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Research Article

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Evolution of Innovative Surgical Techniques Using the Example of Selective Splenorenal Anastomosis Surgery

A.Yu. Anisimov [1] ✉ ***, F.B. Mavlonov*** [2]***, D.E. Erkinova*** [1]***, A.I. Andreev*** [1]***, R.A. Ibragimov*** [1]***, E.Yu. Mandryka*** [1]

Department of Emergency Medicine and Simulation Medicine
[1] Kazan (Volga Region) Federal University
Kremlin Street 18, Kazan, Russian Federation 420008
[2] National Research Center for Transplantation of Human Organs and Tissues
Mayakovskaya Str. 2, Dushanbe, Republic of Tajikistan 743012

✉ **Contacts:** Andrey Yu. Anisimov, Doctor of Medical Sciences, Professor, Head of the Department of Emergency Medical Care and Simulation Medicine, Center of Medicine and Pharmacy, Higher School of Medicine, Institute of Fundamental Medicine and Biology, Kazan (Volga Region) Federal University. Email: aanisimovbsmp@yandex.ru

RELEVANCE Despite the obvious successes of transjugular intrahepatic portosystemic shunt and orthotopic liver transplantation in some high-tech centers of the Russian Federation, the relevance of substantiating the use of selective splenorenal anastomoses in the treatment plan for portal hypertension, when hundreds of patients return to emergency surgery departments every year after conservative treatment with new episodes of bleeding, liver failure and high mortality rates, is beyond doubt.

AIM OF THE STUDY To substantiate the viability of the selective splenorenal anastomosis operation by improving the technique of performing the intraoperative vascular maneuver exposure and venous reconstruction through the use of modern original innovative approaches.

MATERIAL AND METHODS A retrospective controlled clinical study included 56 patients with intrahepatic portal hypertension with relatively preserved liver function, in whose complex treatment program for secondary prevention of bleeding, various options for selective splenorenal bypass surgery were used. In 21 patients of comparison group A, who were treated between 2006 and 2017, selective splenorenal anastomoses were performed using the traditional technique. In 35 patients of the main group B, who were treated between 2018 and 2021, the surgical technique was improved through the use of two innovative surgical techniques: intraoperative vascular maneuver exposure and venous reconstruction during the formation of a splenorenal shunt.

RESULTS Original intraoperative vascular maneuver exposure at the first stage of surgery in patients with portal hypertension provides convenient volumetric-spatial relationships in the surgical wound, creates comfortable conditions for performing the main surgical technique, vascular anastomosis. The duration of surgical interventions in patients of group A was 35% longer, and the average intraoperative blood loss was 58.6% higher than in patients of group B. The difference was statistically significant. The suggested intraoperative maneuver of vascular exposure has a minimal risk of developing specific complications associated with the approach to the vessels of the left retroperitoneal space.

Seven days after the operation, patients in both groups showed a decrease in the size of the portal and splenic veins and the volume of the spleen. The blood flow velocity indices in the portal vein decreased, while those in the splenic vein increased. Turbulent blood flow was observed in the lumen of the shunts. No thrombosis of vascular conduits was detected in the early postoperative period according to Doppler ultrasound data. The observed differences were statistically insignificant.

In group A, 7 patients (33.3%) died during the study period, and in group B, 3 patients (8.6%). The differences in mortality were statistically significant. The survival rate of patients in group A was significantly lower than that of patients in group B.

CONCLUSION Changing the technique of execution through the use of modern innovative surgical techniques intraoperative vascular maneuver exposure and venous reconstruction during the formation of the splenorenal shunt allowed to improve the treatment results of patients with portal hypertension, reduce the duration of surgical interventions from 305.5±44.3 to 198.6±21.1 min (p=0.00155), average intraoperative blood loss from 930.0±198.6 to 385.1±84.7 ml (p=0.00004), reduce the incidence of complications in the early postoperative period, including postoperative pancreatitis from 19.0% to 0, anastomotic thrombosis from 28.6% to 5.7%, and mortality from 33.3% to 8.6% (p< 0.05), increase the 8-week survival rate, thereby confirming the viability of the selective shunt operation splenorenal anastomosis, conditioned by the reserve for evolution built into it by the authors.

When performed in a center with technical expertise, the procedure provides long-term survival and reliable hemostasis, potentially obviating the need for liver transplantation in a significant number of appropriately selected patients with portal hypertension and relatively preserved liver function.

