

Splenic autotransplantation for treatment of portal hypertension

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Background: When total splenectomy is unavoidable it is important to preserve splenic function in some form in order to prevent the complications of asplenism. Splenic autotransplantation is a good alternative in such cases. We describe the use of splenic autotransplantation for the treatment of portal hypertension. **Methods:** We carried out total splenectomy on 31 patients (21 men, 10 women), ranging in age from 21 to 68 years, with schistosomal portal hypertension. From each removed spleen, we took 20 fragments and implanted them on the greater omentum. This procedure was combined with abdominal portal–variceal disconnection. Transgastric running suture of the lower esophageal and gastric varices completed the treatment of portal hypertension. All patients underwent clinical, hematologic, immunologic and scintigraphic assessment. The results with respect to morbidity and mortality, and hematologic and immunologic findings were compared with those in 36 patients submitted to other splenic procedures. **Results:** There was no complication related to the splenic implants and none of the patients died. Hematologic and immunologic findings were normal. Scintigraphy registered images of splenic tissue in all cases. **Conclusion:** The implantation of splenic fragments on the greater omentum seems to be a safe and useful procedure for maintaining splenic function after total splenectomy.

Contexte : Lorsqu'une splénectomie totale est inévitable, il importe de protéger la fonction splénique sous une forme quelconque afin de prévenir les complications de l'asplénie. L'autotransplantation splénique est une bonne solution de rechange dans de tels cas. Nous décrivons l'utilisation de l'autotransplantation splénique pour traiter l'hypertension portale. **Méthodes :** Nous avons pratiqué une splénectomie totale chez 31 patients (21 hommes, 10 femmes) dont l'âge variait de 21 à 68 ans, qui avaient une hypertension postschistosomiale. Nous avons prélevé sur chaque rate enlevée 20 fragments que nous avons implantés sur le grand épiploon. On a combiné cette intervention à une déconnexion porto-variqueuse abdominale. Une suture continue transgastrique des varices gastrique et œsophagienne inférieures a complété le traitement de l'hypertension portale. Tous les patients ont subi une évaluation clinique, hématologique, immunologique et scintigraphique. On a comparé les résultats relatifs à la morbidité et à la mortalité, ainsi que les résultats hématologiques et immunologiques, à ceux de 36 patients qui ont subi d'autres interventions à la rate. **Résultats :** Les implants de fragments de rate n'ont causé aucune complication et aucun des patients n'est mort. Les résultats hématologiques et immunologiques étaient normaux. La scintigraphie a enregistré des images de tissu de rate dans tous les cas. **Conclusion :** L'implantation de fragments de rate sur le grand épiploon semble sans danger et utile pour maintenir la fonction splénique après une splénectomie totale.

Wethe number have previously reported the successful use of subtotal splenectomy in the treatment of 109 patients with schistosomal portal hypertension complicated by bleeding esophageal and gastric varices.¹⁻⁵ Subtotal splenectomy combined with central splenorenal shunt is a reasonable choice for young pa-

tients without systemic disease and was performed on 23 of these patients.^{1,2,5} In 86 patients, we combined subtotal splenectomy with portal–variceal disconnection.^{3,5}

In an attempt to preserve at least part of the spleen, thus avoiding the complications of asplenism, we performed subtotal splenectomy not

only for the treatment of portal hypertension, but also for splenic trauma (56 patients), myelofibrosis and myeloid metaplasia (8 patients), Gaucher's disease (6 patients), retarded growth and sexual development associated with splenomegaly (4 patients), a huge cystadenoma of the pancreatic tail (1 patient) and

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chronic lymphocytic leukemia (1 patient).^{2,3,6-12}

Splenic autotransplantation has been described mainly after splenectomy for traumatic injury.¹³⁻¹⁷ Experimental studies have indicated that the best place to implant splenic fragments is the greater omentum,¹⁸⁻²⁵ because it has a rich blood supply and blood drainage is to the liver by the portal system, which is also the natural drainage of the orthotopic spleen. This factor may be useful in terms of splenic function and production of immunoglobulins, complement and metabolic substances (e.g., bile, metals, tuftsin, properdin).²⁶⁻³⁴

We describe here our experience with 31 patients who underwent total splenectomy and autotransplantation of splenic slices on the greater omentum for the treatment of portal hypertension. We combined this procedure with portal-variceal external disconnection and transgastric ligation of the varices.

