Case Report

https://doi.org/10.23934/2223-9022-2021-10-3-589-597

First Clinical Experience of Venous Reconstruction with Autologous Vascular Prosthesis from the Falciform Ligament of the Liver with Partial Portosystemic Bypass Surgery

***A.Yu. Anisimov*[1] ✉, *A.A. Anisimov*[1], *A.I. Andreev*[2], *R.A. Ibragimov*[2], *A.T. Garaev* [1]**

Department of Emergency Medicine and Simulation Medicine
[1] Kazan (Privolzhsky) Federal University
18, Kremlyovskaya St., Kazan 420008, Russian Federation
[2] Municipal Clinical Hospital № 7
54, Chuikov St., Kazan 420103, Russian Federation

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

AIM OF STUDY Presentation of our own first clinical experience of venous reconstruction in portosystemic bypass surgery with the use of autologous vascular prostheses of the falciform ligament of the liver in the splenorenal position in a patient with portal hypertension syndrome in the outcome of liver cirrhosis of viral etiology.

MATERIAL AND METHODS Clinical observation of a patient born in 1978 with a diagnosis of cirrhosis of the liver of viral etiology (HCV) Child-Pugh A (6). MELD 10 points. Inactive phase. Intrahepatic portal hypertension syndrome. Esophageal varices grade III according to A. G. Scherzinger, gastric varices type I (GOV1) according to Sarin. Condition after repeated recurrent esophageal-gastric bleeding. Due to the high risk of another bleeding, as a secondary prevention of esophageal-gastric bleeding, partial splenorenal anastomosis of "H" - type was performed with the use of an autologous vascular prosthesis of the falciform ligament of the liver in the splenorenal position.

RESULTS A flap measuring 60.0x20.0 mm was cut from the falciform ligament of the patient's 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 in the formation of an "H" - type splenorenal anastomosis with the imposition of two end-to-side anastomoses between the splenic vein and one end of the conduit and between the left renal vein and the other end of the conduit. The patency of the anastomosis was checked using intraoperative sonography. In a satisfactory condition, the patient was discharged for outpatient follow-up treatment at the place of residence. At the moment of writing the article, the follow-up period was 8 months. The bleeding did not recur. No varicose veins were found in the esophagus and stomach during control endoscopic examinations. The patency of the splenorenal shunt was confirmed by ultrasound dopplerography.

CONCLUSION The first clinical experience of venous reconstruction with portosystemic bypass surgery using as a possible replacement of autologous vascular prostheses of the falciform ligament of the liver in the splenorenal position in a patient with portal hypertension syndrome in the outcome of cirrhosis of the liver of viral etiology gives hope for the possibility of further successful testing of this method of splenorenal bypass surgery to reduce the risk of bleeding from varicose veins.

Keywords: portal hypertension; surgical treatment; splenorenal anastomosis; falciform ligament of the liver; venous reconstruction

For citation Anisimov AYu, Anisimov AA, Andreev AI, Ibragimov RA, Garaev AT. First Clinical Experience of Venous Reconstruction with Autologous Vascular Prosthesis from the Falciform Ligament of the Liver with Partial Portosystemic Bypass Surgery. *Russian Sklifosovsky Journal of Emergency Medical Care.* 2021;10(3):589–597. https://doi.org/10.23934/2223-9022-2021-10-3-589-597 (in Russ.)

Conflict of interest Authors declare lack of the conflicts of interests

Acknowledgments, sponsorship The study had no sponsorship

Affiliations

Andrey Yu. Anisimov	Doctor of Medical Sciences, Professor, Head of the Department of Emergency Medicine and Simulation Medicine, Institute of Fundamental Medicine and Biology, Kazan (Privolzhsky) Federal University. Chief External Specialist, Surgeon of the Ministry of Health of the Republic of Tatarstan; https://orcid.org/0000-0003-4156-434X, aanisimovbsmp@yandex.ru; 40%, performing operations, concept and design, writing an article, correcting an article, approving the final version for publication
Andrei A. Anisimov	Lecturer of the Department of Emergency Medicine and Simulation Medicine of the Institute of Fundamental Medicine and Biology of Kazan (Privolzhsky) Federal University; https://orcid.org/0000-0002-5323-7226, aa_anisimov@bk.ru; 25%: literature review, article writing, statistical analysis, approval of the final version for publication
Andrey I. Andreev	Head of the Department of Surgery No. 4 of Kazan City Clinical Hospital No. 7; aandreyi@yandex.ru; 15%: performing operations, correcting an article, approving the final version for publication
Rinat A. Ibragimov	Surgeon of the Department of Surgery No. 4 of Kazan City Clinical Hospital No. 7; https://orcid.org/0000-0003-0788-9845, rinatibr@mail.ru; 15%: performing operations, correcting an article, approving the final version for publication