Keywords: portal hypertension, surgical treatment, selective splenorenal anastomosis, innovative surgical techniques, intraoperative vascular maneuver exposures, venous reconstruction

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Affiliations

Andrey Yu. Anisimov	Doctor of Medical Sciences, Professor, Head of the Department of Emergency Medical Care and Simulation Medicine, Center for Medicine and Pharmacy, Higher School of Medicine, Institute of Fundamental Medicine and Biology, Kazan Federal University; https://orcid.org/0000-0003-4156-434X, aanisimovbsmp@yandex.ru;

30%, development of the concept and design of the study, execution of operations, editing of the article, approval of the final version of the manuscript, responsibility for the integrity of all parts of the article

Fayzaly B. Mavlonov — Candidate of Medical Sciences, Deputy Director for Clinical Work, State Institution National Scientific Center for Transplantation of Human Organs and Tissues;
https://orcid.org/0009-0008-6321-4168, faizimavlon@mail.ru;
20%, data analysis and interpretation, article editing, approval of the final version of the manuscript

Dilnoza E. Erkinova — 5th Grade Student, Institute of Fundamental Medicine and Biology, Kazan Federal University;
https://orcid.org/0009-0000-6527-596X, erkinova-dilya@mail.ru;
20%, writing the article, collecting and statistical processing of data

Andrey I. Andreev — Candidate of Medical Sciences, Senior Lecturer, Department of Emergency Medical Care and Simulation Medicine, Center for Medicine and Pharmacy, Higher School of Medicine, Institute of Fundamental Medicine and Biology, Kazan Federal University;
https://orcid.org/0000-0003-0788-9845, aandreyi@yandex.ru;
10%, performing operations, analyzing and interpreting data

Rinat A. Ibragimov — Candidate of Medical Sciences, Associate Professor, Department of Emergency Medical Care and Simulation Medicine, Center for Medicine and Pharmacy, Higher School of Medicine, Institute of Fundamental Medicine and Biology, Kazan Federal University;
https://orcid.org/0000-0003-0788-9845, rinatibr@mail.ru;
10%, performing operations, analyzing and interpreting data

Evgeny Y. Mandryka — Assistant, Department of Emergency Medical Care and Simulation Medicine of the Center for Medicine and Pharmacy, Higher School of Medicine, Institute of Fundamental Medicine and Biology, Kazan Federal University;
http://orcid.org/0009-0000-0963-8877, mister_mk01@mail.ru;
10%, data collection and statistical processing

AIASA – angle of inclination of the axis of surgical action
ALT – alanine aminotransferase
APTT – activated partial thromboplastin time
ASA – angle of surgical action
ASA WL – angle of surgical action along the length of the wound
ASA WW – angle of surgical action along the width of the wound
AST – aspartate aminotransferase
INR – International Normalized Ratio
LRV – left renal vein
SV – splenic vein
WD – wound depth
WL – wound length
WW – wound width

RELEVANCE

Is it possible at the turn of the first quarter of the 21st century, when indications for bypass surgery have significantly decreased, to use selective splenorenal anastomoses in the treatment program for portal hypertension? The relevance of this issue in the Russian Federation in modern conditions, when despite the obvious successes of transjugular intrahepatic portosystemic shunting and orthotopic liver transplantation in certain high-tech centers, hundreds of patients return to emergency surgery departments every year after conservative treatment with new episodes of bleeding, liver failure and high mortality rates, is beyond doubt.

Selective splenorenal shunt is one of the most elegant operations in portal hypertension surgery, which allows achieving effective and long-term results in the treatment of patients with variceal bleeding by implementing two pathophysiological principles. On the one hand, it ensures control of variceal bleeding by selective decompression of gastroesophageal varices through the spleen and splenic vein (SV) into the left renal vein (LRV). On the other hand, it preserves the function of the cirrhotic liver by maintaining increased pressure in the superior mesenteric and portal veins and portal perfusion [1–3].

In the 56 years since the introduction of the *Warren shunt*, few operations have been subjected to such rigorous testing in numerous randomized trials, comparing it again and again with the then new alternative treatments, from total anastomoses, azygoportal disconnection, devascularization to endoscopic therapy and transjugular intrahepatic portosystemic shunt [4–7].

The long-term viability and encouraging results of this operation, reproduced in most surgical centers where it has been used, are associated with the reserve for evolution built into it by the authors. It allows periodically, at a certain historical stage, through the use of newly emerging innovative surgical techniques, to improve the technique, and thereby improve the results of patient treatment, reduce the frequency of complications, the length of hospital stay and mortality [8].

There is no consensus on what constitutes an "innovative surgical procedure." In surgical hepatology, as a section of clinical surgery where the pace of surgical innovation shows no signs of slowing down, it typically ranges somewhere between minor modifications of a technique and completely new approaches [9, 10].

Our own clinical experience of 103 portocaval bypass operations suggests that selective splenorenal anastomosis is an excellent procedure for improving surgical technique through various innovative surgical techniques [11]. This allows it to remain a good option for patients with preserved liver function and variceal bleeding refractory to endoscopic and medical treatment when X-ray endovascular decompression is not possible.

In connection with the above, **the aim of the study** was to substantiate the viability of the selective splenorenal anastomosis operation by improving the technique of performing the intraoperative maneuver of vascular exposure and venous reconstruction through the use of original modern innovative approaches.

