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The Probability of Applying Splenosuprarenal Anastomosis Subject to Angio-architectonics of Lineal and Left Renal Basin Vessels

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Abstract Investigation results of 189 patients with portal hypertension have been carried out. All patients were performed a portosystemic shunting: splenosuprarenal anastomosis – in 123 patients; H-shaped splenorenal anastomosis with an insert from internal jugular vein to the right – in 66 patients. The variants of splenic and the left renal veins anatomy at portal hypertension (PH) have been analyzed. A histologic structure of porto-caval basin's vessels certain parts in patients with PH has been studied. The efficiency of splenorenal anastomosis with the use of the left renal vein flow for the prophylaxis of esophageal varices hemorrhage and the post-shunting complications in the nearest and long-term periods has been assessed.

Keywords Liver cirrhosis, Portal hypertension, Esophageal varices, Splenorenal anastomosis

1. Background

At present, the only method which significantly improves a prognosis of patients with liver cirrhosis (LC) and portal hypertension (PH) is the liver transplantation. But it is not available to the overwhelming majority of patients due to the deficiency of donor organ, a high cost and technical complicacy and also due to the imperfection of a legislative base in the field of transplantology [1-4].

In this connection, a portosystemic shunting (PSS) in the modern surgery of PH remains as one of the priority lines of prophylaxis against variceal hemorrhage. But in patients with LC a decompressive effect of shunting surgeries promotes not only the portal pressure dropping but also a forming of hepatofugal portal blood flow against the background of which the development risk of the hepatic failure and encephalopathy can reach up to 25-40% [5, 6].

At present time the majority of surgical schools dealing with the issues of prophylaxis against variceal hemorrhage in patients with LC adhere to the concept of the central partial decompression which was offered by K. Johansson in 1989. This original method competing with selective types of shunting provides not only an adequate decompression of the portal system but guarantees a long-term preservation of liver portal perfusion [7-11].

The occurrence of such unsatisfactory effects as thrombosis of intervascular insert, the recurrences of variceal hemorrhages, a sharp progressing of the hepatic failure, encephalopathy make to use the natural flows of the left renal vein for the forming "false H-shaped shunts". From one side, it reduces the risk of anastomosis thrombosis (as unicameral shunt is formed), and from the other side, it does not require an additional intervention on the neck to intake venous insert from internal jugular vein. The flows of the left renal vein can be also used at the formation of anastomosis with splenic vein. But its wide use is limited by anatomic-morphologic features, technical difficulties at the applying of anastomosis conditioned by small diameter or a thin wall of vessel and also by the absence of stated indications to this type of shunting [12-16].

So, it is necessary to have a complex, detailed estimation of the porto-caval basin vessels regional angio-architectonics and histologic structure with a definition of indications to the use of the left renal vein flows to apply splenorenal anastomosis.

2. Materials and Methods

In our center splenosuprarenal anastomosis (SSRA) in the surgery of PH in patients with LC first was performed in 1992. 123 SSRA were carried out up to 2016 inclusive. As this type of shunting refers to the false "H-shaped" variants of decompression, a comparison group (66 patients) was consisted of patients with the true "H-shaped" shunting (an intake of venous insert from the right internal jugular vein for applying "H-shaped" splenorenal anastomosis (H-SRA) with a necessity of forming two cameras – a venous insert with a splenic vein and the other end of the insert with the left renal

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vein. The mean age of all the patients was 27.6 ± 1.1 years (SSRA) and 27.3 ± 1.6 years (H-SRA). In the majority of cases young patients and teen-agers were performed the surgery – 175 (92.6%), males were in 1.6 times more than females.

The cause of PH in 166 (87.8%) cases was LC and in 23 (12.2%) patients with anhepatic form of PH – the portal vein thrombosis. An old omphalitis was the main factor of the portal vein thrombosis development.

The review of LC development factor showed that 161 (85.2%) patients had HBV, HCV in the anamnesis, 2 (1.1%) patients – malaria, 15 (7.9%) – abused alcohol and 3 (1.6%) – contacted with weed and pest-killer chemicals. In the rest 8 (4.2%) patients the etiological factor was not specified, but at the survey of 6 (75%) patients we defined the markers of viral hepatitis.

The following instrumental ways of investigation were performed in all patients: fibroesophagogastroscopy, hepatoscintigraphy, echography, splenoportography. We also used optical and electron microscopy for morphometric estimation of the vessels histological structure.