Almaz T. Garaev	Lecturer of the Department of Emergency Medicine and Simulation Medicine of the Institute of Fundamental Medicine and Biology of Kazan (Privolzhsky) Federal University; https://orcid.org/0000-0002-6152-5033, micro116@mail.ru; 5%: statistical analysis, approval of the final version for publication

ALT – alanine aminotransferase

APTT – activated partial thromboplastin time

AST – aspartate aminotransferase

INR – international normalized ratio

INTRODUCTION

Numerous works of the late XX - early XXI century postulated the position that bleeding from the esophageal-gastric veins is a critical surgical complication of portal hypertension in the outcome of chronic diffuse liver diseases [1-3]. Bypass surgery is one of the effective directions in terms of preventing recurrent bleeding and increasing the life expectancy of patients on the waiting list for liver transplantation [4–6]. The specific tasks of selective varicose decompression were and remain the selective reduction of pressure and volume of flow through the gastroesophageal veins; maintenance of portal venous perfusion of the liver and persistent venous hypertension in the intestinal vessels, taking into account possible liver transplantation [7-9]. The rationale for the anastomosis of the distal end of the splenic vein with the left renal vein is to decompress the critical area of varicose veins of the esophagus and stomach by diverting the splenic venous flow through the spleen and left renal vein, maintaining high pressure in the intestinal veins, while the superior mesenteric and portal venous flows are supported in the axis of the superior mesenteric and portal veins and continue to perfuse the stomach and liver [10–12]. One of the most beneficial features of the *W.D. Warren* shunt is that the encouraging results of this operation are regular in most surgical centers where it has been used [13]. Long-term survival can be achieved in well-matched portal hypertensive patients with a large volume of portal venous flow and relatively preserved liver function [11]. On the other hand, this variant of portocaval shunting not devoid of a number of disadvantages, preventing its wide clinical use [14, 15]. First of all, this is associated with the variant topographic anatomy of the veins of the splenic-portal and left renal circulations and its dependence on anthropometric parameters, which determine the technical difficulties of performing a surgical intervention [16].

The standard *W.D. Warren* technique for performing surgery involves the complete mobilization of the pancreas using electrocoagulation and tissue ligation along its entire lower border length, so that the pancreas is completely turned on its side. In this case, the pancreas must be carefully separated from the anterior and superior surfaces of the splenic vein to the junction with the superior mesenteric vein [17]. Mobilization of the splenic vein when it is deeply located behind the pancreas or in the thickness of the latter is fraught with a high risk of intraoperative pancreatic injury - the main cause of postoperative pancreatitis, shunt thrombosis, recurrent bleeding from varicose veins and, ultimately, death. That is why the topographic and anatomical variant of the location of the splenic vein behind the pancreas makes it necessary to abandon the distal splenorenal shunt [18, 19]. Our own clinical experience of 103 portocaval shunting operations indicates that with the length of diastasis between the splenic and left renal veins up to 4 cm, the formation of a distal splenorenal shunt is almost always possible without tension on the vessels by creating an end-to-side anastomosis. However, with a greater length of diastasis between the vessels, an autovein or a synthetic prosthesis must be used to restore the lumen and patency. Vascular reconstructions performed during portocaval shunting made it possible to increase the number of radical interventions. The reasonability of this approach is dictated by *"H"* -type partial anastomoses, autologous internal jugular vein grafts [20], *ePTFE*- prostheses with atrombogenic carbon coating [21-25], synthetic grafts "Ekoflon" (Russia) introduction into clinical practice [26]. Thus, vascular venous reconstructions allow, on the one hand, to provide decompression of the portal system sufficient for regression of varicose veins and prevention of gastroesophageal bleeding, on the other hand, to maintain reduced portal blood flow to maintain satisfactory liver function. However, the use of the technique of vascular venous reconstruction during distal splenorenal bypass grafting in modern economic conditions is justified in the case of using quickly available, biologically safe, cheap material, which provides a relative ease of formation of venous anastomoses. This can help reduce reluctance to perform portal decompression, which requires a long-term shunt. At the same time, the use of an autovenous conduit from the internal jugular vein significantly increases the duration of the operation and the invasiveness of the intervention, requires additional

operative access and mandatory reconstruction of the internal jugular vein. There is an increased risk of bleeding or size mismatch resulting in insufficient venous flow with an increased risk of turbulence that can contribute to conduit thrombosis [3]. In addition, synthetic grafts consisting of polytetrafluoroethylene (PTFE) or polyethylene terephthalate (PET) carry a serious risk of thrombosis and infection, and postoperative anticoagulant therapy is time-consuming [27]. On the other hand, modern surgery has experience of safe and effective use as an autologous material for venous reconstruction during operations for oncological diseases of the hepatopancreatobiliary area in the absence of corresponding vascular grafts of the parietal peritoneum [28] and the falciform ligament of the liver [29–31].

