Total embolization of the main splenic artery as a supplemental treatment modality for hypersplenism

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Abstract

AIM: To study the safety and feasibility of total embolization of the main splenic artery as a supplemental treatment modality for hypersplenism with thrombocytopenia or leukocytopenia accompanying liver cirrhosis.

METHODS: Fifteen consecutive patients with hypersplenism due to cirrhosis were enrolled in this study from January 2006 to June 2010. All patients underwent total embolization of the main splenic artery. Clinical symptoms, white blood cell (WBC) and platelet (PLT) counts, splenic volume, and complications of the patients were recorded. The patients were followed up for 1 and 6 mo, and 1, 2, 3 years, respectively, after operation.

RESULTS: Total embolization of the main splenic artery was technically successful in all patients. Minor complications occurred in 13 patients after the procedure, but no major complications were found. The WBC and PLT counts were significantly higher and the residual splenic volume was significantly lower 1 and 6 mo, and 1, 2, 3 years after the procedure than before the procedure ($P < 0.01$). Moreover, the residual splenic volume increased very slowly with the time after embolization. All patients were alive during the follow-up period.

CONCLUSION: Total embolization of the main splenic artery is a safe and feasible procedure and may serve as a supplemental treatment modality for hypersplenism with thrombocytopenia or leukocytopenia accompanying liver cirrhosis.

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Key words: Liver cirrhosis; Hypersplenism; Coil embolization; Splenic artery

INTRODUCTION

Partial splenic embolization (PSE) is a non-surgical procedure for hypersplenism resulting from hepatic disease and can thus avoid the disadvantages of splenectomy. It has been shown that PSE can increase peripheral blood cell counts. However, PSE often results in a number of complications, including daily intermittent fever, abdominal pain, nausea, vomiting, postemboliza-
Total embolization of the splenic artery is a safe and effective procedure for splenic artery aneurysms. Moreover, stainless steel spring coils are used to embolize the main branch of splenic artery to increase the platelet (PLT) count before splenectomy. To date, no report is available on the treatment of hypersplenism with total embolization of the main splenic artery. The present study was to study the safety and feasibility of total embolization of the main splenic artery for hypersplenism with thrombocytopenia or leukocytopenia accompanying liver cirrhosis.

MATERIALS AND METHODS

Patients
Fifteen consecutive patients (10 males and 5 females with a mean age of 50.07 ± 8.98 years, ranging 38-60 years) with hypersplenism due to cirrhosis were enrolled in this study from January 2006 to June 2010 and subsequently underwent computed tomography (CT) follow-up at our hospital. The causes of cirrhosis were hepatitis B virus (HBV) infection in 13 patients and hepatitis C virus (HCV) infection in 2 patients. The patients were diagnosed as hypersplenism based on their history, clinical laboratory tests, ultrasonography and CT. The protocol was approved by The Ethics Committee of Fudan University and the patients provided their written informed consent.

The inclusion criteria were those with hypersplenism, HBV/HCV-related active cirrhosis, neutropenia (neutrophil count ≤ 2.0 × 10^9 cells/L), thrombocytopenia (PLT count ≤ 50 × 10^9 cells/L) or both, and follow-up time > 2 years. Those with severe jaundice [serum total bilirubin (TB) level > 81.4 μmol/L] or spontaneous bacterial peritonitis were excluded from the study.

Hypersplenism was classified as Child-Pugh class A in 10 patients, class B in 3 patients, and class C in 2 patients. The demographics of these patients are summarized in Table 1.

Endovascular techniques
Metallic coils and gelfoam were used as embolization materials, either alone or in combination. In general, the embolization coils used in this series were standard 0.089-cm (0.035-in.) fibered coils, microcoils (Tornado; Cook Inc., Bloomington, IN, USA).

Embolization was performed in all patients via the femoral artery. Selective angiography of the celiac trunk, splenic artery, and superior mesenteric artery was performed via the right femoral artery with a 5-Fr diagnostic catheter (Cook). Patency of the collateral arteries connected to the hilar splenic artery from the left gastric artery or from the gastroduodenal artery on a celiac arteriogram was monitored to avoid total splenic infarction.

Mann-Whitney test, χ^2-test or Fisher’s exact test when ap-
The mean splenic volume decreased from 769.87 (60.51) × 10³ cm³ before the procedure to 314.60 (44.52) cm³, 304.0 (36.10) cm³, 300.80 (35.20) cm³, 301.73 (35.17) cm³, and 306.00 (32.02) cm³, respectively, 1 and 6 mo, and 1, 2, 3 years after the procedure (P < 0.05). During the follow-up, the residual splenic volume in these patients increased very slowly. The mean infarction rate of the spleen was 60% (range, 59%-61%) 3 years after the procedure. No death occurred during the follow-up.

