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DISTRIBUTION PECULIARITIES OF THE RENAL ARTERY BRANCHES IN THE KIDNEY PARENCHYMA AND MORPHOMETRIC ASSESSMENT OF EXCRETORY SECTOR VOLUMES IN THE DUPLEX COLLECTING RENAL SYSTEM IN DIFFERENT VARIANTS OF ITS BLOOD SUPPLY

Abstract. The resulting study data suggest a theoretical basis and add the development of new techniques perform conservative surgery on the kidneys.

Key words: kidney, kidney artery, pyelocaliceal complex, excretory sector

Introduction. Exclusive standards to the results of surgery, a wide application and elaboration of new mini-invasive surgical methods on the kidneys require obtaining more comprehensive knowledge concerning individual anatomy of the organ and its internal structures [2,3,5]. Herewith, new organ-saving methods of surgical treatment of the kidneys require further comprehension and generalization of knowledge concerning topographic-anatomical peculiarities of the human renal arterial stream in order to obtain more accurate anatomical basis to perform surgery on the organ [1,4].

Objective. We have examined topography and morphological-functional organization of the human renal arterial stream in different structural variants of its caliceal-pelvic complex. The task of our research is to substantiate the morphometric assessment system of the residual functional volume of the kidney excretory sectors after ligation of the renal artery branches during organ-saving surgery performed on it.

Methods. Classical methods were applied in conducting the research: anatomical dissection and making corrosive specimens. The data obtained were statistically processed.

Materials. 119 specimens obtained from the kidneys removed from dead bodies of middle-aged, old and elderly people of both sexes who dies due to accidents or diseases not associated with kidney pathology were examined in our study.

Results. In the result of our studies 113 specimens with branchy structure of the caliceal-pelvic complex and 6 specimens with ampullary shape when single renal calix enters directly the pelvis were obtained. Our study was aimed to find the peculiarities of blood supply of the human renal excretory sectors with branchy structure of the caliceal-pelvic complex, since according to our findings it is determined in 94,7% of cases. 38 specimens (33,3% cases) were obtained consisting of two excretory sectors – upper and lower. According to our observation most often (21 specimens) such kind of the kidney is supplied with blood by means of two branches of the renal artery, which in their turn can be located in the parenchyma of the anterior and posterior surface of the kidney, that was found in 15 specimens, and then they can divide into its upper and lower poles. Such variant of the intra-organ division of the renal artery is found in 6 specimens. In 17 cases double pelvis kidneys is supplied with blood by means of the three branches of the renal artery: anterior upper, anterior lower and posterior.

Discussion. Having analyzed the number of renal pelvises in every excretory sector with different variants of distribution of the renal artery branches we have found that the kidney consisting of two excretory sectors possesses a maximum average number of renal calices (6,6) in all the excretory sectors when it is supplied with blood by means of the three branches of the renal

artery, and minimum number (4,8) – when it is supplied by two branches of the renal artery directed to the renal poles. Herewith, the biggest average number of renal calices (2,8) is found in the upper excretory sector, and the smallest one – in the lower sector (2,0) was determined in case of blood supply of the double pelvis kidneys through the two branches of the renal artery directed to both poles of the organ. The biggest average number of renal calices in the lower excretory sector (3,8) was determined in the double pelvis kidneys when they are supplied by three branches of the renal artery.

While examining the capacity of excretory sectors of the double pelvis kidneys with different variants of their blood supply, we have taken into account the volumes of separate kidney calices considering stability index (anatomical heterogeneity index) defined by M.A. Padalytsia [6].

The maximum volume of the upper excretory sector was found to be determined in the kidney consisting of two sectors with different variants of its blood supply. In the double pelvis kidney supplied by two branches of the renal artery directed to the poles of the organ we have found maximum capacity of the upper secretory sector (69,14% out of the total capacity of the excretory sectors). Although, with the same variant of blood supply of the kidney the capacity of the lower excretory sector remains minimum (30,86%).

The smallest capacity of the upper excretory sector (51,86%) in the double pelvis kidney was determined in case of its blood supply through the three branches of the renal artery. With the similar variant of distribution of the renal artery branches in the kidney parenchyma we have found the biggest capacity of the lower excretory sector.

When double pelvis kidneys are supplied by two branches of the renal artery passing to the anterior and posterior surfaces of the organ, the capacity of the upper and lower excretory sectors is approximately average (57,6% and 42,4%, respectively).

Conclusions.

1. Anatomy of the intra-organ arterial stream of the human kidney depends on the number of excretory sectors in it.

2. Kidneys consisting of two excretory sectors

in 71,4% of cases are supplied by two branches of the renal artery directed to the anterior and posterior surfaces of the organ (anterior-posterior distribution).

3. In the double pelvis kidneys supplied by three branches of the renal artery, an average number of renal calices in both excretory sectors is bigger ($6,650 \pm 0,856$), than that of the kidney supplied by two branches of the renal artery with their different distribution in the organ parenchyma ($4,95 \pm 0,75$). When the double pelvis kidney is supplied by three branches of the renal artery maximum number of kidney calices (3,8) is determined in the lower excretory sector. Kidneys consisting of two excretory sectors and supplied by two branches of the renal artery always possess more kidney calices ($2,73 \pm 0,70$) in the lower excretory sector when arteries are directd to the anteriro and posteriror surfaces of the organ, than those when branches of the renal artery pass to its poles ($2,00 \pm 0,63$).

4. The capacity of the upper excretory sectors in the double pelvis kidneys is stable maximum with any variants of their blood supply. When these kidneys are supplied by two branches of the renal artery directed to the poles, the capacity of the upper excretory sector ($4,842 \pm 0,310 \text{ cm}^3$) is twice as much than the capacity of the lower one ($2,161 \pm 0,230 \text{ cm}^3$). When these kidneys are supplied by three branches of the renal artery the capacity of the upper and lower sectors does not much differ ($4,773 \pm 0,310 \text{ cm}^3$ and $4,431 \pm 0,230 \text{ cm}^3$, respectively).

5. Minimum capacity of all the excretory sectors is determined in the double pelvis kidneys supplied by two branches of the renal artery directed to the poles of the organ ($7,003 \pm 0,270 \text{ cm}^3$).

Prospects of further studies. The results of the conducted research are of certain interest for specialist involved in the study of theoretical and practical aspects concerning the issue of blood supply in the kidney parenchyma in order to perform organ-saving surgery on the kidney. The search for technical opportunities of the previous ligation of the renal artery branches before kidney resection in order to prevent life-threatening hemorrhages appears to be rather promising.

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