Based on the foregoing, the **aim of this work** was to present our own first clinical experience of venous reconstruction during portosystemic shunting using, as a possible replacement for autologous vascular prostheses of the falciform ligament of the liver in the splenorenal position in a patient with portal hypertension syndrome due to cirrhosis of the liver of viral etiology. We have not found similar observations in the available world literature.

Case report

Patient Y., born in 1978. (Medical Record No. 2470204). He sought help on April 8, 2020 with complaints of general weakness, lack of appetite, feeling of nausea, black coloration of feces within the previous 2 days. He had a history of cirrhosis of the liver as a result of viral hepatitis C. In June 2019 and February 2020, bleeding from varicose veins of the esophagus occurred twice. Both times, hemostasis was achieved by tamponade with a *Sengstaken – Blackmore* obturator in combination with drug therapy in the central district hospital of the community. When examining a patient in the admission department: a state of moderate severity. Normal consciousness. Pale skin. Blood pressure 120/80 mm Hg, pulse 74 bpm, rhythmic, satisfactory filling. The abdomen of the regular shape, participating in the act of breathing, soft upon palpation, the liver - along the margin of the costal arch. The spleen was not palpable. Rectally - no melena. In blood tests: hemoglobin - 114 g/l, RBC - $3.71 \cdot 10^{12}$/l, hematocrit - 36.5%, platelets - $69 \cdot 10^{9}$/l, prothrombin index - 60%, INR (international normalized ratio) - 1.49, APTT (activated partial thromboplastin time) - 47.2 s, total bilirubin - 22.5 μmol/L, ALAT (alanine aminotransferase) - 33 U/L, AST (aspartate aminotransferase) - 41 U/L, total protein - 51.8 g/l. Performed videoesophagogastroduodenoscopy. One collector of varicose vein with a diameter of 4 mm was found in the esophagus at a distance of 20 cm from the incisors. Starting from the level of 25 cm from the incisors, there were three collectors of varicose veins from 4 to 10 mm in diameter with “cherry ripe” spots, angiectasias. They do not collapse during insufflation. In the stomach during inversion examination in the area of the cardiac pulp in the direction of the lesser curvature - three varicose veins from 3 to 5 mm in diameter. Collapse with air insufflation. The mucous membrane was changed according to the type of hepatic gastropathy. The lumen contained a moderate amount of mucus and bile. No fresh blood was found. In ultrasound examination, the size of the right lobe of the liver was 140 mm, the left lobe was 105 mm. The liver parenchyma was hyperechoic, heterogeneous, with symptoms of diffuse steatosis. Portal vein - 13 mm. The spleen was 184x110 mm. The parenchyma was homogeneous. Splenic vein - 10 mm. The diagnosis was established: Hepatic cirrhosis of viral etiology *(HCV)* according to *Child – Pugh* (6). *MELD* - 10 points. Inactive phase. Intrahepatic portal hypertension syndrome. Varicose veins of the esophagus III degree according to A.G. Scherzinger, stomach - type I (*GOV*1) according to *Sarin*. Condition after repeated recurrent esophageal-gastric bleeding. On April 9, 2020, a spiral computed tomography of the abdominal organs with intravenous bolus contrast enhancement, multiplanar and three-dimensional reconstruction was performed. The study revealed a disproportion in the lobes of the liver. Its contours were uneven, clear. The structure of the liver parenchyma was homogeneous. Portal vein - up to 15.4 mm, splenic vein - convoluted up to 11.4 mm, with regional anastomoses. Superior mesenteric vein - up to 15 mm. The left renal vein is 16 mm. The distance from the splenic vein to the left renal vein is about 30 mm. The spleen was of normal shape, enlarged, with smooth, clear contours. The position, shape and size of the kidneys were not altered. Their contours were smooth, clear. The pelvicaliceal system of both kidneys was not deformed or expanded. The perinephric tissue was unremarkable. In such a clinical situation, taking into account the history of repeated recurrent esophageal-gastric bleeding and the high risk of developing another bleeding, it was decided to perform a selective distal splenorenal anastomosis according to *W.D. Warren* as a secondary prevention of gastroesophageal bleeding.

After appropriate drug preparation, on April 13, 2020, under endotracheal anesthesia, an upper median laparotomy, mobilization of the splenic and left renal veins were performed. During the revision of the vessels, it was found that the size of the diastasis between them was 50 mm (Fig. 1).