Methods

Thirty-one patients (21 men and 10 women) ranging in age from 21 to 68 years (mean [and standard deviation] (SD) 44.9 [14.3] yr) with hematemesis and melena due to esophageal or gastric variceal hemor-

rhage, were admitted to the Alfa Institute of Gastroenterology at the Hospital of Clinics of the Federal University of Minas Gerais. All patients were classified as having Child's group A liver function.³⁵ They also had splenomegaly provoked by Manson's schistosomiasis. The planned operations were total or subtotal splenectomy combined with external and intragastric portal-variceal disconnection and ligation of the esophageal gastric varices.³ The Ethics Committee of the Hospital of Clinics of the Federal University of Minas Gerais approved the operations and all individual procedures, which were in accordance with ethical standards of the Helsinki Declaration of 1975, as revised in 1983.

The abdominal cavity was entered through a supraumbilical left paramedian incision to avoid damage to the hepatic round ligament veins. However, total splenectomy was necessary for a number of reasons: major splenic bleeding; lesions of the splenic upper pole, caused by its dissection from strong adhesions to the diaphragm; accidental removal of the spleen during its dissection caused by pulling the organ with exaggerated force; and the absence of splenogastric vessels.^{4,5}

Portal-variceal disconnection in-

cluded total splenectomy and ligation of the left gastric vein, all posterior gastric veins, the veins of the lesser curvature above the incisura angularis and all vessels surrounding the lower third of the esophagus. The anterior gastric wall was longitudinally opened from the cardia to the middle of the stomach body. Running 0 Vicryl suture surrounded all gastric and esophagogastric varices from the stomach to the lower third of the esophagus.

Twenty spleen slices measuring 1-2 cm and weighing 2-4 g each, with a total weight over 50 g, were sutured to the greater omentum with 3-0 catgut thread (Fig. 1a). The number, the weight and the size of the spleen slices followed a protocol based on reports in the literature^{15,17,19,25,28,36} and on previous studies of our group.^{16,20,21,22,37}

The postoperative assessment of these patients, after 6 months, included hematologic and immunologic examinations, upper gastrointestinal endoscopy and abdominal scintigraphy with technetium-99m sulfur colloid. A 2-mL blood sample was collected from each patient for complete blood counts. Blood smears were stained with the May-Grünwald-Giemsa method for Howell-Jolly bodies.

