The Egyptian Journal of Hospital Medicine (July 2017) Vol.68 (3), Page 1475-1480

The Effect of Partial Splenic Artery Embolization in The Control of Hypersplenism

Mohamed Haroun Hassan Ibrahim, Shrief Hamed MostafaAbogamra, Ahmed Samy Abdelrahman Abdelazeem
Radiology Department, Faculty of Medicine, Ain shams University

ABSTRACT

Aim of the work: A descriptive study to investigate the effect of partial splenic artery embolization in the control of hypersplenism.

Patients and methods: Fifteen patient with hypersplenism due to chronic liver disease were included.

This was a prospective study that included patients with thrombocytopenia (platelet count <70.000) which referred from the Tropical Department at Ain Shams University Hospitals to the Interventional Radiology Unit for partial splenic embolization.

Partial splenic arterial embolization was performed to reduce the hyperfunction of the spleen in patient with hypersplenism. **Results:** The mean age of the selected patients was about 48years old.

The most common cause of hypersp1enism is chronic 1iver disease due to HCV infection in 12 patients (80%), bi1harzial disease in 2 patients (13%) and mixed HCV and bi1harzial infection in 1 patient (7%).

The most frequent risk factors were past history of b1ood transfusion in 7 patients (47%), past history of surgery in 5 patients (33%), and pasthistory of parentral antibilharzia1 treatment in 3 patients (20%).

Bleeding tendency was found in 15 patients (100%), while abdominal pain was found in 12 patients (80%). As regards other symptoms, lower limb swelling and abdominal enlargement were noticed in 30% and 20% of patient respectively, anemic manifestations and recurrent infections were noticed in 53% and 47% of patient respectively.

Postembolization syndrome was the most common complication and occurred in all patients (100%). Newly developed ascites occurred in 2 patients (13%). Splenic abscess was developed in 2 patients (13%). No other complications had been reported.

Conclusion: Partial splenic arterial embolization is an effective method for the treatment of thrombocytopenia resulting from hypersplenism in patients with liver cirrhosis; however, the procedure is associated with complications, and hence must be performed only if clearly indicated and by an expert person.

Keywords: Splenic arterial embolization (SAE); Partial splenic arterial embolization (PSE); Hepatitis C Virus (HCV); Complete Blood Count (CBC); Ultrasound (US), Computed Tomography (CT).

INTRODUCTION

Hypersplenism is a pathological condition characterized by increased pooling ordestruction of the blood corpuscularelements by the spleen, which isoften managed by surgical removal ortrans-catheter ablation of the spleen[1].

Many disorders may lead to hypersplenism, including cirrhosis with portal hypertension, hematologicabnormalitiessuchasidiopathicthrombocytopenicpurpura, thalassemiamajor, and hereditary spherocytosis ; and diffusesplenicinfiltrationfrom primary malignanciessuchas leukemia and lymphoma[2].

Symptoms of hypersplenism may include abdominal discomfort, pain and respiratory distress, while signs include splenomegaly, thrombocytopenia, leukopenia and anemia [3].

An effective treatment for hypersplenism may be total splenectomy, however; it impairs the ability of the body to produce antibodies against encapsulated microorganisms and predisposes patient to sepsis. After splenectomy, a second surgical operation or additional transfusion may be required as the condition that is treated with thissurgery may recur [4].

The useofsplenic artery embolization is used for the intentional infarction of splenictissuesto reduce their consumptive activity. In 1973, Maddison reported the initial clinical trial with splenic arterial embolization, but severe complications of complete splenic infarction including splenic abscesses formation and other grave complications, such assplenic rupture, septicemia and pneumonia, have prevented its acceptance as a viable treatment option. Since then, many author sadvocated incomplete or partial splenic arterial embolization,

Received:7 / 6 /2017 DOI:
Accepted:16 /6 /2017 10.12816/0039691

in which a portion of the parenchyma of the spleenis left viable to preserve its immunological function[4].

Partial splenic arterial embolization, if adequately performed, is a safe and useful alternative tosplenectomy with improvement in anemia, leukopenia and thrombocytopenia[5].