DISCUSSION

The results of his study show that total embolization of the main splenic artery with coils is a safe and feasible procedure for hypersplenism due to liver cirrhosis. The peripheral blood cell parameters including WBC and PLT counts increased significantly during the follow-up and the residual splenic volume increased very slowly after embolization.

Hypersplenism is a well-known complication of portal hypertension due to cirrhosis, which can result in thrombocytopenia and/or leukocytopenia. Splenectomy can eliminate hypersplenism-induced blood cell destruction, but the incidence of severe complications after splenectomy is 9.6%-26.6% whether laparoscopy or open splenectomy is performed[6-10]. In addition, splenectomy is often associated with an increased long-term risk of septic events[6-10].

Although PSE is an effective alternative to splenectomy to increase the peripheral blood cell counts[6-8], severe complications of PSE, such as splenic abscess, splenic rupture, pneumonia, refractory ascites or pleural effusion, and gastrointestinal bleeding[6-8], greatly limit its use. Furthermore, the complications of PSE are correlated with the infracted splenic volume. In addition, when 50% or less than 50% of the spleen is embolized, hypersplenism would relapse shortly after PSE[16-18]. Therefore, to ensure a sustained increase in PLT and leukocyte counts,
the splenic infarction rate should be greater than 50%\(^\text{[8]}\), which, however, inevitably results in severe complications. To increase the PLT and leukocyte counts and reduce the rate of severe complications, total embolization of the main splenic artery was performed for hypersplenism due to liver cirrhosis in the present study.

The key procedure for reducing the severe complications and ensuring the sustained increase in PLT and leukocyte counts is to confirm the patency of collateral arteries connected to the hilar splenic artery from the left gastric artery or from the gastroepiploic artery. If these connections are absent or incomplete, total embolization of the main splenic artery should not be performed because the procedure may result in more severe complications.

When the main splenic artery is completely embolized, the main blood flow supplying the spleen is stopped, but the collateral arteries connected to the hilar splenic artery from the left gastric artery or from the gastroepiploic artery may provide a small amount of blood for the spleen to avoid complete infarction of the spleen. Thus, most of the spleen should be embolized with reservation of a partial normal spleen. Thus, the PLT and leukocyte counts increase after the procedure, and the occurrence of severe complications can be circumvented. In this study, the safety and feasibility of total embolization for hypersplenism of the main splenic artery were studied.

As compared with PSE, total embolization of the main splenic artery has the following advantages, including a low risk of procedure-related complications, persistent maintenance of normal WBC and PLT counts, and a very slow increase in residual splenic volume.

Although these results are encouraging, this study had the following limitations. First, it was not a comparative study and the number of patients was small with no control group. Future randomized multicenter trials comparing PSE with total embolization are needed to determine their long-term clinical efficacy and risk of complications. Second, total embolization could not be performed in patients with no or incomplete collateral arteries.

In conclusion, total embolization of the main splenic artery is a safe and feasible procedure for hypersplenism with thrombocytopenia or leukocytopenia accompanying liver cirrhosis and may serve as a supplemental treatment modality for it. Further clinical trials and expanded follow-up studies are needed to confirm its safety.

**COMMENTS**

**Background**
Partial splenic embolization (PSE) is a non-surgical procedure for hypersplenism resulting from hepatic disease, thus avoiding the disadvantages of splenectomy. However, after PSE, patients often experience complications, including daily intermittent fever, abdominal pain, nausea, vomiting, and postembolization syndrome.

**Research frontiers**
Total embolization of the splenic artery has been widely used in treatment of splenic artery aneurysms, but no report is available on treatment of hypersplenism with it. In this study, total embolization of the main splenic artery for hypersplenism with thrombocytopenia or leukocytopenia accompanying liver cirrhosis was studied.

**Innovations and breakthroughs**
Total embolization of the main splenic artery was devised for the treatment of hypersplenism with thrombocytopenia or leukocytopenia accompanying liver cirrhosis. All procedures were performed under fluoroscopic control. This is the first study reporting the treatment of hypersplenism with total embolization of the main splenic artery.

**Applications**
Total embolization of the main splenic artery is a safe and feasible procedure and may serve as a supplemental treatment modality for hypersplenism with thrombocytopenia or leukocytopenia accompanying liver cirrhosis with a low complication rate and a good mid-term clinical efficacy.

**Terminology**
Hypersplenism is a well-known complication of portal hypertension due to cirrhosis, which can result in thrombocytopenia and leukocytopenia.

**Peer review**
The finding in this study is interesting. Further study is needed to confirm its safety in a much larger series of patients.

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