MATERIAL AND METHODS

A retrospective controlled clinical study included 56 patients with intrahepatic portal hypertension and relatively preserved liver function, in whose complex treatment program various variants of selective splenorenal bypass surgery were used to achieve long-term survival and reliable hemostasis. All patients were divided into two groups. In 21 patients of comparison group *A*, who were treated between 2006 and 2017, selective splenorenal anastomoses were performed using the traditional technique. In 35 patients of the main group *B*, who were treated between 2018 and 2021, the surgical technique of performing selective splenorenal bypasses was improved through the use of two innovative surgical techniques: an intraoperative vascular exposure maneuver and venous

Table 1

Clinical characteristics of patients at the time of admission

Indicator	Group *A* 2006–2017 (*n*=21)		Group *B* 2018–2021 (*n*=35)	
Floor				
Men	15	71.4	22	62.9
Women	6	28.6	13	37.1
Age				
From 15 to 39 years old	7	33.3	8	22.9
From 40 to 59 years old	11	52.4	25	71.4
Above 60	3	14.3	2	5.7
Etiological factors of liver cirrhosis				
Viral hepatitis *B*	3	14.3	1	2.9
Viral hepatitis *C*	12	57.1	27	77.1
Autoimmune hepatitis	1	4.8	2	5.7
Alcoholic cirrhosis	5	23.8	5	14.3
Degree of cirrhosis compensation according to *Child–Pugh criteria*				
Class *A*	15	71.4	28	80.0
Class *B*	6	28.6	7	20.0
Class *C*	–	–	–	–
Activity of liver cirrhosis				
Inactive	18	85.7	30	85.7
Low activity	3	14.3	5	14.3
Highly active	–	–	–	–
History of bleeding episode				
Yes	13	61.9	26	74.3
No	8	38.1	9	25.7
History of compression hemostasis with Sengstaken-Blakemore tube				
Yes	13	100.0	26	100.0
No	–	–	–	–
History of compression hemostasis with self-expanding nitinol stent				
Yes	2	15.4	5	19.2
No	11	84.6	21	80.8
History of endoscopic ligation				
Yes	11	84.6	21	80.8
No	2	15.4	5	19.2
Nature of the operation				
Distal splenorenal anastomosis	13	61.9	33	94.3
H-type splenorenal anastomosis	8	38.1	2	5.7

reconstruction during the formation of a splenorenal bypass.

For statistical analysis of the results, the Student's *t* -test of independent samples [12] was used with a probability of error of the first kind (α) of less than 0.05. Graphs for assessing the survival function of patients for 8 weeks after the end of treatment were constructed using the Kaplan-Meier method [13].

Clinical and laboratory characteristics of patients in both groups at the time of admission to hospital are presented in Tables 1 and 2.

Table 2

Laboratory parameters of patients at the time of admission

Indicator, level	Reference values	Group *A* 2006–2017 (*n*=21)	Group *B* 2018–2021 (*n*=35)	*p*
Hemoglobin, g/l	120–160	82.7±23.1	83.1±21.8	0.319
Hematocrit, %	36–48	26.1±2.1	26.8±3.2	0.246
RBC, $\times 10^{12}$/l	3.7–5.1	2.3±0.1	2.1±0.3	0.716
Platelets, $\times 10^{9}$/l	150–350	121.3±55.8	119.5±67.1	0.335
Aspartate aminotransferase, U/L	31–37	42.7±11.4	40.3±12.1	0.399
Alanine aminotransferase, U/L	34–45	49.3±13.1	48.8±11.5	0.339
Total bilirubin, μmol/l	0–21	45.1±2.1	49.6±3.1	0.352
Prothrombin index, %	70–100	56.0±13.2	53.9±11.4	0.386
Serum albumin, g/l	35–52	30.9±0.9	31.4±0.7	0,160

As follows from the analysis of the data presented in Table 1, both groups were comparable in terms of gender, age, etiology, degree of compensation, and activity of cirrhosis upon admission to the hospital. As follows from the analysis of the data presented in Table 2, the difference between the liver function test values was statistically insignificant. This also allowed us to conclude that both groups were comparable upon admission to the hospital.

RESULTS

IMPROVING THE SURGICAL TECHNIQUE OF INTRAOPERATIVE VASCULAR EXPOSURE MANEUVER

In group *A,* mobilization and connection of the SV and LRV was performed from a traditional intraperitoneal approach through a transverse incision in the mesentery of the transverse colon (Fig. 1) [1].

Fig. 1. Traditional intraperitoneal access to the splenic and left renal veins through a transverse incision in the mesentery of the transverse colon

However, with deep location of the SV behind the pancreas or in the thickness of the latter, such an approach carries a high risk of unintentional intraoperative damage to both the vessel itself and the pancreas. This can increase intraoperative blood loss, lead to postoperative pancreatitis, and ultimately to thrombosis of the anastomosis, which often forces us to abandon splenorenal shunting [14, 15].

Taking into account the above, we have developed a technique for intraoperative access to the SV and LRV, which is based on a surgical technique known as the Mattox maneuver, or left-sided medial visceral rotation [16, 17].

