Supplementary Online Content

Arvieux C, Frandon J, Tidadini F, et al; Splenic Arterial Embolization to Avoid Splenectomy (SPLASH) Study Group. Effect of prophylactic embolization on patients with blunt trauma at high risk of splenectomy: a randomized clinical trial. *JAMA Surg.* Published online September 16, 2020. doi:10.1001/jamasurg.2020.3672

This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix. Consensus Definitions

D0 CT-scan analysis: AAST/MOORE/OIS classification of spleen traumas

OIS 1, 2: no detectable problem
OIS 3: = fracture line > 3 cm, subcapsular hematoma > 50%, intra-parenchymal hematoma > 5 cm, and all ruptured hematomas. All intra-parenchymal or subcapsular hematomas with a hemoperitoneum (except hemoperitoneum related to associated lesions) should be considered as grade 3 because a hemoperitoneum signifies the rupture of a hematoma.
OIS 4: >25% devascularization. Even if the fracture line extends to the hilum it remains Moore grade 3 if there is less than 25% devascularization. We include 50% fragmented spleen because this implies a significant loss of the parenchyma.
OIS 5: very severely fragmented spleen. If the spleen is totally devascularized or shattered this is an exclusion criterion.

Large Hemoperitoneum
In view of the difficulties of the panel to define precise volumes and the contradictory data in the literature, it is agreed to define a "**moderate**" a hemoperitoneum when there is splenic trauma associated with a peri-splenic effusion, and **"large**" when the effusion is also visible at the pelvic level.

D0 CT-scan analysis: Extravasation or blush?
Extravasation (preferred term) is retained if present in arterial and portal phases with reinforcement in the portal phase. Otherwise, when this early hyperdensity becomes homogeneous in the portal phase we speak of "blush"; this corresponds to the persistence of opacification of the sinusoidal cavities without true extravasation. If there is a minimal arterial leak (or a blush) and the radiologist believes that the patient should be monitored because the probability of spontaneous thrombosis is high, the patient can be included in the trial (the vascular anomaly is therefore not a formal exclusion criterion).

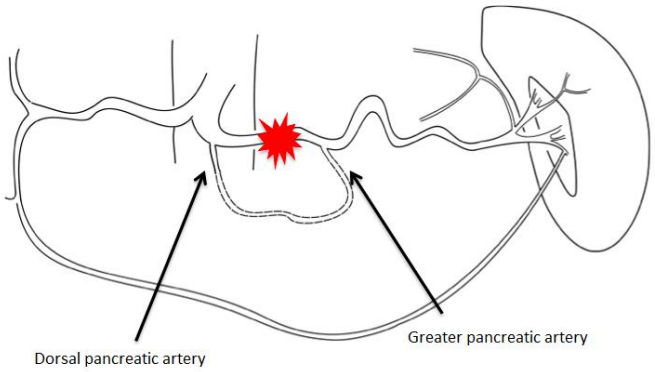
Embolization: Complications of embolization
One should distinguish between true complications (for example, coil migration with occlusion of a branch) and technical incidents without secondary repercussions (for example, migration of coils in the trunk of the splenic artery without occlusion). Report all true complications; whether they are related to catheterization, to injection of the contrast medium or to embolization.

Embolization: Technique
Perform proximal embolization by plug whenever possible so as to reduce the risk of complications, especially the migration of material. It is strongly recommended that centers equip themselves with the appropriate material. In case of amputation of a segmental vascular branch with visible stump, we recommend occlusion of the stump by distal embolization using coils to avoid secondary rupture.

eFigure. Technique of Splenic Artery Embolization Used in the Study

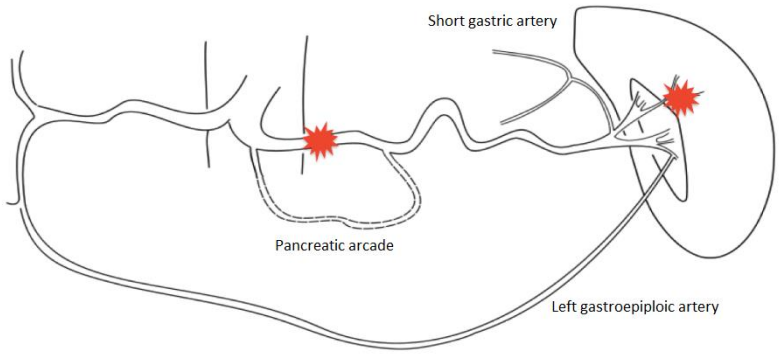
The embolization was performed by a interventional vascular radiologist in an interventional radiology room with an angiography device with at least subtraction, serial images at 3 frames per second and fixed-arch with multiple angulation features. The arterial approach was preferably performed via the femoral artery or in case of an unfavorable anatomy of the celiac trunk by a humeral approach, with an introducer having a maximum diameter of French 6. Temporary emboli, liquid agents and microparticles were not used in this trial.

