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The importance of the anatomy of the splenic artery and its branches in splenic artery embolisation

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Splenic artery embolisation can be performed preoperatively in an attempt to decrease thrombocyte destruction, or as an alternative to surgery, to obtain partial or total organ ablation. During this procedure, it is very important to deliver embolising agents distal to the origin of pancreatic branches to avoid the risk of pancreatitis. Therefore, a detailed knowledge of the anatomy of the splenic artery and its branches is required to achieve safe embolisation.
The purpose of our study is to measure the average distance between the origin of the last pancreatic branch and the splenic hilum in digital angiograms and cadaver specimens.

key words: embolisation, splenic artery

INTRODUCTION

The splenic artery is the largest branch of the coeliac trunk. It lies posterior to the omental bursa and extends along the superior margin of the pancreas to the splenic hilum. It is composed of 4 anatomic divisions, including suprapancreatic, pancreatic, prepancreatic and prehilar segments. The suprapancreatic segment is between the origin of the splenic artery and pancreas, which curves anterior to the aorta and reaches the superior margin of the pancreas [1, 5, 17]. The pancreatic segment is the most tortuous part of the splenic artery (Fig. 1) and extends along a groove located on the posterosuperior surface of the pancreas, although its course may rarely be off the pancreas. The prepancreatic segment crosses the upper border of the pancreas and lies obliquely and anteriorly. The prehilar segment lies between the pancreatic tail and the splenic hilum and is the terminal part of the splenic artery (Fig. 2) [1, 5, 12]. The reported lengths of the segments of the splenic artery are given in Table 1.

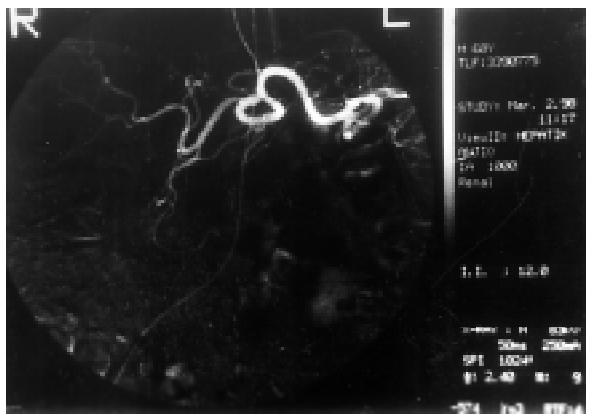

Figure 1. Selective coeliac angiography shows the proper hepatic artery, left gastric artery, splenic artery and their branches. The most tortuous part (pancreatic segment) of the splenic artery can be seen.

Splenic artery embolisations are performed in the form of total or partial organ ablation, either preoperatively or as an alternative to surgery [2, 8, 9]. Current indications for splenic artery embolisation and em-

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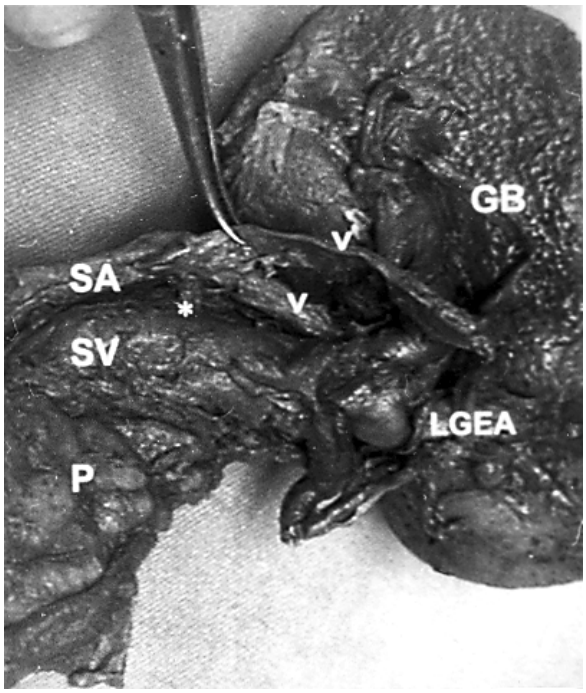

Figure 2. Prepancreatic and prehilar segments of the splenic artery; SA — splenic artery, SV — splenic vein, P — pancreas, arrow — splenic artery branches, LGEA — left gastroepiploic artery, GB — gastric branch of the splenic artery, *last pancreatic branch coming from splenic artery.

Table 1. Lengths of splenic artery segments reported in the literature [4]

Segment	Length [cm]	Maximum [cm]	Minimum [cm]
Total	17.3	33	8.5
Suprapancreatic	2.5	7	1
Pancreatic	10.4	22.5	5
Prepancreatic	2.5	6	0.4
Prehilar	1.5	4.5	0.3

Table 2. Indications for splenic embolisation

Traumatic parenchymal, capsular and subcapsular splenic haemorrhage
Haemorrhage due to portal hypertension and hypersplenism
Hypersplenism in children
Thalassemia major
Varixial haemorrhage due to splenic vein thrombosis
Thrombocytopenia
Chronic idiopathic thrombocytopenic purpura
Gaucher disease
Hodgkin disease

bolisation materials are listed in Table 2 and Table 3. Initial experience with splenic embolisation was associated with a high rate of complication [11, 18].