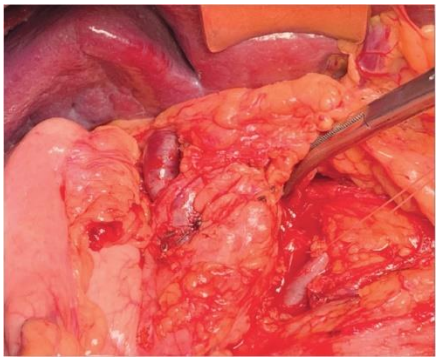

Fig. 1. Performed mobilization of the splenic and left renal veins. The size of the diastasis between them is 50 mm

Taking into account the topographic and anatomical variant of the deep location of the splenic vein 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 splenorenal *"H"*-type anastomosis using an autologous vascular prosthesis as a replacement falciform ligament of the liver in the splenorenal position. From the falciform ligament of the patient's liver, a 60.0x20.0 mm flap was cut out (Fig. 2).

From the latter, after adjusting the size of the graft to the individual needs of the patient, an autologous conduit was formed (Fig. 3).

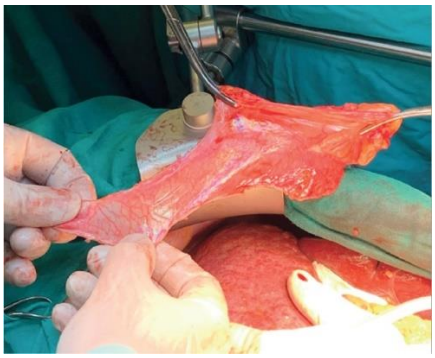

Fig. 2. The flap with dimensions of 60.0x20.0 mm was formed of the falciform ligament of the patient's liver

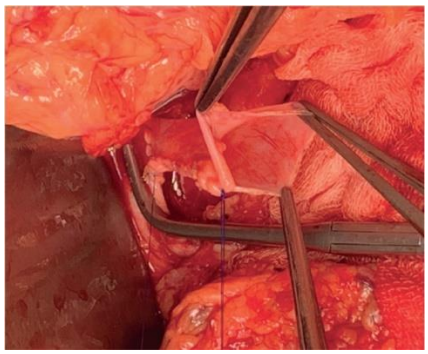

Fig. 3. After adjusting the size of the graft to the individual needs of the patient, an autologous conduit was formed from the falciform ligament flap of the liver

It was used as an insert to form an *"H"*-type splenorenal anastomosis with two end-to-side anastomoses between the splenic vein and one end of the conduit and between the left renal vein and the other end of the conduit (Fig. 4).

The patency of the anastomosis was verified by intraoperative sonography (Fig. 5).

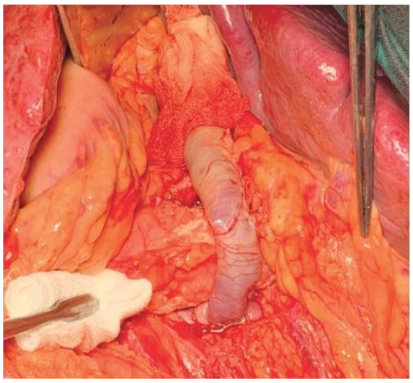

Fig. 4. H-type splenorenal anastomosis was made forming two end-to-side anastomoses between the splenic vein and one end of the conduit and between the left renal vein and the other end of the conduit

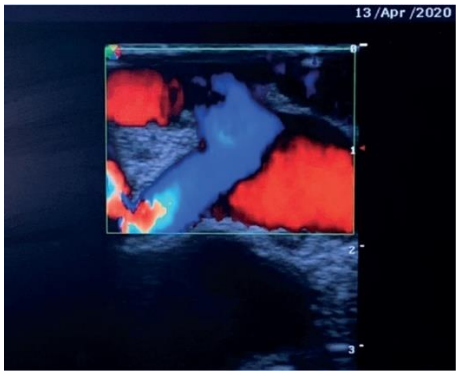

Fig. 5. The patency of the anastomosis was checked using intraoperative sonography

In the postoperative period, the patient received albumin, lactulose, prednisolone - 60 mg/day, fraxiparin - 0.8 ml/day, omeprazole - 40 mg/day, Heptral - 400 ml/day. On April 17, 2020, a repeated spiral computed tomography of the abdominal organs with intravenous bolus contrast enhancement, multiplanar and three-dimensional reconstruction was performed. Splenorenal shunt was formed. The blood flow was intense, fairly uniform. Infiltration of mesenteric tissue. Traces of liquid along the left lateral channel. On April 28, the wound healed by primary intention. The stitches were removed. Blood tests: hemoglobin - 95 g/l, RBC - 3.17 10^{12}/l, hematocrit - 30.2%, platelets 79 10^{9}/l, prothrombin index - 48%, INR - 1.78, APTT - 46.1 s, total bilirubin - 17.5 μmol/L, ALT - 26 U/L, AST - 45 U/L, total protein - 55.5 g/L. In satisfactory condition, he was discharged for outpatient follow-up care at the place of residence. At the time of writing the article, the observation period is 8 months. Bleeding did not recur. On confirmatory endoscopic studies, there were no varicose veins in the esophagus and stomach. The patency of the splenorenal shunt was confirmed by Doppler ultrasound data.