Proximal Embolization:



The embolization material was positioned in a compact bundle, at the level of the trunk of the splenic artery, upstream of its division into branches and if possible downstream of the dorsal pancreatic artery. If possible the embolization was done using a Type 2 or 4 Amplatzer ™ plug. Rigid coils of 0.035 inch could be used whereas the use of microcoils was not recommanded. Proximal embolization was preferred for high grade lesions without a vascular abnormality.

Combined Embolization:



This technique combined a proximal embolization with a distal embolization. It was reserved for focal vascular abnormalities associated with high-grade AAST traumas or with an abundant hemoperitoneum. The distal lesions were occluded with mircocoils, fragments of gelatin sponge or glue.

eTable 1. Motives of Noninclusion Before Randomization

Due to		**n (%)**
AAST grade	OIS grade 1,2	152 (29.0)
	OIS Grade 3 without large hemoperitoneum nor NISS>15	26 (4.9)
	OIS grade 5 with a shattered spleen	1(0.2)
Patient	Age <18 or > 75	55 (10.5)
	Renal failure	1(0.2)
	Foreigner (non EEC)	3 (0.6)
	Immunologic deficiency	1(0.2)
	Coagulopathy	3 (0.6)
	Pregnancy	1(0.2)
	Refused study	37(7.0)
	Ineligible for other reasons	6 (1.1)
Center	Team temporary not informed, team unavailable	16 (3.0)
Circumstances	Needing emergency surgery/hemodynamic instability	110 (21.0)
	Spleen trauma >48h	30 (5.7)
	Needing embolization of the spleen because active leak of splenic contrast agent on the initial CT scan	68 (13.0)
	Needing embolization of the spleen because splenic pseudoaneurysm on the initial CT scan	7 (1.3)
	Needing embolization or other radio-interventional procedure of another organ	
	- Liver embolization	2 (0.4)
	- Kidney embolization	2 (0.4)
	- Pelvic embolization	1(0.2)
	- Aortic prosthesis	1(0.2)
Total		523 (99.9)

eTable 2. Criteria for Complications

Spleen rescue:	The spleen must be immunocompetent, i.e., intact, or treated by surgical procedures allowing preservation of at least 50% of the vascularized splenic tissue in cases of secondary laparotomy, or with necrosis of less than 50% of the volume. This criterion is validated by expert reading of the masked initial scan by two radiologists from the expert committee on imaging.
Splenic abscess	Diagnosed by the presence of an intra-splenic fluid collection on an abdominal CT scan and hyperthermia > 38.5° OR hyperthermia > 38° associated with a biological inflammatory syndrome (Hyperleukocytosis > 12000, CRP > 20) AND absence of other diagnosed infection.
Abscess on wall of abdominal scar or femoral puncture point	With discharge of pus or redness associated with a hyperthermia > 38
Deep abscess	Diagnosed by the presence of an intra-peritoneal fluid collection on the abdominal CT scan and hyperthermia > 38.5° OR hyperthermia > 38° associated with a biological inflammatory syndrome (Hyperleukocytosis > 12000, CRP > 20) AND absence of other diagnosed infection.
Allergy to contrast agent	Reaction during or just after injection of iodinated contrast agent: occurrence of redness, rash, nausea, pruritus, facial edema, bronchospasm, low arterial blood pressure, pulmonary edema, neurological disorders, cardiac arrest or cardiorespiratory disorders.
Pulmonary complication	Pneumopathy or pleural effusion, diagnosed by a clinical symptom (dyspnea, fever or chest pain) that led to the request for a chest x-ray.
Thrombo-embolic complication:	Lower limb phlebitis diagnosed by lower extremity ultrasound scan performed due to clinical symptoms (pain, redness, unilateral edema, unexplained hyperthermia > 38°).
Pulmonary embolism	Diagnosed by thoracic angioscan performed due to clinical symptoms (Dyspnea, tachycardia > 100).
Splenic vein, superior or portal mesenteric vein thrombosis	Diagnosed on the routine abdominal CT scan before discharge.
External pancreatic fistula:	With a level of amylase in the drainage fluid 5 times greater than in the blood at D5 with flow > 50ml/day OR level of amylase 3 times greater than blood levels from D3 for 3 days.
Hemorrhage	Defined by the need for the transfusion of at least 2 packs of packed red blood cells during hospitalization OR a fall in hemoglobin > 3g/dl with an identified bleeding site OR a fall in hemoglobin > 4g/dl without an identified bleeding site.
Splenic infarction	Diagnosed on the abdominal CT scan (% devascularization of splenic parenchyma)
Renal insufficiency	Creatinine clearance calculated according to the Cockcroft & Gault formula < 80ml/min
Peritonitis	Diagnosed on intraoperative bacteriological specimens

