

Left Hemiliver Medial Sector-Portal Venous Anatomy.

Dragica Jurkovikj

Assistant Research, Institute of Anatomy, Medical Faculty, University "Ss. Cyril and Methodius", Skopje, Republic of Macedonia.

Received: April 2016

Accepted: April 2016

Copyright: © the author(s), publisher. It is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: The aim of this study was to classify the left hemiliver medial sector portal branches on the basis of their site of origin and area that supply. The leading motive for this investigation was to contribute to the modern liver practice, especially to the respective and transplantation ones. **Methods:** The examined material consisted of 27 portobiliary casts performed by injection-corrosive method using adult cadaveric human liver specimens. During observation under magnifying lens were determined the site and kind of origin of medial sector portal branches, numerical frequency of segmental portobiliary elements and their relation. **Results:** According to the supplied area two distinct segments-superior IVa and inferior IVb were distinguished. At the level of each segment portal branches appeared as main, additional and newly ramified. As to their origin at the level of segment IVa the mixed origin (separate and common) was prevalent versus separate or only common origin - 17/7/2 cases and portal branches were not observed in only one case in this segment. Also, at the level of segment IVb the mixed origin of portal branches was prevalent versus separate ones - 19/8 cases. The incidence of newly ramified branches to segment IVa was 22.22% and to segment IVb 37.037%. At the level of segment IVa there were additional or newly ramified branches on the superior surface of umbilical portion of the left portal vein branch (37.037%) and only additional branches for segment IVb on the superior, as well as inferior surface of this portion (7.41%). **Conclusion:** In the left hemiliver medial sector portal branches supply two distinct segments-superior SgIVa and inferior SgIVb. At the level of each segment multiple branches with varied number appear as main, additional and newly ramified. According to their origin the branches may be either separate for each segment or additionally to the branches with separate origin common branches for both segments and only with common origin branches to the SgIVa.

Keywords: Anatomy, Liver, Medial Sector, Portal Vein.

INTRODUCTION

As stated by Kim et al. studies on liver anatomy have developed alongside clinical achievements. Using cadaver dissection, they identified newly glissonian pedicles (GPs) between lateral and medial section of the liver located superior to the umbilical fissure.^[1] Nagino et al. reported ligation of small portal branches arising from the cranial side of umbilical portion (UP) during 8 anatomic right hepatic trisectionectomy with caudate lobectomy.^[2] The portal venous territories in the human liver on the basis of portal corrosion casts and their CT images were re-examined by Fasel.

classification, but pointed out that number, size, shape, and denomination of these areas are still a controversial issue.^[4] It is well-known that further division of the medial segmental branches into superior and inferior area branches does not have any fixed pattern of division-Gupta et al.^[5] These notions have given us an idea to perform a study about left hemiliver medial sector portal venous anatomy.

MATERIALS AND METHODS

Thirty cadaveric human liver specimens were used in this study. By injection-corrosive method using different coloured odontolite acrylate the casts of intrahepatic portal and biliary ramifications were made. On 27 casts with adequate filling under magnifying lens were observed and determined:

1. Portal venous segmentation for each specimen
2. Segmental biliary ducts for each specimen
3. At the level of Segments (Sgs) IVa and IVb:

Name & Address of Corresponding Author

Dr. Dragica Jurkovikj,
Assistant Research, Institute of Anatomy,
Medical Faculty, University "Ss. Cyril and Methodius",
Skopje, Republic of Macedonia
E-mail: dragica.jurkovikj@gmail.com.mk

The branches from the right border and ventral surface of the UP were attributed to segment IV, but subdivided in a cranial IVA and caudal IVB portions.^[3] Later Fasel and Schenk presented their findings as a concept for liver segment

- 3.1. The site of origin of main segmental portal branch, additional branches and newly ramified branches
- 3.2. Kind of origin, separate or common, of both segmental branches
4. Numerical frequency of segmental portobiliary elements at the level of the left hemiliver medial sector
5. Relation between numerical frequency of portal and biliary elements at the level of Sgs IVa and IVb

RESULTS

According to the origin of portal branches that supply Sgs IVa and IVb main segmental branch, additional branches and newly ramified branches were determined for each segment. The second parameter of classification was the vascular area of branches i.e. whether they supply only one or both segments and separate and common origin of branches for Sgs IVa and IVb was determined. Considering the mentioned criterion at the level of IVa segment the following origin of portal segmental branches was observed: 1) separate, 2) additionally to the separate origin a common origin with Sg IVb portal branches 3) only common origin with Sg IVb portal branches and 4) absence of portal branches for this segment.