3. Results and Discussion

The probability of using vein afference of the left renal vein system depends on many factors: a diameter of suprarenal flow, its wall thickness, variant anatomy of the left renal artery and transformation of the splenic vein in PH conditions – does not always create optimal conditions not only for SSRA but also for the other types of PSS.

The main indications for the central decompression are portal hypertension and the old variceal hemorrhages, but the primary assessment for applying anastomosis belongs to the ultrasound investigation (USD). At the absence of contraindications from the side of hepatocytes functional status, permissible changes of blood red cells (HB higher than 80 g/l), a compensated condition of the hemostasis system and concomitant pathology – decompressive interventions are the privileged direction in the surgery of PH. But there is a small group of patients who cannot be performed PSS in the conditions of the planned surgery and that is why they are carried out surgeries which disconnect gastro-esophageal venous collector.

The main cause of the PH in our country is intrahepatic block (LC) which reaches 95% in the general structure of all etiologic causes, the simple USD with dopplerography allows to assess a vascular permeability of the portal basin, veins diameter and blood flow rate, the evidence of splenomegaly syndrome and etc.

Patients were randomized to 3 groups: the 1st (SSRA) and the second group (H-SRA) were compared between each other due to the similarity of decompression type; the 3rd group - with other types of anastomosis.

In the condition of PH due to LC, the efficiency of USD with dopplerography on visualization of the portal basin basic veins makes up 100% and it is not complicated for the qualified specialist. The same statement can be refered to the left renal vein. But the flow system of the mentioned veins is often inaccessible for the objective assessment by USD. So, the left gastric vein is succeeded to be visualized approximately in one third of patients with PH; the flows of the left renal vein are succeeded to be assessed more often (suprarenal vein is detected in 62.3-85% of patients, genital flow – in 56.6-68.3%). The main reasons of detailed ultrasound estimation's impossibility for the left renal vein system were splenomegaly syndrome with renal allotopia and the existence of compensatory dilated retroperitoneal vessels making difficult to identify the veins of the second order. The indices of vessels diameter between groups are presented in the Table 1.

Table 1. Preoperative diameter of splenorenal basin's vessels in patients with SSRA, H-SRA and the other types of PSS by USD data

Index (cm)	SSRA	H-SRA	The other central PSS
Portal vein diameter	1.37±0.08	1.42±0.06	1.41±0.06
Splenic vein diameter	1.18±0.08	1.19±0.05	1.18±0.09
Renal vein diameter	1.21±0.07	1.23±0.04	1.19±0.07
Suprarenal vein diameter	0.65±0.04*	0.37±0.02	0.34±0.04
Genital vein diameter	0.30±0.04	0.28±0.03	0.26±0.03

* - (P<0,05) significant difference from the other groups rate

The basic stage of the diagnostics reflecting the condition of the patient's portal system bloodstream is a dynamic splenoportography (SPG) – it allows to evaluate a variant transformation of portolienal basin in the conditions of PH.

The main variants of the splenic vein's transformation forms at PH are presented in the Fig.1. The tortuosity of the vessel in the area of expected shunting has been taken as a base, from one knee directed upwards (cephalad) or down (caudad), up to the several knees of the splenic vein.

A retrospective analysis of SPG in 157 patients with the central type of decompression from 2006 to 2007 showed the following results: in 139 cases the direction and the level of the splenic vein were eligible for applying SSRA and only in 18 (11.5%) patients even at the extensive release of the splenic and the left renal veins a big diastasis was kept between the mentioned veins. The length of the suprarenal vessel was not enough for anastomosis applying. It is necessary to mention that this analysis includes the estimation of the probability of SSRA application only by the level and the direction of the splenic vein's trunk as only 74 patients among 139 ones were performed SSRA application due to the other factors (the diameter and the thickness of suprarenal vein).

Subject to the level of basic knee of the splenic vein the possibility of performing SSRA was 60% (in 21 among 35 patients) at passing of the splenic vein at the level of the 12th thoracic vertebra (the linear direction and cephalad U-shaped form were not suitable for this type of anastomosis) (Tab. 2). The possibility of SSRA application at the level of the

1st lumbar vertebra made up 95.2% (in 79 among 83), at the level of the 2nd lumbar vertebra there is always a possibility of SSRA regardless of the type at the adequate release of the vessels.