PATIENTS AND METHODS:

- Study place: Interventional radiology unit, AinShams University Hospitals – Cairo – Egypt.
- Sample size: 15 patients.
- Inclusion criteria: Adult (≥18 years old) Egyptian patients with various causes of hypersplenism causing bleeding tendency with platelet count less than or equal 70.000/mm3.
- Exclusion criteria: Very old patients with other comorbities (extensive myocardial infarction, massive pulmonary embolism, renal failure) and uncooperative patients i.e. disturbed conscious level and totally non symptomatic patients.
- Toolsused: A 5 French sheath with 5 or 4 French - polyethylene catheter with a cobra head configuration – guide wire - fluoroscopy unit –iodinated contrast – embolizing material which was gelatin sponge hand cut bledges (Gelfoam).

TECHNIQUE OF PARTIAL EMBOLIZATION:

The potential benefits and risks of splenic embolizationare explained to each patient and an informed consentis obtained. All patients began antibiotic prophy1axis 6 hours before embo1ization (ceftazidime 1 gram, combined ampicillin-sulbactam 1 gram and metronidazole 0.5 gram).

Strict sterile technique, during the procedure, should be followed. The splenic artery is selectively catheterized from a femoral arterial approach using a 5-F polyethylene catheter with a modified cobra configuration. A preliminary splenic arteriogram is obtained to determine the exact splenicsize, configuration of the splenic artery, and location of its pancreatic branches. The catheter is then moved forward, if possible, so that its tip liesdistal to the last major pancreatic artery. Embolizing material (Gelfoamparticles 2 x 2 mm or Microsphere 300-700 μm) are mixed with contrast and then injected through the catheter. Embolization was concluded when an estimated 60- 70 % of the spleen was devascularized. A post-embolization anteriogramis obtained to determine the extent of devasculanization.

It is to be noted that partia1 sp1enic arteria1 embo1ization with proxima1 sp1enic arteria1 occlusion proved unsuccessful due to the abundant collateral circu1ation viashortgastric and gastroepip1oic arteries that reestablished the splenic blood supply around the occluded segment of the splenic artery. Partial SAE may be performed with one of two methods:

The first method (selective partial embolization):A few distal branches of the splenic artery are selectively catheterized, and embolized to achieve complete stasis in these branches whi1e severa1 other branches are 1eft untreated. Parenchyma1 phase angiograms may be used to estimate the volume of the remaining viab1e sp1enic tissue. Additiona1 branches then may be catheterized, and embo1ization may be repeated, until the desired effect isachieved. [4].

The second method (non-selective partial embolization): The working catheter tip ispositioned more proximally in the main sp1enic artery but beyond the origin of major pancreatic branches. Embolic particles are injected until the parenchymal b1ush is reduced. Contrast-enhanced CT may be used for follow-up examination[4].

Following SAE, all catheters and vascular access devices were removed, and hemostasis was achieved at the common femoral arteriotomy with manual compression[6].

RESULTS

This study was conducted to evaluate the effect of partial splenic embolization on blood elements (mainly the platelets count) in patients with hypersplenism to assesssafety of the maneuver. *The study was done after approval of ethical board of Ain Shams university and an informed written consent was taken from each participant in the study.*

Demographic criteria of the studied patient as regard age, sex with causes and riskfactors for the causes**(Table 1)**.

The most common cause of hypersp1enism is chronic 1iver disease due to HCV infection in 12 patients (80%), bi1harzial disease in 2 patients (13%) and mixed HCV and bilharzial infection in 1 patient (7%).

The most frequent risk factors were past history of b1ood transfusion in 7 patients (47%), past history of surgery in 5 patients (33%), and past history of

parentral antibilharzia1 treatment in 3 patients (20%).

Bleeding tendency was found in 15 patients (100%), while abdominal pain was found in 12 patients (80%). As regards other symptoms, lower limb swelling and abdominal enlargement were noticed in 30% and 20% of patient respectively, anemic manifestations and recurrent infections were noticed in 53% and 47% of patient respectively **(Table 2)**.

The reported complications after the maneuver **(Table3)** Postembolization syndrome was the most common complication and occurred in all patients (100%). Newly developed ascites occurred in 2 patients (13%). Splenic abscess was developed in 2 patients (13%). No other complications had been reported.

Table (1) Demographic criteria of the studied patient as regard age, sex with causes and risk factors for the causes.

Demographic Data		Number	Percentage
Sex	**Male**	9	60 %
	Female	6	40 %
Age	**<30y**	3	20 %
	30-50y	3	20 %
	>50y	9	60 %

Causes of hypersplenism	Number	Percentage
HCV infection	**12**	**80%**
Bilharzial infection	**2**	**13 %**
Mixed HCV and Bilharzial infection	**1**	**7%**

Risk factors for the cause	Number	Percentage
Blood transfusion	**7**	**47%**
Parentral antibilharzial treatment	**3**	**20 %**
Surgery	**5**	**33%**

Table (2) Shows symptoms of the studied patients.