1. The site of origin of segmental IVa portal branches in specimens with separate origin:

a) Middle of right margin of Rex's recessus (umbilical portion of left portal vein-UP): in specimen no. **I** one branch

b) Main branch from the middle of right margin of UP and additional branches with different origin: in specimen no. **III** one additional branch from beginning of right margin of UP, and in specimen no. **XIV** 3 *newly ramified* branches, the first from the middle of right half of superior surface of UP, the second from the beginning of right margin of UP and the third from the posterior margin of terminal part of transverse portion of left portal vein-(TP)

c) Main branch from the terminal part of right margin of UP and additional branches with different origin: in specimen no. **XIII** 7 additional branches, one from the middle of right half of superior surface of UP, one from the right margin of UP itself and one from its middle and four from the left side of right horn of UP

d) Main branch from the right horn of UP and additional branches with different origin: in specimen no. **VIII** one additional branch from the

superior surface of beginning of right margin of UP [Figure 1]

e) Superior surface of terminal part of TP: in specimen no. **XVI** one branch

f) Right horn of UP: in specimen no. **XXX** one branch with right, right anterior and left posterior segmental terminal branches

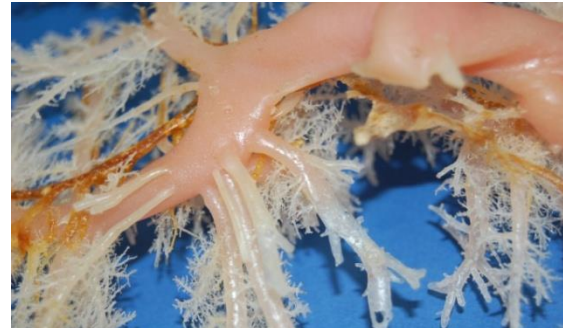


Figure 1: On the inferior surface of case no. VIII it can be seen a separate origin of the main and 3 newly ramified branches to Sg IVb from the right horn of UP and additional branch from the middle of right margin, to Sg IVa main branch from the right horn and additional from the right margin of UP (arrow).

2. The site of origin of segmental IVa portal branches in specimens with separate and common origin with segmental IVb portal branches:

a) Main branch from the middle of right margin of UP and additional branches with different origin: in specimen no. **IV** one ascendant terminal branch from common branch originating from the middle of right margin of UP and 4 additional branches, one from the beginning of right margin of UP, and other from the superior surface of UP at the middle of terminal part, then from the middle of left half of UP and from the beginning part of right half of UP

b) Main branch from the right horn of UP and additional branches with different origin:

-in specimen no. **V** one ascendant terminal and one collateral branches from the main i.e. common branch originating from the right horn of UP and 8 additional branches to Sg IVa, 3 from the middle of right margin of UP and one from its inferior surface and 4 *newly ramified*, 2 from the middle of superior surface of UP and 2 from the middle of right half of UP [Figure 2].

-in specimen no. **VII** one ascendant terminal branch from the main i.e. common branch originating from the right horn of UP and 3 additional branches to Sg IVa, one from the middle of right margin of UP, then one from the terminal part of superior surface of UP, and one from the terminal part of superior surface of TP

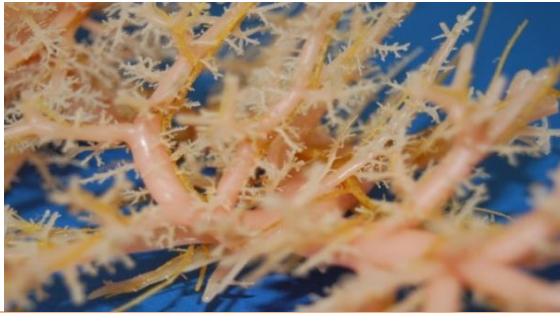


Figure 2: On the superior surface of case no.V it can be seen a newly ramified branches on the superior surface of UP (arrows).