Blood (10 mL) was collected in a

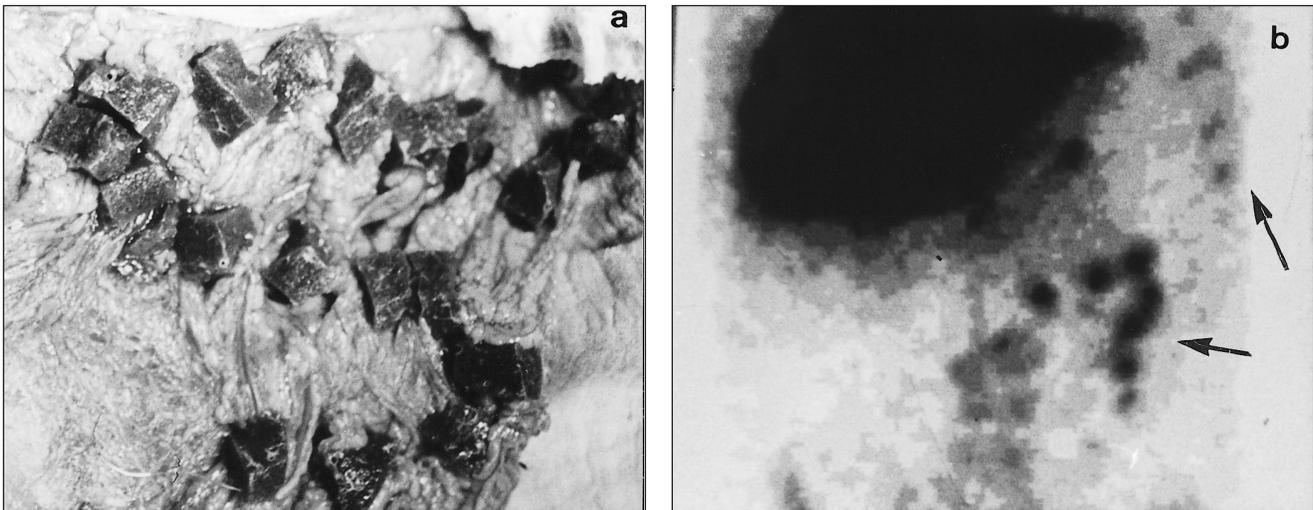


FIG. 1. Splenic autotransplants on the greater omentum in a patient who underwent total splenectomy due to schistosomal portal hypertension: (a) operative image of the implants and (b) scintigraphic image of the implants (arrows), 6 months postoperatively.

heparinized container to measure immunoglobulins IgM, IgA and IgG. Agar immune diffusion was used for immunoglobulin quantification. The Agar solution at 56°C was introduced in 3 separate glass tubes and titred with specific antiglobulins (goat, anti-IgM, anti-IgA and anti-IgG). The solution was poured into plastic plates. After the Agar solidified, several 3-mm holes were made in each plate. Sera from patient and control groups were put into each hole of the 3 plates. The plates were kept at room temperature overnight, and the halos formed around the holes were measured. The diameters of these halos were compared with a standard curve to determine the amount of immunoglobulins in each serum sample.

The findings on hematologic and immunologic examinations of these patients were compared with samples collected from other patients subjected to splenic procedures. The latter were divided into the following 3 groups:

- Total splenectomy due to trauma (*n* = 9);
- Total splenectomy and portal-variceal disconnection due to schistosomal portal hypertension (*n* = 12);
- Subtotal splenectomy, preserving only the upper splenic pole, combined with centralized splenorenal shunt (*n* = 6) or portal-variceal disconnection (*n* = 9) due to schistosomal portal hypertension.

Results

Total operating time ranged from 3 to 4 hours. Blood loss was minimal in 27 patients, but 4 patients needed 1 unit of blood.

The patients had uncomplicated postoperative courses, and, following a protocol, all were fed only on the postoperative day 3 because of the gastrotomy required to suture the varices. They were discharged from the hospital between the 4th and 7th postoperative days.

During a follow-up of 5 months to 9 years (mean [and SD], 5.9 [2.0] yr), no patient had any sign of gastrointestinal bleeding or severe infection. Twenty-two patients suffered episodes of fever without infection during the early postoperative period, but this resolved spontaneously after less than 4 months. No patient had any complication related to the splenic implants throughout the postoperative follow-up.

The hematologic examinations of the patients who underwent splenic autotransplantation gave the following results: erythrocytes ranging from 4.0 to 5.5 × 10¹²/L; leukocyte count ranging from 6.8 to 13.2 × 10⁹/L and platelets ranging from 178 to 388 × 10⁹/L (Table 1). Abnormal circulating Howell-Jolly particles, commonly present after total splenectomy, were not found in the blood specimens of the patients who underwent autotransplantation or subtotal splenectomy. On the other

hand, 4–5 Howell-Jolly bodies were found in each red cell field examined from the patients who underwent total splenectomy due to trauma or portal hypertension.

The results of immunologic examination of the patients who underwent autotransplantation showed IgG values ranging from 11.09 to 34.23 (normal 8.50–18.00) g/L, IgM ranging from 1.40 to 2.90 (normal 0.50–2.00) g/L and IgA ranging from 2.20 to 5.01 (normal 0.80–4.00) g/L (Table 1).

Postoperative endoscopy performed on all patients revealed absent, small- or medium-sized varices in the esophagus, and absent or small varices in the gastric fundus. The scintigraphic images of the autologous splenic implantations were positive in all cases (Fig. 1b).

Discussion

Although it is not a new procedure, autologous splenic implantation is rarely considered when total splenectomy must be performed. Most surgeons do not believe that splenic slices implanted into the abdomen have any function.^{13,25,29,30,33,34,38} In fact, the role of such implants on organic protection, metabolism or hematologic function were not clearly proved.