Symptoms	Number	Percentage
Bleeding tendency	15	100 %
Anaemic manifestation	8	53%
Recurrent infection	7	47%
Abdominal Pain	12	80%
Lower Limb swelling	5	30%
Abdominal Enlargement	3	20%
Haematemsis or melena	8	53%

Table (3) Shows the reported complications after the maneuver.

Complications	Number of patients
Postembolizationsyndrome	15 (100%)
Ascites	2 (13%)
Splenicabscess	2 (13%)
Left sideeffusion	-
Portal or splenic vein thrombosis	-
Pancreatitis	-

DISCUSSION

Hypersplenismis a pathological condition characterized by increased pooling or destruction of the blood corpuscular elements by the spleen.

Hypersplenism can be diagnosed by the presence of splenomegaly, anemia, thrombocytopenia and/or leucopenia together with bone marrow hyperplasia in order to compensate for peripheral blood pancytopenia[7].

Thrombocytopenia is the most common symptom of hypersplenism and can cause spontaneous bleeding, complicating the successful control of variceal bleeding. Thrombocytopenia prevention can be achieved by decreasing splenic volume in patients with hypersplenism. In addition, PSE decreases the incidence of gastrointestinal bleeding caused by esophageal and fundal variceal rupture in patients with cirrhosis and portal hypertension[5]. Although many patient with hypersplenism are asymptomatic and do not require treatment, yet splenectomy may be performed to treat hypersplenism, but it is associated with immunologic impairment and increased susceptibility to overwhelming bacterial infection. In recent years, splenic arterial embolization is increasingly performed to treat hypersplenism. Although, patients treated with total splenic embolization were developed serious complications such as splenic abscess, splenic rupture and septicemia, yet those who were managed by partial embolization were greatly reduced the incidence of such complications [8].

Hypersplenism is not the only indication for splenic arterial embolization, but such procedure has an important role in management of splenic trauma and portal hypertension as well [7].

Characteristics of the study population and details of the procedure:

The current study was conducted to study the effect of partial splenic artery embolization to correct the values of the blood elements (especially the platelet count) in patients with hypersplenism and to determine possible complications of the maneuver.

To achieve these aims, the study included 15 patients with hypersplenism proved by bone marrow examination (all of them were complaining of chronic liver disease with consequent portal hypertension and hypersplenism). All patients were thoroughly examined and investigated before partial splenic embolization and then they were followed up after one month.

Splenic arterial embolization may be selective, where a few distal branches of the splenic artery are selectively catheterized and embolized, or nonselective, where the catheter tip is positioned more proximally in the main splenic artery but beyond the origin of major pancreatic branches. In current study, selective embolization technique was followed using gelatin sponge hand cut bledges (Gelfoam) which was mixed with contrast and injected until the parenchymal blush was reduced[7].

In particular, an emphasis on the principles, including limited volume embolization, sterile technique, antibiotic coverage, and adequate analgesia, has led to improved outcomes and widespread utilization in a variety of settings [9].

Occlusion of the splenic arterial supply during PSE leads to a decrease in splenic size secondary to ischemic necrosis. The splenic infarction rate appears to be an important indicator of PSE efficacy for the treatment of hypersplenism. Studies showed that embolization of < 50% of the spleen was associated with shorter hypersplenism relapse times, suggesting that PSE should cover a minimum of 50% of the spleen to be effective [7].

Comparison between the current study results with other nearly similar studies:

a) Regarding platelet count

Mean platelet count was 50,066 ± 17,575 /uL before the maneuver and changed to 176,733 ± 86,320 /uL after one month follow up.

This agrees with other authors that used Gel foam in splenic artery embolization in patients with hypersplenism and portal hypertension. Mean platelet count was 56,600± 5,000/uL before the maneuver and changed to 158,330± 12,000 /uL after short term follow up [8] .

So, results of this research showed that PSE is highly effective in improving thrombocytopenia in patients with chronic liver disease and hypersplenism.

a) Regarding WBCs count

The mean WBC was 3.073± 1.173 (x103/uL) before the maneuver and changed to 6.130±2.607(x103/uL) after that. This agrees with other authors[15].