-in specimen no. **IX** one ascendant terminal branch from the main i.e. common branch originating from the right horn of UP and other one ascendant terminal branch from the common branch originating from the ending middle of UP and 2 additional branches to Sg IVa, one from the terminal part of right margin of UP, and the second from its superior surface and 2 *newly ramified* from the terminal part of superior surface of TP

-in specimen no. **X** 2 ascendant terminal branches from the 2 common branches originating from the right horn of UP and 5 additional branches to Sg IVa, one from the beginning and 2 from the middle of right margin of UP, as well as 2 *newly ramified*, one from the middle of superior surface of UP and the other from the middle of right margin of UP [Figure 3].

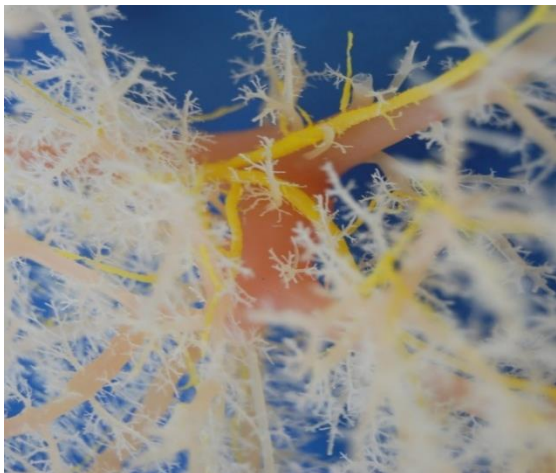


Figure 3: On the superior surface of case no. X it can be seen a newly ramified branches to Sg IVa on the superior surface of UP (arrows).

-in specimen no. **XII** one ascendant terminal branch from the main i.e. common branch originating from the right horn of UP and additional branch from the middle of right margin of UP

-in specimen no. **XV** 2 ascendant terminal branches, one right superior and the other left superior from the main i.e. common branch originating from the right horn of UP and 4

additional branches, one from the middle of inferior surface of right margin of UP, 2 from the superior surface of UP at the middle of terminal part and from the middle of right margin and one collateral from the branch originating from the medial third of superior surface of TP

-in specimen no. **XX** a stem of the main i.e. common branch originating from the anterior side of right horn of UP as well as one ascendant collateral from the second common branch originating from the right horn of UP and 4 additional branches to Sg IVa, from the right margin of UP, then from the beginning and terminal part of superior surface of right margin of UP and from the middle of superior surface of TP

-in specimen no. **XXII** a branch to Sg IVa originating from the right horn of UP that gave origin to one collateral for Sg IVb and additional branch to Sg IVa from the terminal part of anterior margin of superior surface of TP

-in specimen no. **XXIIIa** left terminal branch of the main i.e. common branch originating from the right horn of UP and a second common branch originating from the right horn of UP, one ascendant terminal branch from the collateral to Sgs IVa+IVb and another one collateral and 2 additional branches to Sg IVa, from the right margin of UP and from the beginning of right margin of superior surface of UP.

-in specimen no. **XXIV** 2 collaterals from the anterior i.e. common branch originating from the right horn of UP and 6 additional branches to Sg IVa, 2 from the middle and one with 2 collaterals from the inferior surface of right margin of UP and one from the terminal part of right margin of superior surface of UP

-in specimen no. **XXV** an ascendant terminal branch and 2 collaterals from the main i.e. common branch originating from the right horn of UP and 3 additional branches to Sg IVa, one from the initial part of right margin of UP, and one from the initial part of right margin of superior surface of UP and one *newly ramified* from the middle of right margin of UP

-in specimen no. **XXVI** left and right collaterals from the branch to Sg IVb originating from the anterior side of right horn of UP and one additional branch to Sg IVa from the initial part of superior surface of right margin of UP