DISCUSSION

Global trends in the surgical treatment of patients with portal hypertension indicate that the effectiveness of the *W.D. Warren* distal splenorenal shunt in selective decompression of the portal circulation in liver cirrhosis is associated with ensuring a sufficient reduction in portal pressure to prevent esophageal bleeding and at the same time maintaining it above normal values to ensure portal perfusion taking into account possible liver transplantation [5, 6, 8, 10, 32]. However, if the length of diastasis between the splenic and left renal veins exceeds 40 mm, the formation of a distal splenorenal shunt to ensure blood flow requires appropriate methods of venous reconstruction with autologous tissues or synthetic materials. All of the above determines the relevance of the search for new surgical materials for the formation of vascular conduits during portosystemic shunting in patients with cirrhosis of the liver and varicose veins of the esophagus and stomach against the background of portal hypertension syndrome. Autologous materials are probably more suitable for ensuring the continuity of venous blood flow. In this regard, the search for the most suitable localization for obtaining material is still a difficult and urgent task. In this report, we consider 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 in the outcome of liver cirrhosis of various origins.

The *falciform* ligament of the liver *(lig.falciforme hepatis)* is a wide and thin fold of the peritoneum. It has a sagittal direction, starting immediately above the umbilicus from the anterior abdominal wall, connects it and the lower surface of the diaphragm in the midline with the diaphragmatic surface of the liver. The falciform ligament runs along the border between the right and left lobes of the liver [33, 34]. The surface of the peritoneum is lined with a layer of flattened polygonal cells - mesotheliocytes, having numerous microvilli covered with the thinnest layer of glycoproteins on the apical surface, intensively adsorbing serous exudate. Due to this, rubbing effect on the surface of the mesothelium is sharply reduced. Anatomical and histological features of the structure may be a prerequisite for the formation of an autologous conduit from thefalciform ligament of the liver for the reconstruction of venous blood flow with a high postoperative patency and a low risk of infection. Due to the possibility of adjusting the size of the graft to individual characteristics based on local intraoperative findings, it is possible to optimally match the size of the conduit and, therefore, the risk of its thrombosis and segmental occlusion may be reduced [35, 36]. In our opinion, the falciform ligament has a number of advantages. During the period of our follow-up, we found good graft permeability, which is comparable to the results of other studies using various autologous tissues or transposition grafts mixed with polytetrafluoroethylene [37–41]. However, retrieval as well as implementation is much easier and sizes can be tailored to individual needs based on intraoperative results. In addition, due to its autologous nature, the risk of infection and the need for long-term anticoagulant therapy after surgery are likely to be limited. In addition, cost-effective availability leads to verifiable benefits in favor of an autologous falciform ligament. Thus, in 2018 *T. Malinka et al.* shared their experience of reconstruction of the mesenteric and portal veins with fragments from the falciform ligament of the liver in the surgical treatment of locally advanced pancreatic cancer [30]. According to these authors, the ability to tailor the graft size to individual needs based on local results allowed them to optimally select the size of the conduit. Thus, the risk of developing stenosis or segmental occlusion was further reduced. Falciform ligament grafts have been tailored to individual needs based on local findings. Fragments of the falciform ligament were excised with scissors and placed in saline. To give the grafts a cylindrical shape, the cut fragments were rolled onto a tube and then *sutured* with 6.0 *Prolene* threads. In the postoperative period, all patients were followed up for at least one day in the intensive care unit. Anticoagulant therapy after venous reconstruction was performed by continuous administration of unfractionated heparin to achieve a prothrombin time of 40-50 seconds for 5 days. A

laboratory study of blood clotting parameters was performed every 8 hours. After that, the prevention of venous thromboembolism was achieved by subcutaneous administration of low molecular weight heparin during the entire period of hospital stay. Anticoagulant therapy was discontinued after discharge and continued only if additional comorbidities or the patient's primary diagnosis required it. The blood flow in the portal and superior mesenteric veins was assessed by duplex ultrasound examination intraoperatively, immediately after surgery, as well as on the first and second postoperative days. A final duplex ultrasound was performed prior to discharge. Contrast-enhanced abdominal computed tomography was performed on clinical grounds rather than routinely. The mean duration of surgical intervention was 361 minutes, and the mean time to occlude the mesenteroportal blood flow was 34 minutes. The median length of ICU stay and total hospital stay were 4 (1 to 12) and 23 (12 to 59) days, respectively. Finally, the need to ensure the possibility of liver transplantation is no less important in modern conditions, and the prerequisite for that is the disconnection of the previously formed portosystemic shunt to ensure adequate portal perfusion of the graft [32, 42].

The presented clinical observation indicates the possibility of vascular venous reconstruction with a fragment of the falciform ligament of the liver, on the one hand, to provide decompression of the portal system sufficient for regression of varicose veins and prevention of gastroesophageal bleeding, and on the other hand, to maintain reduced portal blood flow to maintain satisfactory liver function.