So, the white blood cell count shows significant improvement after PSE

b) Regarding RBCs count

The mean RBC count which was 3.730± 0.56(x106/uL) before the maneuver became 4.1± 0.48(x106/uL) after one month. So, the red blood cell count shows also significant change after PSE.

In this study, two patients developed transient ascites which could be resulted either from hepatic decompensation secondary to splenic necrosis or from peritoneal inflammation. They resolved shortly after diuretic therapy.

Fortunately, the other possible complications of splenic artery embolization as pancreatitis, peritonitis, splenic abscess, portal or splenic vein thrombosis were not reported.

Complications of Splenic Embolization

Hematologic response and the severity of complications correlate with the amount of infarcted splenic tissue. Most interventionalists have attempted to achieve infarction in about 60% of the splenic mass.

The procedure-related complications were classified according to the Society of Interventional Radiology Standards of Practice Committee's classification of complications. Morbidity was defined as the occurrence of a complication within 30 days of SAE[9]. Several mechanisms may cause complications after complete splenic infarction:

1- Induced immunosuppression,
2- Anaerobic bacterial growth in the hypoxic tissue,
3- Percutaneous introduction of exogenous bacteria with catheter contaminated from the skin or secondary to bacterial contamination of the embolic particle.
4- Retrograde transport of enteric pathogensvia a reversed portal flow [4].

The most important complications of PSE are:

1-Postembolization syndrome

Postembolization syndrome, including pain, fever (below 39°C), paralytic ileus and vomiting, is the most common side effect, but it isusually regarded as tolerable by the patient themselves. Daily intermittent fever is usually related to the release of pyrogens by inflammatory cells inside the infarcted region. An injection of steroidscan therefore prevent pyrexia. Abdominal pain occurs for severaldays after PSE and can be controlled with Non steroidal anti-inflammatory drugs[10].

The post-embolization syndromeis the most frequent side-effect (78%) but it resolved rapidly in almost all the patients[11].

However this side-effect may last more than 1 week and require major analgesic administration and a long stay in hospital[12].

2-Pulmonary complications

Pulmonary complications of PSE, such as pneumonia, atelectasis, and pleural effusion, usually develop in the left lung and are associated with embolization of the upper pole of the spleen; this is due to poor left hemidiaphragm motions as a result of postsplenic-infarction left upper quadrant pain. Splenic embolization of the lower pole of spleen should reduce these complications. Also effective pain control by analgesics allows better lung expansion and thus minimizing the pulmonary [13].

3-Pancreatitis

Unintentional embolization of the pancreatic artery and the administration of contrast media may causepancreatitis after PSE, but theseproblems can usually be avoided by expectant management [17].

4-Splenic abscess, septicemia and peritonitis

An important limitation of total splenic infarction is the high incidence of splenicabscess and septicemiacaused by damaging the immune function of the spleen. PSE can reduce the incidence of splenicabscess, but somereportshave documented the development of splenicabscess after PSE[9].

In the case of splenic abscess, the most suitable therapeutic approach is still under debate. As suggested, percutaneous puncture and drainage of the abscess should be performed early to obtain bacterial identification and to evacuate most of the purulent collection .This treatment can result in a favourable outcome[16].

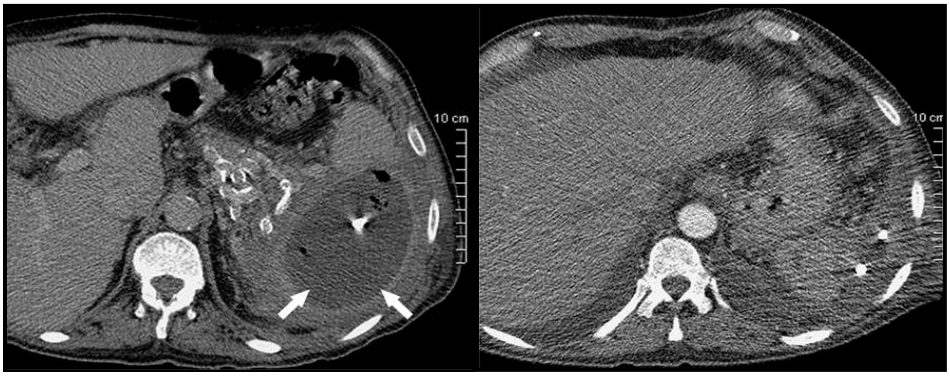

Figure (1): Splenic abscess after splenic arterial embolization.