-in specimen no. **XXVII** an ascendant terminal branch from the main i.e. common branch originating from the right horn of UP and one additional branch to Sg IVa from the terminal one third of superior surface of TP

-in specimen no. **XXVIII** 2 ascendant terminal branches, the first one from the main i.e. common branch originating from the right horn of UP and the second one from the collateral to Sgs IVa+IVb originating from the anterior surface of the common branch, and a collateral to Sg IVa

originating from the posterior margin of the common branch and additional branch to Sg IVa from the middle of superior surface of right margin of UP

-in specimen no. **XXIX** a collateral to Sg IVa from the right margin of branch to Sg IVb originating from the right horn of UP and additional to Sg IVa left and right terminal branches and collaterals of branch originating from the superior surface of terminal part of anterior margin of UP

c) Main and additional branches from medial branch of TP trifurcation into Sg II branch, lateral branch to Sg III and medial branch to Sg IV

-in specimen no. **XXI** 3 collaterals from the branch to Sg IVa originating from the common branch which was a collateral of medial branch and additional branch from the superior surface of medial branch and 2 *newly ramified*, one from the posterior surface of medial branch and the other one from the right margin of lateral branch

3. The site of origin of segmental IVa portal branches in specimens with common origin alone with segmental IVb portal branches:

-in specimen no. **XI** one ascendant terminal branch and some collaterals from common branch originating from the right horn of UP

-in specimen no. **XVIII** one collateral from the branch to Sg IVb originating from the right horn of UP

4. Absence of Sg IVa portal branches in specimen no. **II**

Considering the mentioned criteria at the level of IVb segment the following origin of portal segmental branches was noted: 1) separate and 2) additionally to the separate origin a common origin with Sg IVa portal branches.

1. The site of origin of segmental IVb portal branches in specimens with separate origin:

a) Right horn of UP: in specimen no. **II** four branches

b) Main branch from the right horn of UP and additional branches with different origin:

-in specimen no. **I** 4 additional branches, the first one from anterior and the second one from posterior surfaces of the right horn of UP, the third from the terminal part of right margin of UP and the fourth from the ending middle of UP

-in specimen no. **VIII** 2 additional branches, the first one from the right horn of UP and the second one from the middle of right margin of UP and 3 *newly ramified* from the posterior side of right horn of UP [Figure 1]

-in specimen no. **XIII** 2 additional branches, the first one from the posterior surface of right horn of

UP and the second one from the angle between UP and TP

-in specimen no. **XIV** 4 additional branches, one from the right horn of UP and 2 from its posterior side, and one from the terminal part of right margin of UP and 2 *newly ramified*, the first one from the middle of inferior surface of right margin of UP and the second one from the superior surface of terminal part of right margin of UP

-in specimen no. **XVI** 5 additional branches, 2 from the right horn of UP and 2 from its posterior side, as well as one from the ending middle of UP and one *newly ramified* from the anterior margin of TP

-in specimen no. **XXX** 7 additional branches, one from the right horn of UP, 3 from the ending middle of UP as well as 3 from inferior surface of the ending middle of UP

c) Anterior and posterior branches from the right horn of UP and additional branches with different origin: in specimen no. **III** 2 additional branches to Sg IVb, the first one from the middle of inferior surface of UP and the second one from the lateral third of anterior margin of TP

2. The site of origin of segmental IVb portal branches in specimens with separate and common origin with segmental IVa portal branches:

a) All branches from the right horn of UP:

-in specimen no. **V** a descendant terminal branch from the main i.e. common branch and 4 additional branches to Sg IVb from the right horn of UP [Figure 4]

