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Changes in portal hemodynamics and hepatic function after partial splenic embolization (PSE) and percutaneous transhepatic obliteration (PTO)

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Abstract. Since April 1985, we have performed a multidisciplinary therapy consisting of partial splenic embolization (PSE), percutaneous transhepatic obliteration (PTO) or transileocolic vein obliteration (TIO), and endoscopic injection sclerotherapy (EIS) for patients with severe gastroesophageal varices and those with a portacaval shunt associated with portal hypertension. In this study, PSE and percutaneous transhepatic portography (PTP) were performed at the same time in seven liver cirrhosis patients with hypersplenism, gastroesophageal varices, or hepatocellular carcinoma. The changes in portal blood flow/pressure and hemodynamics were examined by a thermodilution method. The effects of PSE on blood biochemical parameters such as the platelet count, ICG R15, redox tolerance index (RTI), and oral glucose tolerance test (75 g OGTT) were also evaluated. PSE induced a decrease in the blood flow of the splenic artery and in the splenic vein pressure without decreasing the portal blood flow. The platelet count in the peripheral blood and the RTI increased significantly. These results suggest the possibility that PSE may reduce the potential perioperative risk in hepatocellular carcinoma complicated with liver cirrhosis.

Introduction

Since April 1985, we have performed a multidisciplinary therapy consisting of partial splenic embolization (PSE), percutaneous transhepatic obliteration (PTO) or transileocolic vein obliteration (TIO), and endoscopic injection sclerotherapy (EIS) for patients with severe gastroesophageal varices and those with a portacaval shunt associated with portal hypertension [9]. In addition, since 1991 the indications of these interventional therapies have been extended to include improving the bleeding tendency in patients with hepatic cirrhosis complicating hepatocellular carcinoma (HCC), preventing hemorrhage of gastroesophageal varices, and decreasing the perioperative risk. We have also reported improvements in hepatic function after this multidisciplinary treatment in some patients [6]. In this study, the changes in various parameters were analyzed to evaluate the effects of PSE on the portal hemodynamics and hepatic function.

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Patients and methods

The study population consisted of 22 patients with HCC and 17 patients with liver cirrhosis not complicated by HCC. As shown in Table 1, PSE was conducted in 14 patients [HCC(+), 12; HCC(–), 2]; PTO/TIO, in 9 patients [HCC(+), 3; HCC(–), 6]; and PSE+PTO/TIO, in 16 patients [HCC(+), 7; HCC(–), 9; conducted at the same time in 4 patients and at different times in 12 patients].

PSE was carried out in 30 patients with a platelet count in the peripheral blood of less than 100,000/mm^3. During selective splenic arteriography, about 70% embolization was conducted under roentgenographic monitoring with a gelatin sponge (1×1×1 mm) containing an antibiotic. The time-course changes in the platelet count and blood biochemical parameters were examined, and CT was performed to measure the range and percentage of embolization in 22 patients at 3 weeks after PSE.

Table 1. Characteristics of the patients (4/1985–12/1992)

Treatment	Number of patients	NCC (+)	HCC (–)
PSE	14	12	2
PTO/TIO	9	3	6
PSE+PTO/TIO	16	7	9
Totals	39	22	17

PSE was conducted in 14 patients [HCC(+), 12; HCC(–), 2]; PTO/TIO, in 9 patients [HCC(+), 3; HCC(–), 6]; and PSE+PTO/TIO, in 16 patients [HCC(+), 7; HCC(–), 9; conducted at the same time in 4 patients and at different times in 12 patients]

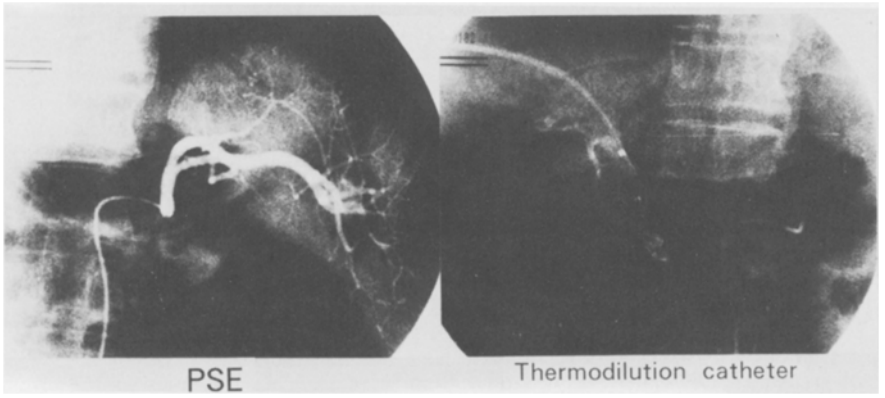

Fig. 1. During selective angiography, about 70% embolization was conducted. The changes in portal hemodynamics were measured with a thermodilution catheter