According to this technique, we first mobilize the descending colon toward its splenic angle, dissecting the parietal peritoneum upward along Toldt's white line. Then, in the avascular plane in the retroperitoneal space, we perform a sequential complete mobilization of the mesentery of the descending colon with its main vessels, retracting it medially. Unlike the Mattox maneuver, which always involves rotation of the spleen, pancreas, and left kidney in the medial direction relative to the midline and the location of the mobilization plane directly on the muscles of the posterior abdominal wall, in our case the spleen, pancreas, and left kidney remain in place, and the mobilization plane is located on Toldt's fascia. This is why we allowed ourselves to call this technique an incomplete Mattox maneuver, or partial left-sided medial visceral rotation.

The technique is an innovative surgical approach that meets the criterion of expanding the indications to a group of patients for whom surgical results may be different [18]. As our clinical experience shows, a correctly performed manipulation ensures a wide

exposure of the anterior surface of the pancreas, spleen, left kidney, SV, LRV and most of their branches, including the inferior mesenteric, left adrenal, left testicular or left ovarian veins (Fig. 2).

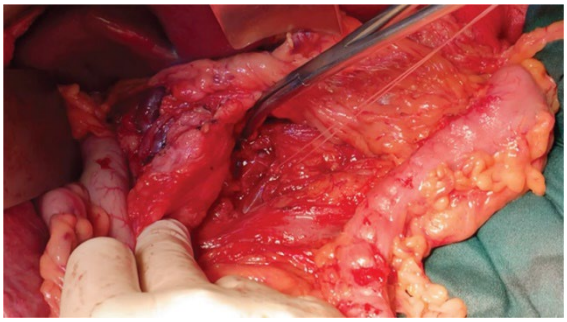

Fig. 2. Original intraperitoneal approach to the retroperitoneal vessels (partial left-sided medial visceral rotation)

In patients of group B, we used the maneuver of partial left-sided medial visceral rotation developed by us. Objective volumetric-spatial characteristics of two intraoperative approaches to the retroperitoneal vessels are presented in Table 3.

As follows from the analysis of the data presented in Table 3, the original intraoperative maneuver of vascular exposure at the first stage of surgery in patients with portal hypertension provides convenient volumetric-spatial relationships in the surgical wound and creates comfortable conditions for performing the main surgical technique - the imposition of a vascular anastomosis.

T-criterion calculated for each of the parameters of operational access were greater than the critical (tabular) value with α equal to 0.05 (2.005). This allowed us to conclude that the difference between the analyzed indicators is statistically significant.

The clinical effectiveness of the proposed intraoperative vascular exposure maneuver is convincingly demonstrated by the clinical characteristics presented in Table 4.

Table 3

Parameters of intraoperative approaches to the vessels of the retroperitoneal space in the studied groups of patients

Operational access parameters	Group *A* 2006–2017 (*n*=21)		Group *B* 2018–2021 (*n*=35)		Student's *t*-test
	Average meaning (*M*)	Average error of the arithmetic mean (*m*)	Average meaning (*M*)	Average error of the arithmetic mean (*m*)	
WL, cm	26.6	0.31	26.1	0.21	7.29
WW, cm	16.2	0.32	17.1	0.33	4.57
WD LRV, cm	14.7	0.26	11.4	0.41	3.74
WD SV, cm	14.9	0.28	11.1	0.17	3.75
ASA for LRV, °	66.1	1.74	98.1	1.05	21.98
ASA for SV, °	62.4	1.20	104.2	1.31	22.26
ASA WW LRV, °	61.7	1.04	84.7	1.03	19.65
ASA WW SV, °	60.3	1.40	82.1	0.61	19.12
AIASA LRV, °	68.2	1.31	90.3	0.21	21.32
AIASA SV, °	67.8	1.02	90.8	0.24	21.32

Notes: WD - wound depth; WL - wound length; LRV - left renal vein; SV - splenic vein; AIASA - angle of inclination of the axis of the surgical action; ASA- angle of surgical action; ASA WL - angle of surgical action along the length of the wound; ASA WW - angle of surgical action along the width of the wound

As follows from the analysis of the data presented in Table 4, the duration of surgical interventions in patients of group *A* was 35% longer than in patients of group *B*. Taking into account that the value of the Student's *t*-test for the indicator "average duration of surgery (min)" was higher than the critical (tabular) value with α equal to 0.05 (2.005), it can be concluded that the difference between the analyzed indicators is also statistically significant.

Table 4

Clinical characteristics of patients

Indicator	Group *A* 2006–2017 (*n* =21)		Group *B* 2018–2021 (*n* =35)		*Students t*-test	*p*
	M±*m*	Range	*M*±*m*	Range		
Average duration of operation, min	305.5±44.3	(260–350)	198.6±21.1	(120–240)	2.43	0.00155
Average intraoperative blood loss, ml	930.0±198.6	(760–1100)	385.1±84.7	(220–540)	4.48	0,00004

The average intraoperative blood loss during surgical interventions in patients of group *A* was 58.6% higher than in patients of group *B*. Taking into account that the value of Student's *t*-test for the indicator "average intraoperative blood loss (ml)" was higher than the critical (tabular) value with α equal to 0.05 (2.005), it can be concluded that the analyzed indicators and the difference between them are also statistically significant.