CONCLUSION

Our first clinical experience of venous reconstruction in portosystemic shunting using as a possible replacement for autologous vascular prostheses of the falciform ligament of the liver in the splenorenal position in a patient with portal hypertension syndrome due to cirrhosis of the liver of viral etiology gives hope for the possibility of further successful testing of this method of splenorenal shunting to reduce the risk bleeding from varicose veins. At the same time, although the indicators of the patency of the anastomosis in our patient are promising, the interpretation of the results is rather difficult due to the small number of clinical cases. Further experimental studies and clinical observations in this direction should clarify the overall result.

REFERENCES

1. Eramishantsev AK, Shertsinger AG, Kitsenko EA. Portal'naya gipertenziya. In: Savel'ev VS, Kirienko AI (eds.) *Klinicheskaya khirurgiya*. In 3 vol. Vol. 2. Ch. 63. Moscow: GEOTAR-Media Publ.; 2009: 626–665. (in Russ.)
2. de Franchis R, Baveno VI Faculty. Expanding consensus in portal hypertension. Report of the Baveno VI Consensus Workshop: Stratifying risk and individualizing care for portal hypertension. *J Hepatol*. 2015;63(3):743–752. PMID: 26047908 https://doi.org/10.1016/j.jhep.2015.05.022
3. Anisimov AYu, Mamkeev EKh, Amirov NB, Loginov AV, Kuznetsov MV, Anisimov AA. Issues of Surgical Treatment of Liver Cirrhotic Patients with Variceal Esophagogastric Bleeding. *The Bulletin of Contemporary Clinical Medicine*. 2016;9(6):20–27. https://doi.org/10.20969/VSKM.2016.9(6).20–27
4. Yoshida H, Mamada Y, Taniai N, Tajiri T, Uchida E. *Surgical Management in Portal Hypertension, Hepatic Surgery*. Open access peer-reviewed chapter. Publ. February 13th 2013. https://doi.org/10.5772/52899 Available at: https://www.intechopen.com/chapters/42371 [Accessed 23 Aug 2021]
5. Nazyrov FG, Devyatov AV, Babadjanov AKh, Mardonov LL. Analysis of quality of life of patients suffered from liver cirrhosis with portal hypertension after portosystemic shunt. *Bulletin of Experimental and Clinical Surgery*. 2012;5(3):509–516. (in Russ.)
6. Sharma N, Bajpai M, Kumar A, Paul S, Jana M. Portal hypertension: A critical appraisal of shunt procedures with emphasis on distal splenorenal shunt in children. *J Indian Assoc Pediatr Surg*. 2014;19(2):80–84. PMID: 24741210 https://doi.org/10.4103/0971–9261.129599
7. Warren WD, Zeppa R, Fomon JJ. Selective trans-splenic decompression of gastroesophageal varices by distal splenorenal shunt. *Ann Surg*. 1967;166(3):437–455. PMID: 6068492 https://doi.org/10.1097/00000658-196709000-00011
8. Sarfeh IJ, Rypins EB, Mason GR. A systematic appraisal of portacaval H-graft diameters. Clinical and hemodynamic perspectives. *Ann Surg*. 1986;204(4):356–363. PMID: 3490229 https://doi.org/10 1097/00000658-198610000-00003
9. Bismuth H, Moreaux J, Hepp J. Central spleno-renal anastomosis in the treatment of portal hypertension]. *Ann Chir*. 1966;20(25):1441–1445. PMID: 5990111
10. Van Praet KM, Ceulemans LJ, Monbaliu D, Aerts R, Jochmans I, Pirenne J. An analysis on the use of Warren's distal splenorenal shunt surgery for the treatment of portal hypertension at the University Hospitals Leuven. *Acta Chir Belg*. 2020;121(4):254–260. PMID: 32022643 https://doi.org/10.1080/00015458.2020.1726099
11. Livingstone AS, Koniaris LG, Perez EA, Alvarez N, Levi JU, Hutson DG. 507 Warren-Zeppa distal splenorenal shunts: a 34-year experience. *Ann Surg*. 2006;243(6):884–892. PMID: 16772792 https://doi.org/ 10.1097/01.sla.0000219681.08312.87
12. Hillebrand DJ, Kojouri K, Cao S, Runyon BA, Ojogho O, Concepcion W. Small-diameter portacaval H-graft shunt: a paradigm shift back to surgical shunting in the management of variceal bleeding in patients with preserved liver function. *Liver Transpl*. 2000;6(4):459–465. PMID: 10915169 https://doi.org/10.1053/jlts.2000.6141
13. Gerunda GE, Faccioli AM. The Distal Splenorenal Shunt. In: Rossi P. (eds.) *Portal Hypertension: Diagnostic Imaging and Imaging-Guided Therapy*. Springer-Verlag Berlin Heidelberg; 2000. pp.183–189.
14. De Franchis R., Baveno V Faculty. Revising consensus in portal hypertension: report of the Baveno V consensus workshop on methodology of diagnosis and therapy in portal hypertension. *J Hepatol*. 2010;53(4):762–768. PMID: 20638742 https://doi.org/10.1016/j.jhep.2010.06.004.