Experimental studies have described less sepsis in animals subjected to autologous splenic implantations than in asplenic controls.^{14,21,26,28,34,39}

Table 1
Hematologic and immunologic parameters in patients who underwent splenic operative procedures*

Group	Hematologic parameters			Immunoglobulins, g/L		
	Erythrocytes, × 10 ¹² /L	Leukocytes, × 10 ⁹ /L	Platelets, × 10 ⁹ /L	IgM	IgA	IgG
Total splenectomy 1†	4.8 (0.6)	7.6 (2.5)	312.7 (98.7)	0.715 (0.412)	2.458 (1.240)	14.700 (3.446)
Total splenectomy 2‡	4.1 (0.4)	3.2 (0.8)	156.7 (88.7)	1.712 (0.413)	4.137 (1.944)	16.017 (3.734)
Subtotal splenectomy§	4.2 (0.6)	4.3 (3.3)	67.9 (22.7)	1.737 (0.654)	4.241 (1.809)	19.637 (3.573)
Autotransplantation¶	4.8 (0.3)	8.8 (2.9)	288.9 (43.4)	2.101 (0.388)	3.899 (1.799)	23.224 (5.180)

*Numbers are means (and standard deviations).
 †Normal subjects who had total splenectomy for trauma.
 ‡Patients with Manson's schistosomiasis who had total splenectomy.
 §Patients with Manson's schistosomiasis who had subtotal splenectomy.
 ¶Patients with Manson's schistosomiasis who had total splenectomy and splenic tissue autotransplantation.

On the other hand, these animals had more infection than controls with an intact spleen or than those subjected to partial or subtotal splenectomy.^{24,40}

Another important aspect is the amount of tissue that should be implanted. Several investigators demonstrated that 25% of normal orthotopic and vascularized spleen is sufficient to maintain complete function. That means, in humans, about 35 g.^{16,19,23,28} Good splenic function cannot be reached with less than 35 g of implanted splenic tissue. These data indicate that few small segments of spleen randomly implanted into different parts of the abdomen are probably not useful.

The total weight of the 20 splenic slices that we implanted into the greater omentum was over 50 g. The choice of the greater omentum followed suggestions made in the literature, and previously confirmed by us,^{15,17,20,24,38} as the best place to implant splenic tissue.^{14,23-25}

Our experience with splenic autotransplantation in the present cases, 53 cases of trauma, 1 of Gaucher's disease, 2 of myeloid metaplasia and 1 of lymphocytic leukemia, showed an absence of abnormal particles in the blood samples. This finding associated with positive scintigraphic images suggests function of the heterotopically placed splenic tissue.^{10,13,16,22,37}

Another important aspect verified in the present investigation and in all other patients of our experience with conservative management of the spleen was the high level of immunoglobulins, mainly IgM, which is usually produced by the spleen.^{25,32,33,41}

Other parts of the reticuloendothelial system are known to compensate for the absence of the spleen and enhance their production of opsonins. However, we believe we can justifiably assume that the splenic implants contribute to remove abnormal circulating particles and to preserve the normal values of immunoglobulins after total splenectomy.

Therefore, according to the results of this study, splenic autotrans-

plants should be done whenever it is impossible to maintain, totally or partially, the spleen in its orthotopic position, and the removal of all splenic tissue is not indicated. Our findings are still preliminary and restricted to schistosomal portal hypertension. Further studies, with more patients and other pathologic conditions, must be done to verify the importance of preserving splenic tissue heterotopically placed. In any case, this procedure seems to be harmless and easily performed.

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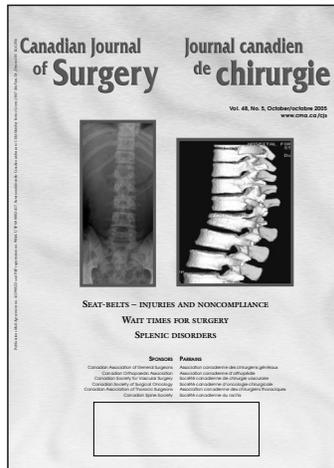
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