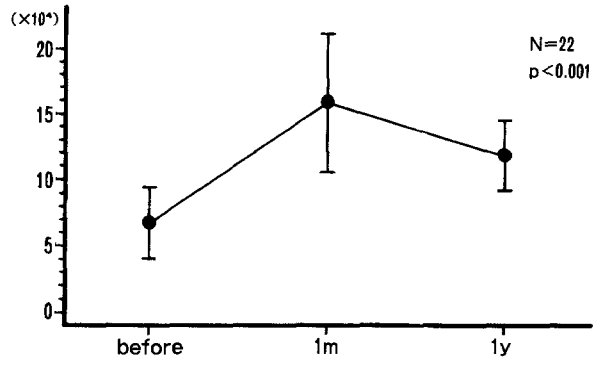

Fig. 2. The mean platelet count on the day of admission was $6.91 \pm 2.67 \times 10^4/mm^3$. It began to increase a few days after RSE, peaked at 2 or 3 weeks, and stabilized at a mean value of $16.07 \pm 5.20 \times 10^4/mm^3$

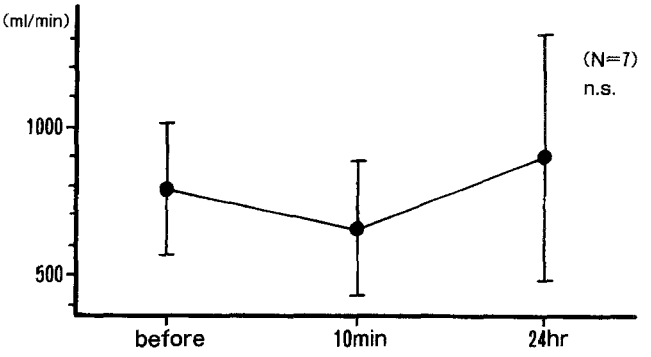

Fig. 4. The change in the portal blood flow was not statistically significant

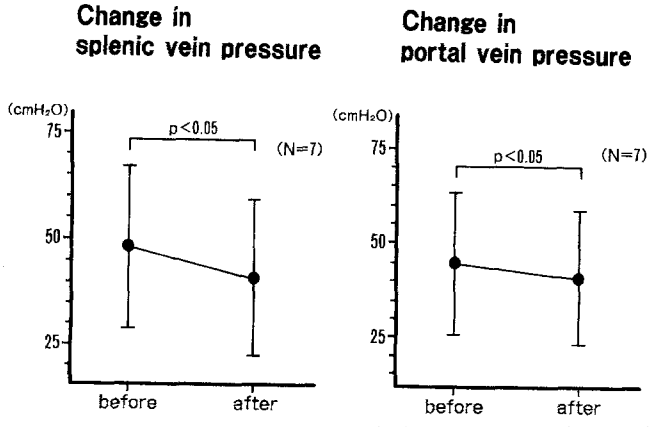

Fig. 3. The portal vein pressure and splenic vein pressure decreased significantly after PSE

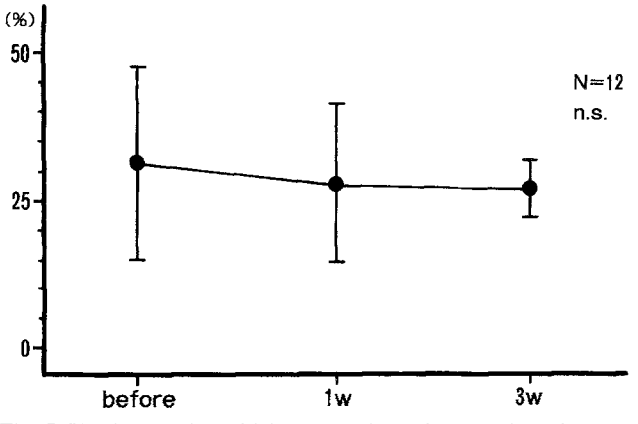

Fig. 5. ICG R15 varied widely among the patients, and no significant difference was found before versus after PSE

PTO/TIO was performed in 25 patients who had portacaval shunts such as gastroesophageal varices and splenorenal shunts. Gastroesophageal varices and portacaval shunts were obliterated with a metallic coil, gelatin sponge, and pure ethanol through a catheter inserted into the portal vein in a percutaneous transhepatic manner under ultrasonic guidance for PTO or through the iliac vein after laparotomy by a lateral pararectal incision of the right lower abdomen with the patient under epidural anesthesia for TIO.