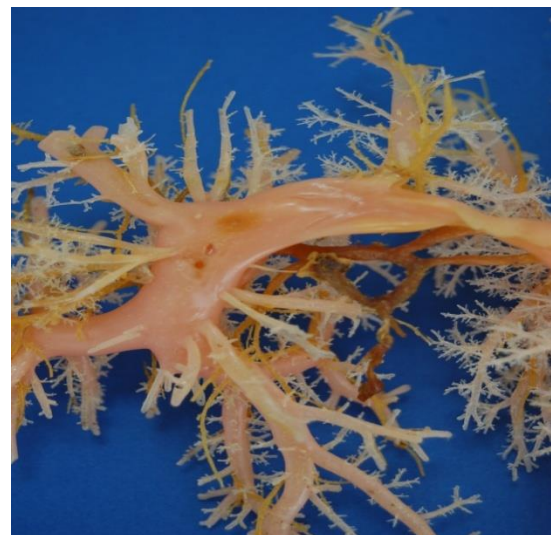


Figure 4: On the inferior surface of case no. **V** it can be seen originating of all branches to Sg IVb from the right horn of UP including a main i.e. common branch (arrow) and additional branches to Sg IVa.

-in specimen no. **XXV** a descendant terminal branch from the main common branch and 3 additional branches to Sg IVb, one from left and 2

from posterior side of the main branch and 4 *newly ramified*, 3 from the anterior and one from the right side of main branch

b) Main branch from the right horn of UP and additional branches with different origin:

-in specimen no. **IV** a stem and a collateral of branch to Sgs IVa+IVb originating from the middle of right margin of UP and 4 additional branches, one from anterior side of right horn of UP and 2 from its posterior side, and one from the beginning of right margin of UP

-in specimen no. **VII** a descendant terminal branch from main i.e. common branch originating from the right horn of UP and a collateral to Sg IVb from ascendant terminal branch to Sg IVa and one additional branch to Sg IVb from the ending middle of UP

-in specimen no. **IX** 2 descendant terminal branches, the first from the main i.e. common branch originating from the right horn of UP and the second one from the common branch originating from the ending middle of UP and 2 additional to Sg IVb from posterior side of the right horn of UP and 2 *newly ramified* from the ending middle of UP

- in specimen no. **X** 2 descendant terminal branches, the first one from the main i.e. common branch originating from the right horn of UP and the second one from the second common branch originating from the right horn of UP and 4 additional branches to Sg IVb, 2 from the right horn of UP and 2 from the terminal part of right margin of UP and one *newly ramified* from the right horn of UP

- in specimen no. **XI** 2 descendant branches from the main i.e. common branch originating from the right horn of UP and 4 additional branches to Sg IVb, 2 from posterior side of the right horn of UP, one from initial and one from terminal part of the right margin of UP and one *newly ramified* from the terminal part of right margin of UP

- in specimen no. **XII** a descendant terminal branch from the main i.e. common branch originating from the right horn of UP and a collateral from the branch to Sg IVa originating from the middle of right margin of UP and 5 additional branches to Sg IVb, 3 from the ending middle of UP, some of which oriented to the right, one from the beginning of right margin of UP and one from the middle of anterior margin of TP

- in specimen no. **XV** 5 additional branches, 4 from the ending middle of UP and one from the inferior surface of right margin of UP

-in specimen no. **XVIII** main branch and 3 additional branches, one from the ending middle of UP, then one from the posterior side of right horn of UP and one from the inferior surface of right margin of UP

-in specimen no. **XX** 4 collaterals from the 2 common branches, the first one originating from the right horn of UP and the second one from the anterior side of right horn of UP and 5 additional branches to Sg IVb, one from the beginning and 3 from the terminal part of right margin of UP and one from the inferior surface of lateral third of TP

-in specimen no. **XXII** one collateral from branch to Sg IVa originating from the right horn of UP and 4 additional branches to Sg IVb, 2 from the right horn of UP and 2 from the middle of anterior margin of TP

-in specimen no. **XXIII** a right terminal branch and 2 collaterals from left terminal branch from the common branch originating from the right horn of UP and a descendant terminal branch and 2 collaterals from the second common branch originating from the right horn of UP and 4 additional branches to Sg IVb, 3 from posterior side of the right horn of UP and one from the right margin of UP

-in specimen no. **XXVI** a common branch from the anterior side of right horn of UP and 4 additional branches, 2 from the terminal part of superior and inferior surfaces of right margin of UP and 2 from the posterior side of right horn of UP