In addition, postoperative pancreatitis complicated the course of the postoperative period in 4 patients (19.0%) in group *A*. At the same time, we did not encounter postoperative pancreatitis in any clinical observation in patients in group *B*. Anastomotic thrombosis in the early postoperative period developed in 6 patients (28.6%) in group *A* and only in 2 (5.7%) in group *B*.

Thus, in our opinion, the proposed intraoperative vascular exposure maneuver has a minimal risk of developing specific complications associated with the approach to the vessels of the left retroperitoneal space.

IMPROVING THE SURGICAL TECHNIQUE OF VENOUS RECONSTRUCTION IN THE FORMATION OF A SPLENORENAL SHUNT

If the length of the diastasis between the SV and LRV exceeds 4 cm, the formation of a distal splenorenal shunt to ensure unimpeded blood flow requires appropriate methods of venous reconstruction with autologous tissues or synthetic materials [19–21]. However, vascular venous reconstructions with conduits from the internal jugular vein or from polytetrafluoroethylene and polyethylene terephthalate have a number of disadvantages and risks. The main ones include an increase in the duration and trauma of the operation; risk of bleeding; discrepancy between the siza and the risk of turbulence; risk of thrombosis or infection of the conduit; the need for long-term postoperative anticoagulant therapy (Fig. 3).

Taking into account the above, we suggested to use the falciform ligament of the liver as an alternative, convenient and reliable autologous material for venous reconstruction of the splenorenal axis with high reliability and patency in portal hypertension as a result of liver cirrhosis of various origins (Fig. 4).

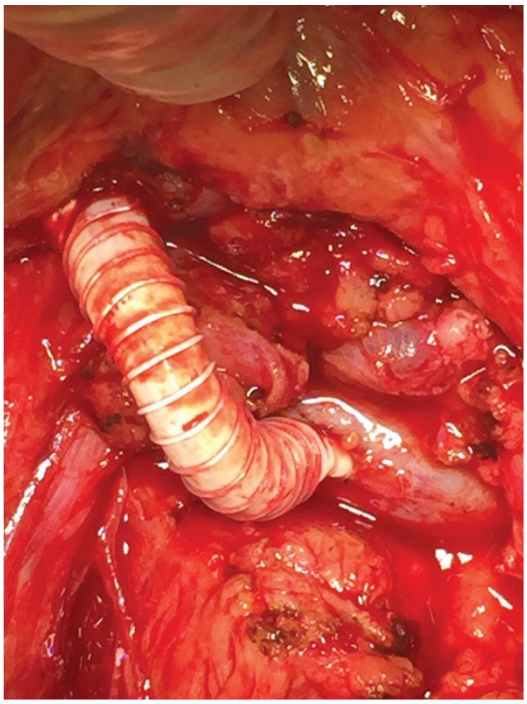

Fig. 3. Venous reconstruction with a synthetic vascular conduit made of polytetrafluoroethylene during portosystemic shunt

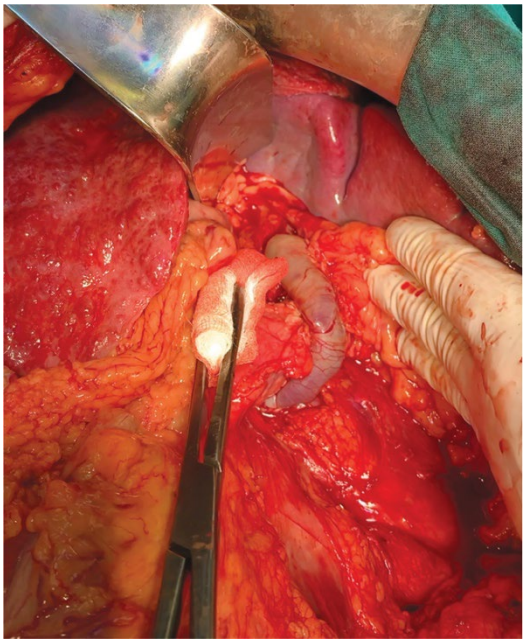

Fig. 4. Venous reconstruction with a vascular conduit from the falciform ligament of the liver during portosystemic shunting

The technique is an innovative surgical approach that meets the criterion of expanding the indications to a group of patients for whom surgical results may be different [22].

In 8 patients of group *A, the H-type* splenorenal anastomosis was performed using synthetic polytetrafluoroethylene conduits for vascular venous reconstruction. In 2 patients of group *B,* the H-type splenorenal anastomosis was performed using a fragment of the falciform ligament of the liver for vascular venous reconstruction.

To control the patency of the anastomoses, all patients underwent dynamic duplex ultrasound examination of the main parameters of portal blood flow. The results of this study are presented in Table 5.