15. Bibalaev M.Kh., Dydykin S.S., Scherbyuk A.N. Surgical Treatment of Complications of Portal Hypertension Using Splenorenal Anastomosis. *Grekov's Bulletin of Surgery*. 2018;177(1):100–103. (In Russ.) https://doi.org/10.24884/0042-4625-2018-177-1-100-103
16. Nazyrov FG, Devyatov AV, Babadzhanov AKh, Baibekov IM, Raimov SA. Features of Angioarchitectonics and Hemodynamics in the System of the Portal Vein in Patients with Cirrhosis of the Liver with Portal Hypertension. *Journal of Experimental and Clinical Surgery*. 2014;7(3):181–189. https://doi.org/10.18499/2070-478X-2014-7-3-181-189
17. Henderson JM, Rosemurgy AS, Pinson CW. Technique of portosystemic shunting: portocaval, distal splenorenal, mesocaval. In: Jarnagin WR (ed). *Blumgart's Surgery of the Liver, Biliary Tract, and Pancreas*. 6th ed. Philadelphia, PA: Elsevier; 2017: ch. 86. pp.1231–1239.
18. Riddell AG, Bloor K, Hobbs KEF, Jacquet N. Clinical Problems Elective Splenorenal Anastomosis. *Br Med J*. 1972; 1(5802):731–732. https://doi.org/10.1136/bmj.1.5802.731
19. Zatevakhin II, Shipovskiy VN, Tsitsiashvili MSh, Monakhov DV. *Portal'naya gipertenziya. Diagnostika i lechenie*. Moscow: Buki Vedi; 2015. (in Russ.)
20. Barsoum MS, Rizk-Allah MA, El-Said Khedr M, Khattar NY. A new posterior exposure of the splenic vein for an H-graft splenorenal shunt. *Br J Surg*. 1982;69(7):376–379. PMID: 7104604 https://doi.org/10.1002/bjs.1800690706
21. Bacourt F. Prospective randomized study of carbon-impregnated polytetrafluoroethylene grafts for below-knee popliteal and distal bypass: results at 2 years. The Association Universitaire de Recherche en Chirurgie. *Ann Vasc Surg*. 1997;11(6):596–603. PMID: 9363305 https://doi.org/10.1007/s100169900097
22. Adam R, Diamond T, Bismuth H. Partial porta-caval shunt: renaissance of an old concept. *Surgery*. 1991;111(6):610–616. PMID: 1595057
23. Batignani G, Vizzutti F, Rega L, Zuckermann M, Fratini G, Pinzani M, et al. Small diameter H-graft porta-caval shunt performed at different stages of liver disease. *Hepatobiliary Pancreat Dis Int*. 2004;3(4):516–521. PMID: 15567736
24. Voskanyan SE, Artemiev Al, Naydenov EM, Shabalin MV, Zabezhinsky DA, Kolyshev lYu. Results of application of the PTFE-conduits in the reconstruction of the main veins of the abdominal cavity mesenteric-portal system in locally advanced pancreatic cancer. *Saratov Journal of Medical Scientific Research*. 2015;11(4):668–672. (in Russ.).
25. Voskanyan SE, Shabalin MV, Volkov OA, Kolyshev IYu. Peculiarities of Vitalization of Grafts Made of Porous Polytetrafluoroethylene in Reconstruction of Major Veins (an Experimental Study). *Angiology and Vascular Surgery.* 2017;23(4):123–133. (in Russ.).
26. Voskanyan SE, Shabalin MV, Voevodin AL, Artemyev AI, Kolyshev IYu, Naydenov EV, et al. H-shaped Partial Splenorenal Shunting with the Use of a Reinforced Graft Made of Porous Polytetrafluoroethylene. *Angiology and Vascular Surgery*. 2020;26(1):108–112. (in Russ.) https://doi.org/10.33529/ANGIO2020116
27. Chandrasegaram MD, Eslick GD, Lee W, Brooke-Smith ME, Padbury R, Worthley CS, et al. Anticoagulation policy after venous resection with a pancreatectomy: A systematic review. *HPB*. 2014;16(8):691–698. PMID: 24344986 https://doi.org/ 10.1111/hpb.12205
28. Dokmak S, Aussilhou B, Sauvanet A, Nagarajan G, Farges O, Belghiti J. Parietal Peritoneum as an Autologous Substitute for Venous Reconstruction in Hepatopancreatobiliary Surgery. *Ann Surg*. 2015;262(2):366–371. PMID: 25243564 https://doi.org/ 10.1097/SLA.0000000000000959
29. Shao Y, Yan S, Zhang QY, Shen Y, Zhang M, Wang WL, et al. Autologous falciform ligament graft as A substitute for mesentericoportal vein reconstruction in pancreaticoduodenectomy. *Int J Surg*. 2018;53:159–162. PMID: 29581044 https://doi.org/10.1016/j.ijsu.2018.03.045