Acute pancreatitis	Diagnosed by abdominal CT scan OR hyperlipasemia > 3 times normal requested due to clinical symptoms (epigastric pain)
Septicemia	Hyperthermia > 38.5° and positive blood culture

eTable 3. Spleen Salvage Rate for Each Center

Center n°	Number of Included patients	Splenic rescue (%)
1	28	28 (100.0)
2	13	12 (92.3)
4	5	5 (100.0)
5	3	3 (100.0)
7	3	3 (100.0)
8	2	2 (100.0)
9	12	12 (100.0)
10	2	2 (100.0)
11	5	4 (80.0)
12	6	6 (100.0)
13	6	6 (100.0)
14	4	3 (75.0)
15	15	14 (93.3)
16	5	5 (100.0)
17	4	4 (100.0)
18	4	3 (75.0)
Total	117	112 (95.8)

eTable 4. Events Occurring Between Day 0 and Month 1 Visit (ie, Over the Whole 30 Days)

		Events occurring between day-0 and month-1 visit Intention to treat Lost of view at day 30 : 8 patients			
Type of complication	**Complication**	**Total (n=130)**	**pSAE (n=65)**	**SURV (n=65)**	***P* Value Fisher's test**
Need for splenic embolization	n (%) missing	23 (18.7) 7	2 (3.4) 6	21[a] (32.8) 1	< 0.001
	Splenectomy, n (%)	3 (2.3)	0 (0.0)	3 (4.6)	0.24
Splenic	Splenic arteriovenous fistula, n (%) missing	4 (3.3) 8	1 (1.7) 6	3 (4.8) 2	0.62
	Splenic pseudo aneurysm, n (%) missing	12 (9.8) 7	1 (1.7) 6	11 (17.2) 1	0.01
Hemorrhagic	Fall in hemoglobin > 3g/dL with an identified bleeding site OR a fall in hemoglobin > 4g/dL without an identified bleeding site, n (%) missing	20 (16.3) 7	7 (11.7) 5	13 (20.6) 2	0.22
	Transfusion, n (%) missing	16 (13.0) 7	7 (11.7) 5	9 (14.3) 2	0.79
	Number of packed RBC units transfused, median [range]	2 [2-4]	2 [1-3]	4 [2-6]	0.04
At least one complication (all)	 missing	61 (48.4) 4	28 (45.2) 3	33 (51.6) 1	0.48

[a] one patient had two embolizations

eTable 5. Complications at Month 6 Visit

		Month-6 visit			
Type of complication	**Complication**	Total (n=97) (%)	pSAE (n=50) (%)	SURV (n=47) (%)	*P* Value
Need for embolization		0 (0.0)	0 (0.0)	0 (0.0)	-
Due to SAE procedure	Hematoma on femoral access	0 (0.0)	0 (0.0)	0 (0.0)	-
	Thrombosis on femoral access	0 (0.0)	0 (0.0)	0 (0.0)	-
	Aneurysm on femoral access	0 (0.0)	0 (0.0)	0 (0.0)	-
	Allergy to contrast agent	0 (0.0)	0 (0.0)	0 (0.0)	-
	Renal insufficiency	0 (0.0)	0 (0.0)	0 (0.0)	-
Splenic	Splenic abscess	0 (0.0)	0 (0.0)	0 (0.0)	-
	Splenectomy	0 (0.0)	0 (0.0)	0 (0.0)	-
	Splenic arteriovenous fistula	0 (0.0)	0 (0.0)	0 (0.0)	-
	Splenic pseudo aneurysm	0 (0.0)	0 (0.0)	0 (0.0)	-
	Splenic pseudocyst	1 (1.0)	0 (0.0)	1 (2.1)	.49
Hemorrhagic	Fall in hemoglobin > 3g/dL with an identified bleeding site OR a fall in hemoglobin > 4g/dL without an identified bleeding site	0 (0.0)	0 (0.0)	0 (0.0)	-
	Transfusion	0 (0.0)	0 (0.0)	0 (0.0)	-
	Number of packed RBC units transfused	None	None	None	-
Infectious	At least one infectious complication	0 (0.0)	0 (0.0)	0 (0.0)	-
	Septicemia	0 (0.0)	0 (0.0)	0 (0.0)	-
Pancreatic	Pancreatitis	0 (0.0)	0 (0.0)	0 (0.0)	-
Thrombotic	Thrombose of spleno-portal trunk	0 (0.0)	0 (0.0)	0 (0.0)	-
	Phlebitis	0 (0.0)	0 (0.0)	0 (0.0)	> .99
	Pulmonary embolism	0 (0.0)	0 (0.0)	0 (0.0)	> .99
Pulmonary	Pleural effusion	2 (2.0)	1 (2.0)	1 (2.1)	> .99
	Thoracic drain if pleural effusion	2 (2.0)	1 (2.0)	1 (2.1)	-
	Pulmonary infection	0 (0.0)	0 (0.0)	0 (0.0)	> .99
At least one complication (all)		7 (7.2)	2 (4.0)	5 (10.6)	.26