As follows from the analysis of the data presented in Table 5, immediately before the operation in both observation groups the sizes of the portal and splenic veins and the volume of the spleen were increased. All patients had a hepatopetal nature of blood flow through the portal and splenic veins.

Seven days after the operation, patients in both groups showed a decrease in the size of the portal and splenic veins and the volume of the spleen. The blood flow velocity indices in the portal vein decreased, while those in the splenic vein increased. Turbulent blood flow was observed in the lumen of the shunts. No thrombosis of the vascular conduits was detected in the early postoperative period according to Doppler ultrasound data.

Student's t -test calculated for each of the ultrasound indices of portal blood flow were less than the critical (tabular) value with α equal to 0.05 (2.005). This allowed us to conclude that the differences between the analyzed indices in the studied groups of patients were statistically insignificant.

In accordance with the recommendations of the international consensus *Baveno Y* II (2021), we monitored mortality for 8 weeks after surgery. In group *A,* 7 patients (33.3%) of the total sample of subjects (21 patients) died during the study period, and in group *B*, 3 patients (8.6%) of the total sample of subjects (35 patients) died. The differences in mortality were statistically significant, since p <0.05 (Table 6).

Table 5

Ultrasound parameters of portal blood flow in the studied groups of patients

Indicator	Before surgery			After surgery		
	Group *A* 2006–2017 (*n*=8)	Group *B* 2018–2021 (*n*=2)	Student's *t*- test	Group *A* 2006–2017 (*n*=8)	Group B 2018–2021 (*n*=2)	Student's *t*- test
Portal vein diameter, mm	15.3±0.8	15.8±1.1	0.12	13.8±1.0	13.2±1.2	0.16
Linear velocity of blood flow in the portal vein, cm/s	15.1±4.1	14.8±1.1	0.07	13.1±0.7	11.6±1.9	0.43
Portal vein blood flow rate, ml/min	991±136	998±127	0.03	689±113	626±143	0.34
Diameter of the splenic vein, mm	13.9±2.1	13.7±1.8	0.05	11.0±1.1	11.3±1.3	0.10
Linear blood flow velocity in the splenic vein, cm/sec	17.0±1.2	16.8±2.3	0.04	25.7±2.4	25.1±3.1	0.09
Volumetric blood flow rate in the splenic vein, ml/min	776±126	789±114	0.06	907±118	923±180	0.06
Spleen volume, cm^3	789±352	805±343	0.07	525±159	507±148	0.19

Table 6

Mortality in the studied groups of patients

Number of patients	Group *A* (*n* =21)		Group *B* (*n* =35)		*p*
	Abs. number	%	Abs. number	%	
Total number of deaths	7	33.3	3	8.6	0.03

Analysis of the Kaplan-Meier 8-week survival curves for the study groups indicates that the survival of patients in group *A* was significantly lower than that of patients in group *B*. In addition, in group *B,* fatal outcomes were noted in the early postoperative period (on the 1st–2nd day), while in group *A*, they occurred during the 7-week observation period.

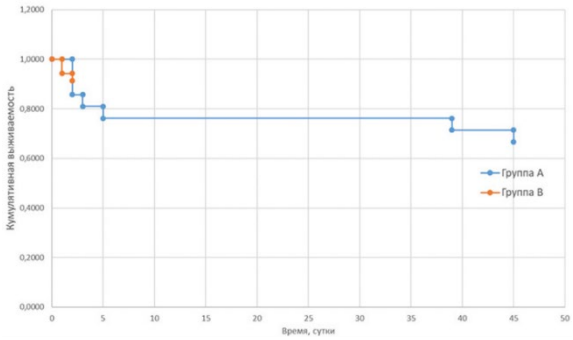

Fig. 5. Kaplan–Meier curves of 8-week survival in the study groups

Clinical observation

Patient M., born in 1980 (ICSB No. 1738925).

Hospitalized in the clinic on March 10, 2020, on a planned basis by referral from one of the central district hospitals. Preliminary diagnosis: Liver cirrhosis of mixed genesis (*HCV* + alcoholic). *Child–Pugh* Class *B*. Portal hypertension syndrome. Esophageal varices complicated by multiple bleeding.

Complaints on admission of general weakness, intermittent, dull, aching pain in the right hypochondrium and epigastric region. History of liver cirrhosis due to viral hepatitis C. From 2016 to 2020, there were five episodes of bleeding from esophageal varices. Each time, hemostasis was achieved by tamponade with a *Sengstaken-Blackmore obturator probe* in combination with drug therapy at the central district hospital at the place of residence. In April 2019, endoscopic ligation of esophageal varices and azygoportal disconnection surgery according to M.D. Paciore were performed.

On examination of the patient in the emergency department, the general condition is satisfactory. Consciousness is clear. Skin is of physiological color. Body temperature is 36.5°C. Respiratory rate is 17 breaths per minute. Blood pressure is 120/80 mm Hg. Pulse is 74 beats per minute, rhythmic, well-filled.