In seven patients, PTP was conducted at the time of PSE. The changes in portal blood pressure/flow and splenic vein pressure were measured with a Webster thermodilution catheter, and changes in hemodynamics were observed by cineangiography (Fig. 1).

For five patients who underwent PSE and PTO/TIO at the same time and eight PSE patients, the following parameters were examined before treatment and at 1 and 3 weeks after treatment: the ICG R15, arterial ketone body ratio (AKBR), redox tolerance index (RTI = $\triangle$KBR/$\triangle$BS) and 75 g oral glucose tolerance test (75 g OGTT), and ratio of total IRI secretion to BS at the time of glucose loading ($\triangle$IRI/$\triangle$BS).

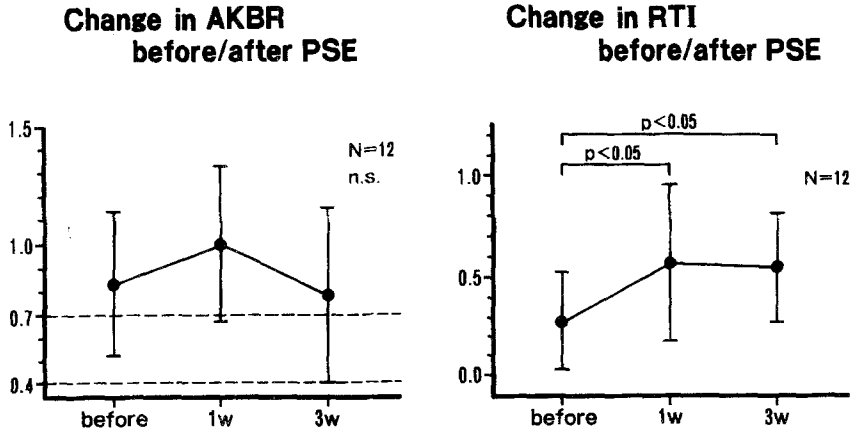

Fig. 6. The change in AKBR was not significant, but RTI (△KBR/△BS) increased significantly after PSE

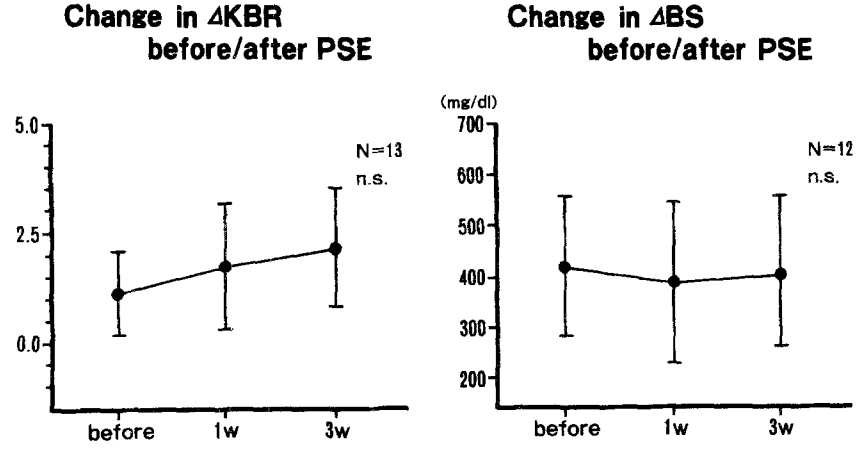

Fig. 7. The change in △BS was not significant, and △KBR tended to increase significantly

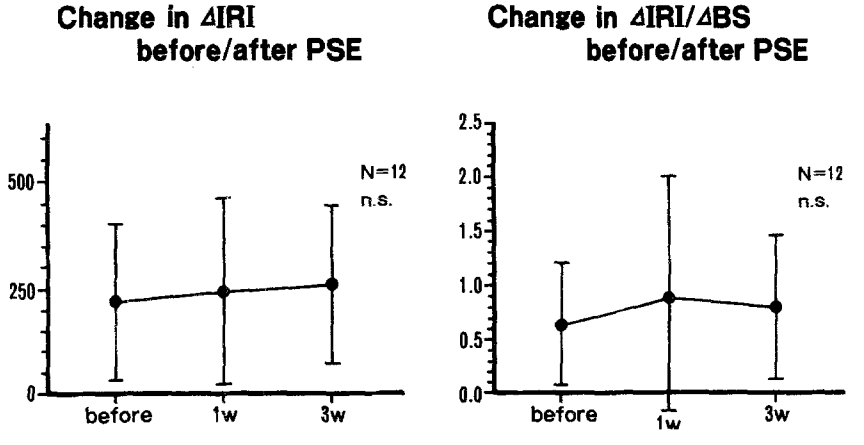

Fig. 8. With 75 g OGTT, no significant difference was found in △IRI or △BS, and the change in △IRI/△BS was also not significant

Results

CT was performed to measure the range and rate of embolization after PSE. The mean splenic infarction range was 74.1% ± 13.1% (n = 30). Fever and pain occurred in all patients, but conservative treatment improved these symptoms in about 1 week in many cases. Pleural effusion and spleen abscess were found in a few patients with severe cirrhosis, but no patient died.