5-Thrombotic manifestations

Decreased portal-vein flow and a rapid increase in the platelet count after excessive embolization may cause portal-vein thrombosis. Decreased splenic-vein flow may likewise cause splenic-veinthrombosis. Portal- or splenic-veinthrombosis should be treated by anticoagulation therapy [10].

6-Ascites

Transient ascites could result either from hepatic decompensation secondary to splenicnecrosis or from peritoneal inflammation. Usually, ascitesresolved rapidly after diuretic therapy [9].

CONCLUSION

Partia1 sp1enic embolization is an effective a1ternative method to splenectomy for the treatment of hypersplenismas it results in improvement of the hemato1ogical status with minimal morbidity and with preservation of the immuno1ogical ro1e of the remaining non-infracted sp1enic parenchyma.

There is statistically significant improvement in b1ood e1ements count (CBC) before and after embo1ization.

REFERENCES

1. **Peck-Radosavljevic, Aguilera N *et al.* (2011):** 1ry vascular neoplasms of the spleen: radiolgic-pathologic correlation. Radiographics, 24: 1137-1163.
2. **Athale, Kaste SC, Bodner SM, Ribeiro RC (2010):** Splenic rupture in children with hematologic malignancies. Cancer, 88:480–90
3. **Dwivedi MK, Pal RK, Dewanga L, Nag P (2012):** Efficacy of partial splenicembolisation in the management of hypersplenism. Indian J Radiol Imaging, 12:371-4
4. **Madoff, Denys A, Wallace MJ, Murthy R, Gupta S, Pillsbury EP, Ahrar K, Bessoud B, Hicks ME (2011):**RadioGraphics. Splenic Arterial Interventions: Anatomy, Indications, Technical Considerations, and Potential Complications, 25:191-211
5. **Hong MP, Lucas D, Novak Z *et al.* (2014):** Preoperative embolization of the spleen in children with hypersplenism. J VascInterv Radiol.,3:647–52.
6. G**aba, Sansalone C, Rondinara G *et al.* (2013):** Splenic artery steal syndrome after orthotopic liver transplantation: diagnosis and treatment. Transplant Proc., 25: 2594–2596
7. **Lee, Thompson H, Kumpe D *et al.* (2015):** Partial splenic embolization in five children with hypersplenism: effects of reduced-volume embolization on efficacy and morbidity.Radiology,209: 803-6.
8. **Yoshioka H, Kuroda C, Hori S,Tokunaga1 ,K Tanaka T *et al.* (2005):** splenic embolization for hypersplenism using steel coils. AJR; 144 :1269-74
9. **Alban Denys *et al.* (2014):** Embolic therapy of hypersplenism. Invest Radiol., 8: 280-1.
10. **Sakai T, Shiraki K, Inoue H *et al.* (2002):** Complications of partial splenic embolization in cirrhotic patients. Dig DisSci., 47:388–391.
11. **N'Kontchou G, Seror O, Bourcier V *et al.* (2005):** Partial splenic embolization in patients with cirrhosis: efficacy, tolerance and long term outcome in 32 patients. Eur J GastroenterolHepatol., 17: 179-84.
12. **Hirai K, Kawazoe Y, Yamashita K *et al.* (2006):** Transcatheter partial splenic arterial embolization in patients with hypersplenism: a clinical evaluation assupporting therapy for hepatocellular carcinoma and liver cirrhosis. Hepatogastro-enterology, 33:105–8.
13. **Israel D, Hassall E, Culham J and Phillips R (1994):** Partial splenic embolization in children with hypersplenism. J Pediatr., 124: 95-100.
14. **Nakai M, Sato M, Sahara S *et al.* (2006):**Transhepaticcatheterdirectedthrombolysis for portal vein thrombosis after partial splenic embolization in combination with balloonoccluded retrograde transvenous obliteration of splenorenalshunt. World J Gastroenterol., 12: 5071–4.
15. **Harned R 2nd, Thompson H, Kumpe D *et al.* (2014)**: Partial splenic embolization in five children with hypersplenism: effects of reduced-volume embolization on efficacy and morbidity. Radiology, 209: 803-6.
16. **Sakai T, Shiraki K, Inoue H *et al.* (2002)**: Complications of partial splenic embolization in cirrhotic patients. Dig Dis Sci., 47:388–391.
17. **Yoshida H, Mamada Y, Taniai N *et al.* (2008)**: Partial splenic embolization. Hepatology Research,38: 225-33.