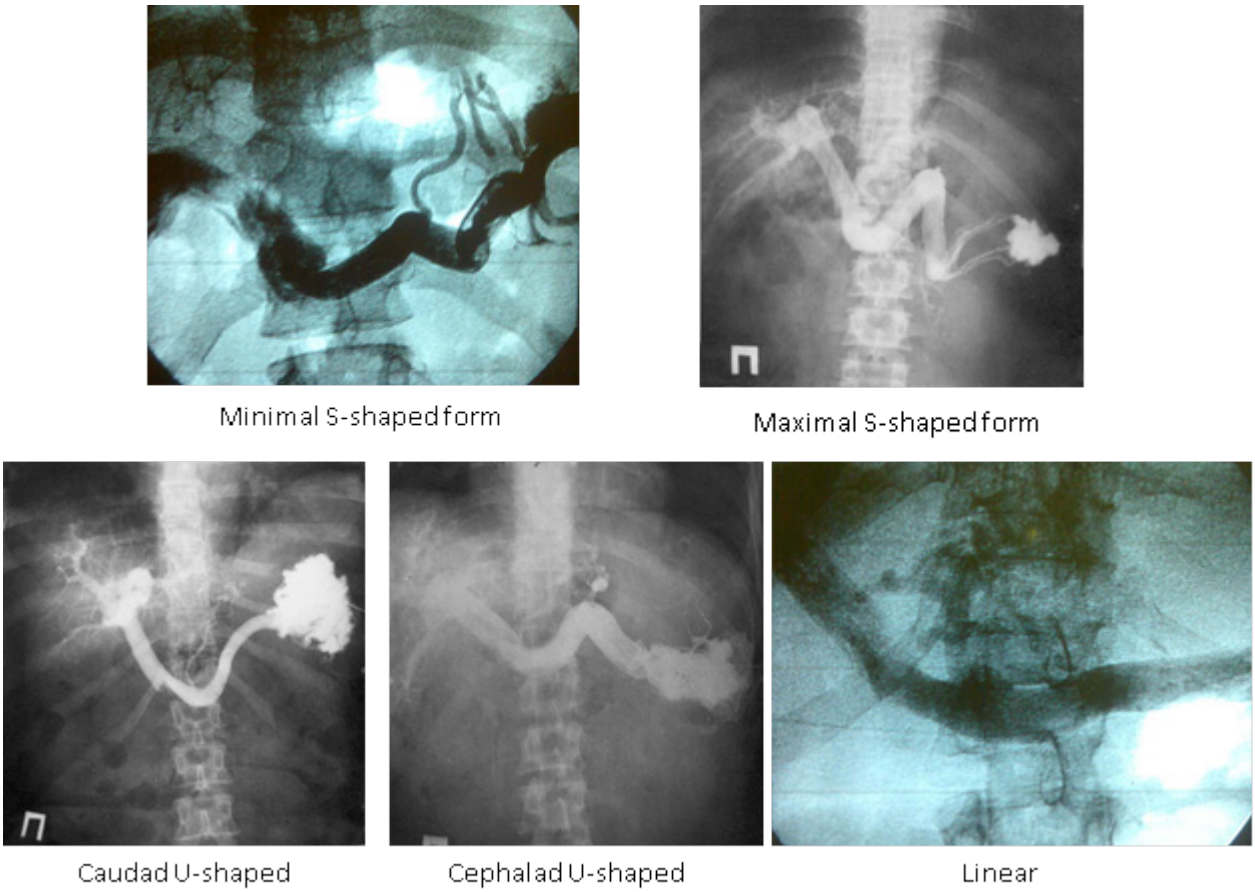


Figure 1. SPG. The splenic vein forms

Table 2. The possibility of SSRA at the indications to the central type of decompression subject to the transformation of the splenic vein by SPG data

Level of main area and form of splenic vein	n	Conditions for SSRA		Another type of anastomosis	
		Abs.	%	Abs.	%
T-XII					
Linear direction	7	2	28.6%	5	71.4%
Minimal S-shaped form	7	4	57.1%	3	42.9%
Maximal S-shaped form	11	8	72.7%	3	27.3%
Caudal U-shaped form	9	7	77.8%	2	22.2%
Cephalad U-shaped form	1	-	0.0%	1	1000%
L-I					
Linear direction	10	8	80.0%	2	20.0%
Minimal S-shaped form	23	23	100.0%	0	0.0%
Maximal S-shaped form	24	24	100.0%	0	0.0%
Caudal U-shaped form	18	18	100.0%	0	0.0%
Cephalad U-shaped form	8	6	75.0%	2	25.0%
L-II					
Maximal S-shaped form	22	22	100.0%	0	0.0%
Caudal U-shaped form	17	17	100.0%	0	0.0%
TOTAL	157	139	88.5%	18	11.5%

Table 3. Intraoperative data and parameters of splenic and renal vessels at the forming of H-shaped shunts