30. Malinka T, Klein F, Denecke T, Pelzer U, Pratschke J, Bahra M, et al. The Falciform Ligament for Mesenteric and Portal Vein Reconstruction in Local Advanced Pancreatic Tumor: A Surgical Guide and Single-Center Experience. *HPB Surgery*. 2018;1:2943879. PMID: 30364084 https://doi.org/ 10.1155/2018/2943879
31. Zhiying Y, Haidong T, Xiaolei L, Yongliang S, Shuang S, Liguo L, et al. The falciform ligament as a graft for portal–superior mesenteric vein reconstruction in pancreatectomy. *J Surg Res*. 2017;218:226–231. PMID: 28985853 https://doi.org/10.1016/j.jss.2017.05.090
32. Porshennikov IA, Marchenko AV, Kim IN, Bykov AYu, Grigorov EV. Partial Portosystemic Shunting by Carbon-Coated ePTFE Grafts for Portal Hypertension in Cirrhotic Patients. *Russian Journal of Transplantology and Artificial Organs.* 2010;12(2):48–53. (in Russ.) https://doi.org/10.15825/1995-1191-2010-2-48-53
33. Martin BF, Tudor RG. The umbilical and paraumbilical veins of man. *J Anat*. 1980;130(2):305–322. PMID: 7400038
34. Ibukuro K, Fukuda H, Tobe K, Akita K, Takeguchi T. The vascular anatomy of the ligaments of the liver: Gross anatomy, imaging and clinical applications. *Br J Radiol*. 2016; 89(1064):20150925. PMID:27163944 https://doi.org/10.1259/bjr.20150925
35. Morin C, Lafortune M, Pomier G, Robin M, Breton G. Patent paraumbilical vein: Anatomic and hemodynamic variants and their clinical importance. *Radiology*. 1992;185(1):253–256. PMID:1523319 https://doi.org/10.1148/radiology.185.1.1523319
36. Ibukuro K, Tanaka R, Fukuda H, Abe S, Tobe K. The superior group of vessels in the falciform ligament: Anatomical and radiological correlation. *Surg Radiol Anat*. 2008;30(4):311–315. PMID: 18286221 https://doi.org/10.1007/s00276-008-0325-6
37. Lee DY, Mitchell EL, Jones MA, Landry GJ, Liem TK, Sheppard BC, et al. Techniques and results of portal vein/superior mesenteric vein reconstruction using femoral and saphenous vein during pancreaticoduodenectomy. *J Vasc Surg*. 2010;51(3):662–666. PMID: 20080375 https://doi.org/10.1016/j.jvs.2009.09.025
38. Yamamoto Y, Sakamoto Y, Nara S, Ban D, Esaki M, Shimada K, et al. Reconstruction of the portal and hepatic veins using venous grafts customized from the bilateral gonadal veins. *Langenbecks Arch Surg*. 2009;394(6):1115–1121. PMID: 19421769 https://doi.org/10.1007/s00423-009-0500-1
39. Gao W, Dai X, Dai C, Jiang K, Wu J, Li Q, et al. Comparison of patency rates and clinical impact of different reconstruction methods following portal/superior mesenteric vein resection during pancreatectomy. *Pancreatology*. 2016;16(6):1113–1123. PMID: 27707648 https://doi.org/10.1016/j.pan.2016.09.010
40. Smoot RL, Christein JD, Farnell MB. Durability of portal venous reconstruction following resection during pancreaticoduodenectomy. *J Gastrointest Surg*. 2006;10(10):1371–1375. PMID: 17175456 https://doi.org/10.1016/j.gassur.2006.09.001
41. Stauffer JA, Dougherty MK, Kim GP, Nguyen JH. Interposition graft with polytetrafluoroethylene for mesenteric and portal vein reconstruction after pancreaticoduodenectomy. *Br J Surg.* 2009;96(3):247–252. PMID:19224515 https://doi.org/10.1002/bjs.6483
42. Hillebrand DJ, Kojouri K, Cao S, Runyon BA, Ojogho O, Concepcion W. Small-diameter portacaval H-graft shunt: a paradigm shift back to surgical shunting in the management of variceal bleeding in patients with preserved liver function. *Liver Transpl*. 2000;6(4):459–465. PMID:10915169 https://doi.org/10.1053/jlts.2000.6141

Received on 13.12.2020

Review completed on 04.06.2021
Accepted on 29.06.2021