The abdomen is of regular shape, participates in the act of breathing. On palpation it is soft and painless. The liver and spleen are enlarged.

Blood tests: hemoglobin 98 g/l, RBC 4.23×10^{12}/l, hematocrit 30.7%, platelets 145×10^{9} l, prothrombin index 42%, INR (international normalized ratio) 2.0, APTT (activated partial thromboplastin time) 40.2 s, total bilirubin 12.8 μmol/l, ALT (alanine aminotransferase) 39 U/l, AST (aspartate aminotransferase) 46 U/l, total protein 60.7 g/l.

Video esophagogastroduodenoscopy was performed. Three varicose vein collectors were found in the esophagus at a distance of 33 to 38 cm from the incisors: one with a diameter of 3 mm, and two with a diameter of 5 mm. There are no "ripe cherry" spots or angioectasias. The veins collapse during insufflation. In addition, there are cicatricial foci from previous ligation in the lower third of the esophagus. There are no varicose veins in the stomach during inversion examination. The mucous membrane is pink with foci of hyperemia, edematous with a pronounced pattern of gastric fields. The lumen contains mucus and bile in moderate quantities. No fresh blood was found.

Spiral computed tomography of the abdominal organs with intravenous bolus contrast reveals uneven, finely tuberous liver contours. The liver parenchyma structure is homogeneous. The craniocaudal size of the right lobe of the liver is 195 mm, the anteroposterior size of the right lobe of the liver is 120 mm, the craniocaudal size of the left lobe of the liver is 108 mm, the anteroposterior size of the left lobe is 74 mm. The spleen is of normal shape, enlarged. The dimensions of the spleen are 200×93×66 mm. The structure is homogeneous. The diameter of the portal vein is 18 mm, SV 13 mm. The diameter of the superior mesenteric vein is 14 mm, LRV 15 mm. The distance from SV to LMV is about 40 mm.

Diagnosis: Liver cirrhosis of mixed etiology (*HCV* + alcoholic) according to *Child–Pugh A-B* (6–7 points). *MELD score*: 13 points. Inactive phase. Intrahepatic portal hypertension syndrome. Esophageal varices grade III according to A.G. Shertsinger. Condition after repeated recurrent esophageal-gastric bleeding. Splenomegaly. Posthemorrhagic anemia grade I.

In this clinical situation, taking into account the repeated recurrent esophageal-gastric bleeding in the anamnesis and the high risk of developing another bleeding, it was decided to perform a selective

splenorenal anastomosis as a secondary prevention of esophageal-gastric bleeding.

After appropriate drug preparation, an upper midline laparotomy was performed under endotracheal anesthesia on March 16, 2020.

Mobilization of the splenic and LVH was performed using the original technique of partial left-sided medial visceral rotation.

First, the descending colon was pulled medially toward the midline of the body. After determining the incision line, the parietal peritoneum was incised and divided along the white line of Toldt. The descending colon was mobilised upward toward its splenic angle. Then, in the avascular plane in the retroperitoneal space, retracting the descending colon medially, blunt dissection and sequential complete mobilisation of the mesentery of the descending colon with its main vessels were performed. In this case, the spleen, pancreas and left kidney remained in place, and the mobilisation plane was located on Toldt's fascia. The maneuver ensured wide exposure of the anterior surface of the pancreas, spleen, left kidney, SV and LRV.

During the revision of the vessels, it was established that the diastasis between them was 60 mm. Taking into account the topographic and anatomical variant of the deep location of the SV behind the pancreas and the high risk of unintentional intraoperative damage during mobilization of both the vessel itself and the pancreas, it was decided to form a partial H-type splenorenal anastomosis using the falciform ligament of the liver in the splenorenal position as a replacement for the autologous vascular prosthesis. A 70.0 × 20.0 mm flap was cut out from the patient's falciform ligament of the liver. From the latter, after adjusting the size of the graft to the individual needs of the patient, an autologous conduit was formed. It was used as an insert when forming an H-type splenorenal anastomosis with the imposition of two end-to-side anastomoses between the SV and one end of the conduit and between the LRV and the other end of the conduit. The patency of the anastomosis was verified using intraoperative sonography.

In the postoperative period, the patient received albumin, lactulose, ceftriaxone, prednisolone 60 mg/day, fraxiparine 0.8 ml/day, omeprazole 40 mg/day, heptral 400 ml/day.

On March 19, 2020, on the 3rd day after the operation, a repeat spiral computed tomography of the abdominal organs was performed with intravenous bolus contrast, multiplanar and three-dimensional reconstruction: a splenorenal shunt was formed; blood flow is intense, fairly uniform; infiltration of the mesenteric tissue; traces of fluid along the left lateral canal.

On March 27, 2020, the wound healed by primary intention. The stitches were removed. Blood tests: hemoglobin 94 g/l, erythrocytes 4.06×10^{12} /l, hematocrit 32.1%, platelets 105×10^{9}/l, prothrombin index 49%, INR 1.75, APTT 32.4 s, total bilirubin 20.8 μmol/l, ALT 20 U/l, AST 385 U/l, total protein 55.5 g/l.