MATERIAL AND METHODS

Splenic artery anatomy was studied in detail with careful dissection of 10 cadavers. For radiologic evaluation, selective splenic arteriograms of 12 patients obtained during splenic embolisations were retrospectively studied. Angiograms were printed in digital subtraction mode to eliminate the superimposition of extravascular tissues. For each examination, the splenic artery was selectively catheterised and 30–40 ml non-ionic contrast media

Table 3. Embolisation materials

Absorbable	Nonabsorbable	
Otolog clot	**Particular materials**	**Enjectable materials**
Oxygel	Otolog fat or muscle	Isobuthyl 2 cyanoacrilate (IBCA)
Gelfoam	Polivinyl alcohol (PVA)	Occlusive amino acid gel
	Micrometric magnetic spheres	Microfibrillar collagen
	Acrylic spheres	Silicone rubber
	Methyl metacrilate spheres	
	Cylastic spheres	
	Sclerosing materials	**Non-particular materials**
	Absolute ethanol	Stainless steel coils
	Hot contrast media	Platinum coils
		Detachable balloons

was injected at the proximal part of the splenic artery.

In all anatomical and radiological examinations, the distance between the origin of pancreatic branches and the splenic hilum was measured by an experienced anatomist and radiologist respectively. Radiological measurements were corrected by the magnification factor, determined using the patient to image distance (PID) and the source to image distance (SID). All statistical analyses were done by using Student t test.

RESULTS

In anatomical measurements, the average distance between the origin of the last pancreatic branch and the splenic hilum was 3.9 ± 0.78 cm (mean ± standard deviation). In one cadaver, the last pancreatic branch originated from the gastroepiploic artery.

On selective splenic angiograms, the average distance between the origin of the last pancreatic branch and the splenic hilum was 3.75 ± 0.68 cm (mean ± standard deviation).

There was no statistically significant difference ($p > 0.05$) between the results of the anatomical and radiological measurements.

Out of 12 patients in whom splenic embolisation was performed, 1 developed pancreatitis and one a splenic abscess, which is not rare despite the prophylactic use of antibiotics. In the former patient, pancreatitis responded to medical therapy and in the latter, splenectomy was performed.

DISCUSSION

In subsequent years, it was reported that complications such as septicaemia, rupture and abscess formation can significantly be reduced with the use of antibiotics and aseptic techniques [15, 16]. In the present study, 1 out of 12 patients developed abscess following splenic embolisation and was treated with splenectomy.

For splenic embolisations and the embolisation of other organs, like the parathyroid gland, adrenal gland and kidneys, a number of embolic materials are used [4, 6, 7, 10, 11, 13, 19, 20] (Table 3). In our patients, distal intrasplenic vessels were embolised with polyvinyl alcohol (PVA), followed by occlusion of the prehilar segment with metallic coils. PVA particles were delivered via a microcatheter located in the distal splenic artery, trying to avoid inadvertent embolisation of the pancreatic branches. Despite meticulous attention, 1 patient developed pancreatitis following the procedure, which was treated medically.

Preoperative angiographic embolisation of the splenic artery for massive splenomegaly has been advocated as a means to decrease this morbidity and mortality [3]. In every embolisation procedure, inadvertent passage of the embolic material to the vessels of the non-target organs is the most dangerous complication. In splenic embolisation, this complication may occur in pancreatic branches of the splenic artery. To avoid this potentially life-threatening complication, a good knowledge of the vascular anatomy of the splenic artery and its branches is required. Of particular importance is the location of the last pancreatic branch in the splenic artery, since the tip of the microcatheter should be distal to the origin of this vessel to achieve a safe embolisation. Besides, temporary splenic artery balloon occlusion can be used for the protection of nonsplenic vascular beds, like pancreatic and gastric arterial branches, during splenic embolisation [14]. In our study, the distance of the origin of the last pancreatic branch to the splenic hilum was measured on splenic angiograms and cadavers, trying to define a safe region in which splenic embolisation can be performed. Our results show that the average distance between the origin of the last pancreatic branch and the splenic hilum was 3.75 ± ± 0.68 cm (mean ± standard deviation) on splenic angiograms and 3.9 ± 0.78 cm (mean ± standard deviation) in cadavers. The smallest distance measured was 3.07 cm on angiograms and 3.12 cm in cadavers.

In conclusion, in order to achieve a safe splenic embolisation and avoid the risk of pancreatitis, embolic materials should be delivered through a catheter whose tip is located in the distal 3.07 cm of the splenic artery.

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