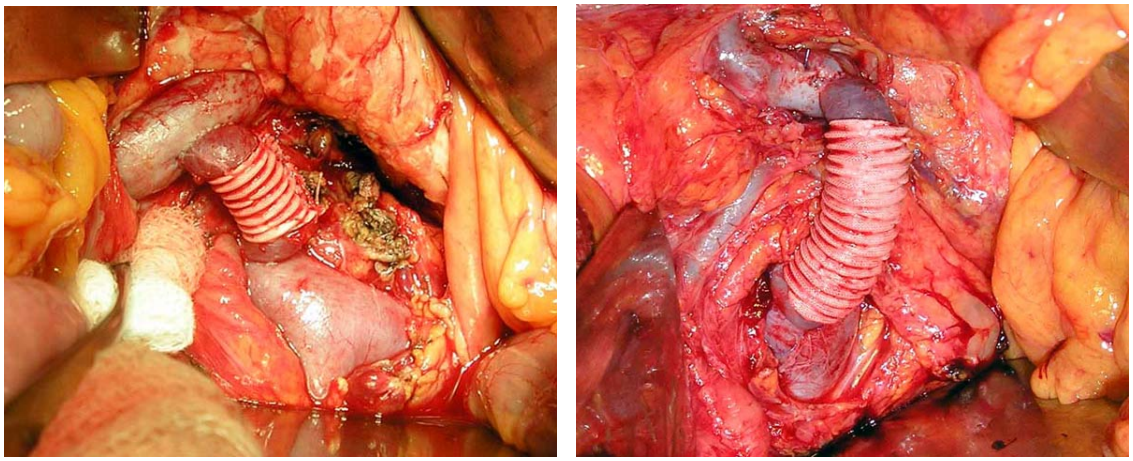
Parameters	SSRA	H-SRA
Diastasis between veins (cm)		
Initial	3.89±0.09	4.60±0.08*
At the lateral release of splenic vein and a complete release of renal vein	3.06±0.07	3.88±0.08*
At the complete release of splenic and renal veins	2.14±0.08	2.91±0.04*
Splenic vein		
Diameter (cm)	1.25±0.27	1.22±0.03
The length of release (cm)	4.51±0.06	3.64±0.05
Renal vein		
Diameter (cm)	1.47±0.08	1.44±0.06
The length of release (cm)	4.28±0.06	3.81±0.05
Suprarenal vein		
Diameter (cm)	0.87±0.06	0.34±0.02*
Length (cm)	2.05±0.08	-
Internal jugular vein		
Diameter of insert (cm)	-	1.16±0.03
Length of insert (cm)	-	3.85±0.05
Anastomosis camera		
With splenic vein (cm)	1.02±0.03	1.16±0.04*
With renal vein (cm)	-	1.18±0.04
Portal pressure (mm of water)		
Before anastomosis	384.1±19.0	374.8±18.6
After anastomosis	270.4±12.62	250.4±14.8
Decompressive effect (%)	29.6±0.3%	33.8±0.5%

* - reliable (P<0,05) difference from another group's index

After releasing a lateral wall of the splenic vein an initial diastasis between it and the renal vein made up 3.89±0.09 cm at the applied SSRA and 4.60±0.08 cm at H-SRA which is reliably (P<0,05) differed. If the renal vein to be released adequately with ligation of all flows (it is technically more simple in compare with the releasing of the splenic vein) – diastasis can be reduced up to 25% at an average. The further releasing of the splenic vein by circumference and length allows to reduce a diastasis up to 2.14±0.08 cm and 2.91±0.04 cm. It is necessary to mention that technical feature for any type of anastomosis is a possibility for applying a shunt on the medium tension – it promotes the reduce of diastasis but requires an adequate thickness of the vessels wall. The length of the released splenic and the left renal veins at H-SRA (3.64±0.05 cm and 3.81±0.05 cm) was rather less than at SSRA (4.51±0.06 cm and 4.28±0.06 cm). The diameter of a suprarenal vein at SSRA made up 0.87±0.06 cm and its length (up to the cross line) – 2.05±0.08 cm, at H-SRA the diameter was 0.34±0.02 cm. The diameter of the insert from internal jugular vein made up 1.16±0.03 cm at an average and reliably (P<0,05) wider than suprarenal vessel, the length of H-insert for H-SRA application made up 3.85±0.05 cm – it also differed from the average length of the used suprarenal vessels. Anastomosis camera at the formation of SSRA made up 1.02±0.03 cm at an average which became possible due to the flexibility of the suprarenal vein and permissible dilatation of the vessel camera up to 1-2 mm and also due to the short oblique direction of the vessel's slice which increased its diameter. It is necessary to apply two cameras at the forming H-SRA; the diameter of anastomosis camera of H-insert from the splenic vein was 1.16±0.04 cm and from the renal vein – 1.17±0.04cm, both the insert diameter and anastomosis camera from the splenic vein were reliably (P<0,05) wider than at SRRA forming. A decompressive effect of the analyzed shunts was rather higher at H-SRA and made up 33.8±0.5%, a portal pressure at SSRA lowered to 29.6±0.3%, but that parameter was received by intraoperative data whereas the analysis of long-term results of the regress level of esophageal varices as the result of decompression was comparable in the groups (Tab.3).