In satisfactory condition, he was discharged for outpatient follow-up treatment at his place of residence. At the time of writing, the observation period was 3 years 10 months. Bleeding did not recur. Control endoscopic examinations did not reveal varicose veins in the esophagus and stomach. The patency of the splenorenal shunt was confirmed by ultrasound Dopplerography (Fig. 6).

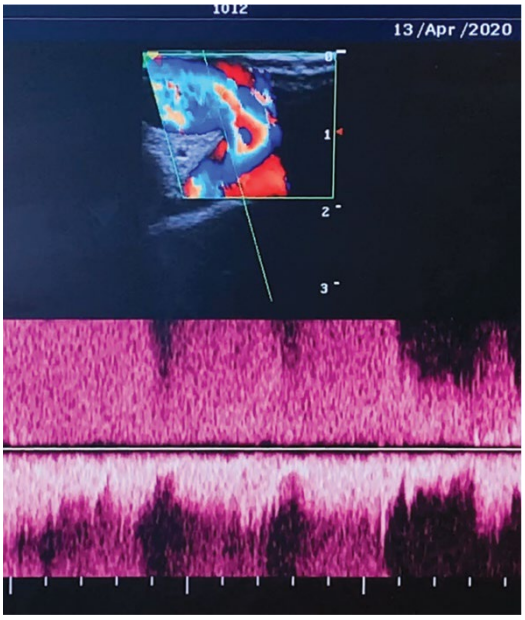

Fig. 6. Patency of the splenorenal shunt confirmed by ultrasound Doppler data

CONCLUSION

Despite the obvious successes in individual high-tech centers of the Russian Federation of transjugular intrahepatic portosystemic shunting and orthotopic liver transplantation, the relevance of substantiating the use of selective splenorenal anastomoses in the treatment program for portal hypertension, when hundreds of patients annually return to emergency surgery departments with new episodes of bleeding, liver failure and high mortality rates after conservative treatment, is beyond doubt [4–7, 11]. Based on the above, in the present

retrospective controlled clinical study in 56 patients with intrahepatic portal hypertension with relatively preserved liver function, the viability of the selective splenorenal anastomosis operation was substantiated by improving the technique of performing the intraoperative maneuver of vascular exposure and venous reconstruction through the use of original modern innovative approaches [9, 10]. In 21 patients of control group A, who were treated between 2006 and 2017, selective splenorenal anastomoses were performed using the traditional technique. In 35 patients of the main group B, who were treated between 2018 and 2021, the surgical technique was improved using an innovative intraoperative maneuver of vascular exposure and venous reconstruction during the formation of a splenorenal shunt. The results obtained during the clinical analysis convincingly indicate that the original intraoperative maneuver of vascular exposure at the first stage of surgery in patients with portal hypertension provides convenient volumetric-spatial relationships in the surgical wound, creates comfortable conditions for performing the main surgical technique - the creation of a vascular anastomosis. The duration of surgical interventions in patients of group *A* was 35% longer, and the average intraoperative blood loss was 58.6% higher than in patients in group *B*. The difference was statistically significant. The proposed intraoperative maneuver of vascular exposure has a minimal risk of developing specific complications associated with the approach to the vessels of the left retroperitoneal space . Seven days after the operation, patients in both groups showed a decrease in the size of the portal and splenic veins and the volume of the spleen. The blood flow velocity indices in the portal vein decreased, while those in the splenic vein increased. Turbulent blood flow was observed in the lumen of the shunts. No thrombosis of vascular conduits was detected in the early postoperative period according to Doppler ultrasound data. The observed differences were statistically insignificant.

In group A, 7 patients (33.3%) died during the study period, and in group B , 3 patients (8.6%) died. The differences in mortality were statistically significant. The survival rate of patients in group A was significantly lower than that of patients in group B.

FINDING

1. Changing the technique of performance through the use of original modern innovative surgical techniques of intraoperative maneuver of vascular exposure and venous reconstruction allowed to improve the results of treatment of patients with portal hypertension, reduce the duration of surgical interventions from 305.5 ± 44.3 to 198.6 ± 21.1 min (p = 0.00155), average intraoperative blood loss from 930.0 ± 198.6 to 385.1 ± 84.7 ml (p = 0.00004), reduce the frequency of complications in the early postoperative period, including postoperative pancreatitis - from 19.0% to 0, anastomotic thrombosis - from 28.6% to 5.7%, and mortality from 33.3% to 8.6% (p 0.05), increase the 8-week survival rate, thereby confirming the viability of the selective venous anastomosis operation splenorenal anastomosis, due to the reserve for evolution built into it by the authors.

2. When performed in a center with technical expertise, the procedure provides long-term survival and reliable hemostasis, potentially eliminating the need for liver transplantation in a significant number of appropriately selected patients with portal hypertension and relatively preserved liver function.

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