-in specimen no. **XXVII** a descendant terminal branch from the main i.e. common branch originating from the right horn of UP and 6 additional branches to Sg IVb, 4 from the inferior surface and 2 from the superior surface of UP and one *newly ramified* from terminal part of the right margin of UP

-in specimen no. **XXVIII** a descendant terminal branch and 5 collaterals from the common branch originating from the right horn of UP and the other one descendant terminal branch from collateral of common branch and 3 additional branches to Sg IVb, the first one from anterior and the second one from posterior side of the right horn of UP and one *newly ramified* from the right margin of UP

-in specimen no. **XXIX** a main branch to Sg IVb originating from the right horn of UP which gave origin to branch for Sg IVa and 3 *newly ramified* from terminal part of the right margin of UP

c) Medial branch of trifurcation of TP

-in specimen no. **XXI** a terminal branch from common branch originating from the medial branch and 3 additional branches to Sg IVb, one from the anterior margin of TP and 2 from the right portal vein branch originating from anterior margin and posterior surface

d) Anterior and posterior branch from the right horn of UP and additional branches to Sg IVb with different origin

-in specimen no. **XXIV** 54 additional branches, two from the terminal part of inferior surface of UP, one from the ending middle of UP, one from the

superior surface of ending middle of UP and one from the beginning of anterior margin of TP.

Numerical frequency of segmental portobiliary elements at the level of the left hemiliver medial sector was as follows:

Sg IVa-no. of portal branches, (range)mean (0-10), 3.9

Sg IVa-no. of segmental ducts, (range)mean (0-8), 4.0

Sg IVb-no. of portal branches, (range)mean (3-10), 5.9

Sg IVb-no. of segmental ducts, (range) mean (2-11), 4.9

At the level of Sg IVa: an equal relation was found in 15/27 cases; a different relation with predominant number of biliary ducts was found in 7/27 cases and a different relation with predominant number of portal branches was found in 4/27 cases.

At the level of Sg IVb: an equal relation was found in 4/27 cases; a different relation with predominant number of biliary ducts was found in 5/27 cases and a different relation with predominant number of portal branches was found in 18/27 cases.

DISCUSSION

The results obtained have shown that in the left hemiliver medial sector there were, except in one case, portal branches in varied number and different origin to two distinct parenchymal areas-Sg IVa and Sg IVb.

At the level of Sg IVa the mixed origin (separate and common with Sg IVb portal branches) was prevalent versus separate or only common origin (17/7/2 cases) and only once Sg IVa portal branches were not observed. This manner of classification has not been previously reported. Couinaud pointed out that for the existence of posterior branches in Sg IV from many pedicles that during transversal division at the level of the hilum are being interrupted. Concerning resection of Sg IV Couinaud thought that quadrate lobe resection was not possible and that anatomical resection of the posterior portion was extremely difficult due to a highly variable number and origin of posterior pedicles.^[6]

Sg IVa portal branches in specimens with separate origin originated mainly at the level of the right margin of UP, followed by the right horn of UP and rarely at the level of TP. In specimens with mixed origin there were 1 to 2 common branches and in majority of them there was 1 ascendant terminal branch-4 cases, then additionally to the terminal branch several collaterals-4 cases, rarely either 2 ascendant terminal branches-2 cases or additionally to the 2 terminal branches 1 to 2 collaterals-2 cases, only 1 to 2 collaterals-4 cases, more collaterals-1

case and in only 1 case it was a branch to Sg IVa. In this manner of origin additional branches to Sg IVa most frequently originated from the right margin of UP, as well as superior surface of UP at the level of its right margin even from its inferior surface, then from its terminal part, at its middle, right or left half. Also, origin from the superior surface and anterior margin of terminal part of TP was observed as well as from the left side of the right horn of UP. In specimens with only common origin the origin was from the right horn of UP.

Similar to our results regarding origin are Couinaud's findings.^[7] Gupta et al. showed medial segmental veins originating from the right side of UP.^[5]

Despite previously mentioned traditional Sg IVa portal branches, newly ramified branches were observed on 6/27 casts(22.22%). Their number ranged from 1 to 4, and their origin was from the middle of right margin of UP or its beginning, middle of superior surface of UP or its right half and from the terminal part of superior surface or posterior margin of TP. In specimen no. XXI, which was an anatomical rarity, these branches originated from the main medial and lateral branches.