eTable 6. Characteristics of Patients in SURV Arm Requiring Delayed Intervention (SAE and/or Splenectomy) at Day 5[a] Visit

	SURV group N = 65			
	Not requiring delayed intervention at day-5 visit N=44	**Requiring delayed intervention at day-5 visit N=21**	**Total**	**Fischer test**
Sex				
Female, n (%)	14 (31.8)	3 (14.3)	17 (26.2)	.23
Male, n (%)	30 (68.2)	18 (85.7)	48 (73.8)	
In employment or student				
No, n (%)	11 (25.0)	4 (20.0)	15 (23.4)	.76
Yes, n (%)	33 (75.0)	16 (80.0)	49 (76.6)	
Missing, n (%)	0	1	1	
Age, median [IQR] (years)	29.5 [22-45]	33 [26-48]	30 [23-47]	.34
Distance hospital-domicile, median [IQR] (Km)	42 [20-100]	26 [11-70]	30.5 [19.5-100]	.39
Time Accident to enrollment in trial, median [IQR] (hours)				
0-23 (hours), n(%)	25 (56.8)	15 (71.4)	40 (61.5)	.29
24-48 hours, n (%)	19 (43.2)	6 (28.6)	25 (38.5	
Circumstances of accident				
traffic, n (%)	27 (61.4)	12 (57.1)	39 (60.0)	.93
domestic, n (%)	3 (6.8)	1 (4.8)	4 (6.2)	
sport, n (%)	10 (22.7)	6 (28.6)	16 (24.6)	
work, n (%)	3 (6.8)	2 (9.5)	5 (7.7)	
other, n (%)	1 (2.3)	0 (0.0)	1 (1.5)	
OIS grade (after expert rereading)				
3, n (%)	35 (79.6)	6 (28.6)	41 (63.1)	< 0.001
4, n (%)	9 (20.4)	13 (61.9)	22 (33.8)	
5, n (%)	0 (0.0)	2 (9.5)	2 (3.1)	
OIS grade ≥4 (after expert rereading)	9 (20.4)	15 (71.4)	24 (36.9)	< 0.001
NISS score, median [IQR]	23 [13-29]	16 [13-25]	19 [13-27]	.09
WOMAC score available before accident				
Yes, n (%)	38 (86.4)	17 (81.0)	55 (84.6)	.72
No, n (%)	6 (13.6)	4 (19.0)	10 (15.4)	
WOMAC score = 0 before accident				
n (%)	32 (84.2)	14 (82.4)	46 (83.6)	>.99

[a] Events occurring between day 0 and day 5 visits (where the day-5 visit was -1d/+3d after enrollment)

eTable 7. Comparison of WOMAC Activity Scores Between pSAE and SURV

	Randomization arm			
	pSAE	SURV	Total	p-value[a]
WOMAC before the accident evaluated retrospectively by the patient				
Median [interquartiles]	0 [0-0]	0 [0-0]	0 [0-0]	0.38
Missing values	6	11	17	
WOMAC at D30				
Median [interquartiles]	4 [0-13]	4 [0-26]	4 [0-17]	.51
Missing values	25	30	55	
WOMAC at D180				
Median [interquartiles]	0 [0-7]	0 [0-6.5]	0 [0-7]	.63
Missing values	24	29	53	

The WOMAC score[33] uses a Lickert scale with 5 possible answers (null = 0; minimal = 1; moderate = 2; severe = 3; extreme = 4) to multiple questions relating to physical functional impairment, pain and stiffness. The minimum score corresponding to no impairment is 0 ; the maximum score for severe disability and distress is 96.

[a]The p-value indicated is from a Mann-Whitney test because the assumptions of normality were not respected

eTable 8. Ability of Patients to Return to Work or Studies (No Missing Data for Patients Declared as Employed or Students on D0) N = 96

Length of time off work or studies	Total	pSAE	SURV	p-value
Return to work at D30, n (%) Missing data	11/88 (12.5) 8	6/43 (13.9) 4	5/45 (11.1) 4	.69
Return to work at D180, n (%) Missing data	49/72 (68.1) 24	27/36 (75.0) 11	22/36 (61.1) 13	.21