Technical features of forming SSRA and H-SRA: at the use of the venous insert of an adequate length the necessity in the lengthy release of the vessels will occur significantly seldom than in the presence of diastasis and small stump of the suprarenal vein. At the same time, the renal vein was completely released practically in all cases (86.4% at H-SRA and 91.9% at SSRA) and more traumatic lengthy release of the splenic vein for SSRA was required in 74.0% of cases whereas at H-SRA – only in 54.5% of patients.

The principle issue at the central decompression of the portal system is a formation of the partial reversed shunt because this type of shunting more often leads to the significant reduce of the portal blood flow with a high probability of hepatic failure and encephalopathy development. We have been using the method of porto-caval shunt restriction with the help of restricted cuff since 1998 in our center. The cuff is conducted over the vessel – it allows to narrow the cuff along the length and to apply a valuable anastomosis camera for the prophylaxis of thrombosis. There is a probability of venous insert due to the high portal pressure at the formation of H-SRA. Unadaptable insert from internal jugular vein is stretched in the nearest postoperative period stipulating the increase of blood flow turbulence in the anastomosis area and increases the risk of its thrombosis. The use of restricted cuff practically in all cases is obligatory at the formation of H-SRA from the method's adoption time – the necessity of the restriction use for this type of shunting made up 66.0% (in 40 among 66 patients), in the rest of cases the insert length was 1.5-1.8 cm, its diameter was 1.0 cm (it did not require the restriction). At the formation of SSRA (Fig.2) the restriction method was used only in 17,9% (in 22 among 123 patients who had the indications for shunt restriction) which was connected with both the less length of the false H-insert and a thicker and dense wall of the suprarenal vein.



SSRA with a restricted cuff H-SRA with a restricted cuff

Figure 2. H-shaped anastomosis with a restricted cuff

Taking into account the fact that a variant anatomy has a principle value at planning SSRA, we present the probability of applying this type of shunting at the indications to the central decompression subject to the diameter of the left suprarenal vein. Anatomic features of the suprarenal vein allowed to apply this type of shunting in 101 patients (7-8 and 9 and more mm), but the presence of the other factors such as diastasis and vessels wall thickness allowed to perform SSRA only in 74 patients.

4. Conclusions

Subject to the peculiarities of splenic vein's angio-architectonics (the form and the level by SPG data), the optimal conditions for applying SSRA are revealed only in 60% of cases at the high location of the vessel (T-XII) and in 95.2-100% of patients with a low variant anatomy (L-I-II). The probability of applying SSRA subject to the diameter of the suprarenal vein made up only 64.3% and the presence of a lengthy diastasis between anastomosed vessels or unfitness of the venous wall thickness reduces this index up to 47.1%. A comparative analysis of the technical levels of performing SSRA and H-SRA showed that at the use of a true venous insert the necessity in the lengthy release of the vessels made up 84.6% for the renal vein and 54.5% for the splenic vein. The release stage for SSRA is more traumatic (91.9% and 74.0%) but from the other side, the formation of H-SRA dictates the necessity of the intake of venous insert and applying of two cameras of anastomosis – it decreases the risk of thrombosis development. Decompressive effect at H-SRA makes up 33.8±0.5% and at SSRA the portal pressure decreases to 29.6±0.3% and this fact stipulates the diameter of H-insert and anastomosis camera (1.22±0.04 cm versus 1.07±0.03 cm, $P<0.05$). In 60.6% of cases at H-SRA formation the necessity in the restriction of porto-caval shunt by the original method occurs in order to keep the optimal level of hepatopetal blood flow and prophylaxix of thrombosis. At SSRA only 17.9% of patients needed the restriction – it was connected both with the less length of the false H-insert and thick and dense wall of the suprarenal vein.

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