The mean platelet count on the day of admission was $6.91 \pm 2.67 \times 10^4/mm^3$. It began to increase a few days after RSE, peaked at 2 or 3 weeks, and stabilized at a mean value of $16.07 \pm 5.20 \times 10^4/mm^3$. For a minimum of 1 year afterward, a high value was maintained (Fig. 2). The portal vein pressure and splenic vein pressure decreased significantly after PSE (Fig. 3), but the change in portal blood flow was not statistically significant (Fig. 4). ICG R15 varied widely among the patients, and no significant difference was found before versus after PSE (Fig. 5). The change in AKBR was not significant, but RTI (△KBR/△BS) increased significantly after PSE (Fig. 6). The change in △BS was not significant, and △KBR tended to increase significantly (Fig. 7). With 75 g OGTT, no significant difference was

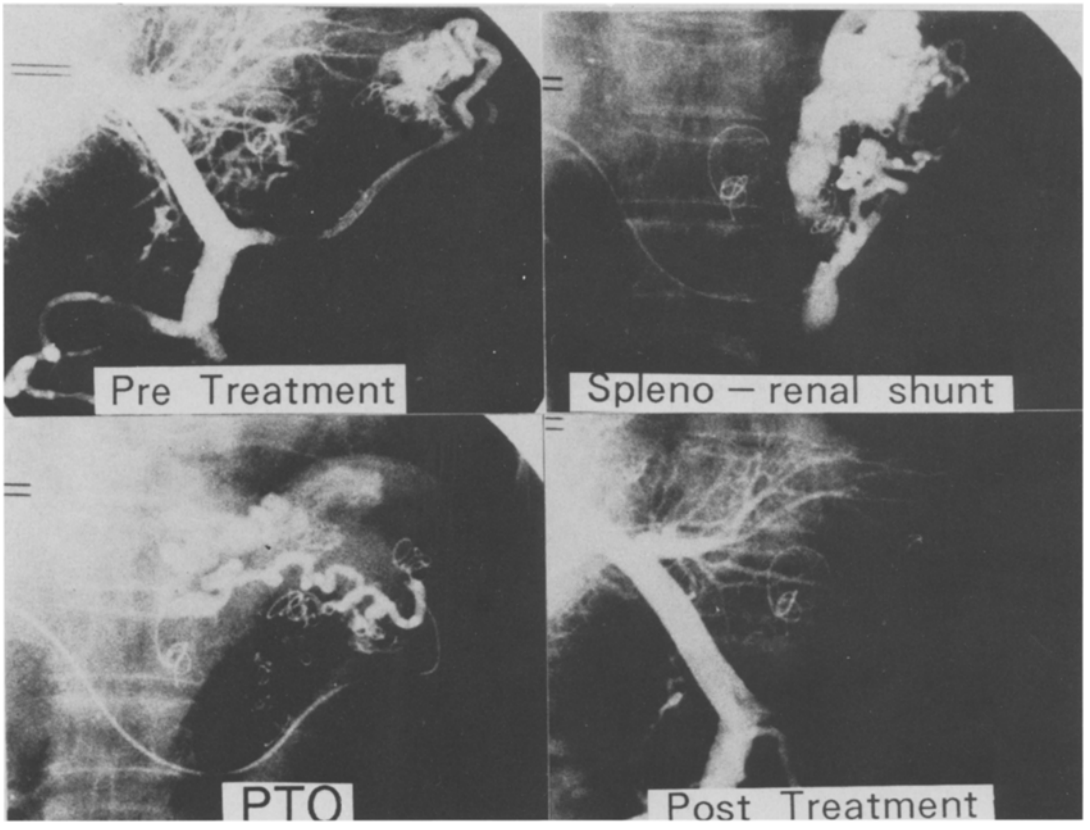

Fig. 9. In this patient, PTO was performed for a splenorenal shunt following PSE. The splenic vein blood flow, which had run away from the liver, was reversed toward the liver, with an improvement being noted both in ICG R15 (from 59% to 21.5%) and RTI (from 0.25×10^{-2} to 0.5×10^{-2})

found in △IRI or △BS, and the change in △IRI/△BS was also not significant (Fig. 8).