Kim et al.^[1] performed a dissection study with an aim to determine whether portal vein branches (P4 days) exist, as they were described by Nagino et al. on the cranial side of UP. They identified "New GPs" based on the umbilical fissure in a very high percent 30/31-96.8%, of which 20/31-64.5% were IVa New GPs.^[2]

In general, in our examined material branches on the superior surface of UP were found in 10/27 cases (37.037%). Their number ranged from 1 to 4 in 7/10 cases as additional branches and in the remaining 3/10 as newly ramified branches.

Also, at the level of Sg IVb the mixed origin of portal branches was prevalent versus separate one (19/8 cases) and common origin alone was not found. As to the origin of portal branches in specimens with separate origin in all cases an origin from the right horn of UP mainly as a main branch to Sg IVb-6/8 cases was observed, then as an anterior and posterior branches and only once all branches originated from this site. In this manner of origin, there were a variable number of additional branches, which originated from the right horn itself, especially as multiple branches from its posterior side and rarely from its anterior side. The more frequent site of origin to these branches were the ending middle of UP, and right margin of UP, but rarely the anterior margin of TP and angle between UP and TP. In specimens with separate and common origin similar to the cases with separate origin all branches originated from the right horn of UP in 2/19 cases (10.5%), then origin of main branch from the right horn of UP and additional branches with different origin in 154/19

cases (78.90%), and in 1 case anterior and posterior branches from the right horn of UP and additional branches with different origin were found. The last case was with one medial branch originating from terminal trifurcation of TP. As to the origin of common branches 1 common branch originated from the right horn of UP in 10/19 cases (52.63%) and from the middle of right margin of UP only in 1/19 cases (5.26%), and 2 common branches in 7/19 cases (36.84%), of which 5 originated from the right horn of UP while in 2 cases the first from the right horn of UP and the second from the middle of right margin of UP or from the ending middle of UP. The total number of common branches was from 1 to 7 because additionally to the descendant terminal branches there was a variable number of collaterals. In this manner of origin, additional branches to Sg IVb originated from the right horn of UP, especially from its posterior side as multiple branches and very rare from its anterior side. The other more frequent site of origin was the terminal part of right margin of UP but origin was observed even from its beginning. Also, these branches originated in variable number from the ending middle of UP and rarely from the terminal part of UP, anterior margin and inferior surface of TP, anterior margin of right portal vein branch and from the main branch itself. At the level of Sg IVb newly ramified branches in 10/27 cases (37.037%) were observed. Their number ranged from 1 to 4, originating more frequently from the terminal part of right margin of UP and rarely from the right horn of UP, common branch from the right horn or anterior margin of TP. Kim et al. found a similar number of newly identified branches (0-4) with an incidence of 77.4%-24/31.^[1]

As to the branches on the UP only additional branches to Sg IVb were found, originating from the terminal part or ending middle of UP at the superior, as well as inferior surface in 2/27 cases (7.41%).

In Couinaud's study^[8] of the intrahepatic portal vein venous pedicles to SgIV were multiple from 1 to 13, more frequently from 6 to 9 whereas branches on the superior surface of UP varied from 1 to 4 with an incidence of 85/103 (82.52%). But, there was no specimen without vein that originated from the right horn and sometimes this horn was pedicle of venous bouquet that permitted a unique ligature.

According to Gupta et al. there were either 2 (21%), 3 (40%), or 4 (39%) branches to Sg IVb.^[5] On the basis of the determined relationship between number of segmental portal branches and segmental ducts it may be concluded that number of portal branches was prevalent at the level of Sg IVb. Probably the observed differences were due to the different manner of ramification, fibro-

obliterative changes and compensatory regeneration.

