.

Gerlock et al used partial splenic embolization for the treatment of immunosuppressant - induced hypersplenism<sup>13</sup>.

Goldman et al performed splenic artery embolization with Bucrylate in 15 patients. The procedure was performed to control bleeding gastric varices in patients with splenic vein thrombosis, to control anemia or leukopenia secondary to splenomegaly and to control bleeding esophageal varices in patients with portal hypertension<sup>10</sup>.

Yoshioka et al (1985) used steel coils for splenic embolization in patients with hypersplenism caused by portal hypertension<sup>9</sup>.

Splenectomy for massive splenomegaly has a high morbidity and mortality. For the purpose Hiatt et al performed a successful preoperative embolization of the splenic artery in 10 patients with huge splenomegaly due to myeloproliferation disorders<sup>14</sup>.

We conclude that splenic embolization is effective in controlling hypersplenism as an alternative to surgery.

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