In the patient shown in Fig. 9, PTO was performed following PSE. The blood flow, which had run away from the liver, was reversed toward the liver, with an improvement being noted in both ICG R15 (from 59% to 21.5%) and RTI (from 0.25×10^{-2} to 0.5×10^{-2}).

Discussion

Since Maddison first reported on PSE [4], a considerable amount of research has been carried out on the effect of PSE on hypersplenism and the change in hepatic function [1, 7], and that the platelet count increases after PSE has also been established.

PTO is a technique for obliterating gastroesophageal varices or portacaval shunts in a percutaneous transhepatic manner. Since the first report by Lunderquist and Vang [3], better materials for obliteration have been examined in the search for persistent hemostasis. TIO has been considered to permit obliteration with fewer complications, even in patients with a complication of a liver tumor or those in whom the bleeding tendency is so strong that PTO cannot be performed [8]. We have also performed TIO mainly in emergency bleeding patients and reported its usefulness.

Regarding the portal blood flow/pressure, it has been reported that the values measured by the thermodilution method correspond well to those obtained by the use of a model [2]. In this study, the portal hemodynamics underwent the following change: the portal blood flow did not decrease even though the portal blood pressure and splenic vein pressure were reduced. We consider this to be because:

1. PSE decreased the splenic vein blood flow.
2. The portal blood flow did not decrease due to a relative increase in the superior mesenteric vein flow.
3. After PTO, the blood flow that had passed into the gastroesophageal varices or portacaval shunt was reversed toward the liver.

It has been reported that AKBR indicates the oxidation reduction reaction of hepatic mitochondria and that RTI reflects the energy chargeability of mitochondria at the time of 75 g OGTT [5]. We also measured these hepatic parameters and found that RTI (△KBR/△BS) was significantly improved after PSE. This can be explained by the above reasons, but ICG R15 and AKBR varied widely. It is suggested that these findings were influenced by factors such as the optimal PSE range and the formation of a new shunt after PTO, which the transient change in the portal blood flow is not sufficient to explain.

Although portal hypertension as a background factor is expected to result in the future formation of a new shunt, the observation that in some patients the present multidisciplinary therapy improved the hemodynamics and hepatic function, albeit transiently, suggests the possibility that it may reduce the potential risk associated with surgery for hepatocellular carcinoma complicated by hepatic cirrhosis. We intend to collect more cases and confirm these results.

References

1. Kawarada Y, Imai T, Iwata M, Yokoi H, Noguchi T, Mizumoto R (1992) Significance of multidisciplinary therapy for hepatocellular carcinoma. Cancer Chemother Pharmacol 31 [Suppl I]: S13
2. Kinoshita H (1989) Percutaneous transhepatic portography: techniques and clinical usefulness in hepatic, pancreatic and biliary surgery. Kanehara & Co., Ltd., Tokyo, p 63
3. Lunderquist A, Vang J (1974) Transhepatic catheterization and obliteration of the coronary vein in patients with portal hypertension and esophageal varices. N Engl J Med 291: 646
4. Maddison E (1973) Embolic therapy of hypersplenism. Invest Radiol 8: 280
5. Mori K, Ozawa K, Yamamoto Y, Maki A, Shimahara Y, Kobayashi N, Yamaoka Y, Kumada K (1990) Response of hepatic mitochondrial redox state to oral glucose load. Redox tolerance test as a new predictor of surgical risk in hepatectomy. Ann Surg 211: 438
6. Mukaiya M, Hirata K (1992) Re-evaluation of hepatic function after the embolization of esophago-gastric varices (in Japanese). Hokkaido Med J 67: 752
7. Tajiri T, Umehara M, Tei J, Kim DY, Aoki N, Yamashita K, Onda M (1985) Transcatheter embolization therapy for esophageal varices and hypersplenism with liver cirrhosis (in Japanese). Jpn J Gastroenterol Surg 86: 1227
8. Ueda T, Isobe Y, Tsutsui T, Aoki Y, Ando M, Ishibashi T (1979) Trans-ileocolic vein obliteration of gastroesophageal varices (in Japanese). J Jpn Soc Clin Surg 34: 685
9. Yamashiro K, Mukaiya M, Kimura H, Nakano M, Takashima K, Watabe K, Oikawa I, Okazaki Y, Hirata K (1991) Multidisciplinary therapy for gastroesophageal varices mainly treated by TIO (trans-ileocolic vein obliteration of gastroesophageal varices) in Japanese). Prog Abdominal Emergency 11: 635