The obtained results with classified origin of portal branches, as well as their differentiation into main, additional and newly ramified branches present a contribution of basic anatomy to the surgical liver practice. The main current problem of this practice is the Future Liver Remnant-FLR and small-for-size syndrome. The human liver regeneration follows after hepatic resection^[9,10] and during development and disease.^[11] This capacity of the liver to regenerate contributed to introduction of preoperative procedures that stimulate liver hypertrophy. During right hepatectomy Farges et al. assessed the impact of liver hypertrophy of the FLR induced by preoperative Portal Vein Embolization-PVE. The absence of hypertrophy of the non-embolized liver following successful PVE should be considered as an indicator of the inability of the liver to regenerate.^[12]

According to Anaya et al. analysis of the degree of hypertrophy of the FLR after PVE (a dynamic test of liver regeneration) is a supplement to the analysis of the pre-PVE FLR volume (a static test). Whether PVE is indicated depends not by what will be removed but by what will remain after resection.^[13]

CONCLUSION

In the left hemiliver medial sector portal branches supply two distinct segments-superior SgIVa and inferior SgIVb. At the level of each segment multiple branches with varied number appear as main, additional and newly ramified. According to their origin the branches may be either separate for each segment or additionally to the branches with separate origin common branches for both segments and only with common origin branches to the SgIVa.

REFERENCES

1. Kim IG, Xu W, Wang HJ, Park YK, Kim BW. Variation or newly identified glissonian pedicles between the lateral and medial sections of the liver, using cadaver dissection. *J Korean Surg Soc.* 2013; 85(6): 261-8.
2. Nagino M, Kamiya J, Arai T, Nishio H, Ebata T, Nimura Y. Anatomic Right Hepatic Trisectionectomy (Extended Right Hepatectomy) With Caudate Lobectomy for Hilar Cholangiocarcinoma. *Ann Surg.* 2006; 243(1): 28-32
3. Fasel JH. Portal Venous Territories Within the Human Liver: An Anatomical Reappraisal. *Anat Record.* 2008; 291: 636-42
4. Fasel JH, Schenk A. Concepts for Liver Segment Classification: Neither Old Ones nor New Ones, but a Comprehensive One. *J Clin Imaging Sci.* 2013; 3: 48.
5. Gupta SC, Gupta CD, Arora AK. Intrahepatic branching patterns of portal vein. A study by corrosion cast. *Gastroenterology.* 1977; 72(No. 4, Part 1): 621-4.

6. Couinad C. Surgical anatomy of the liver revisited. Personal edition. Paris, 1989.
7. Couinaud C. Tell me more about liver anatomy. 1st ed. Paris: Karger; 1999.
8. Couinad C. Étude de la veine porte intra-hépatique. Presse Med. 1953; 61(70): 1434-8.
9. Lin TY, Lee CS, Chen CC, Lian KY, Lin WSJ. Regeneration of Human Liver After Hepatic Lobectomy Studied by Repeated Liver Scanning and Repeated Needle Biopsy. Ann Surg. 1979; 190(1): 48-53
10. Nagasue N, Yukaya H, Ogawa Y, Kohno H, Nakamura T. Human liver regeneration after major hepatic resection. A study of normal liver and liver with chronic hepatitis and cirrhosis. Ann Surg. 1987; 206(1): 30-9
11. Vestentoft PS, Jelnes P, Hopkinson BM, Vainer B, Mollgard K, Quistorff B. Three-dimensional reconstructions of intrahepatic bile duct tubulogenesis in human liver. BMC Developmental Biology. 2011; 11: 56.
12. Farges O, Belghiti J, Kianmanesh R, Regimbeau JM, Santoro R, Vilgrain V et al. Portal Vein Embolization Before Right Hepatectomy. Prospective Clinical Trial. Ann Surg. 2003; 237(2): 208-17.
13. Anaya DA, Blazer III DG, Abdalla EK. Strategies for Resection Using Portal Vein Embolization: Hepatocellular Carcinoma and Hilar Cholangiocarcinoma. Semin Intervent Radiol. 2008; 25(2): 110-22.

How to cite this article: Jurkovicj D. Left Hemiliver Medial Sector-Portal Venous Anatomy. Ann. Int. Med. Den. Res. 2016;2(4):66-73.

Source of Support: Nil, **Conflict of Interest:** None declared