Morphological Variations of Posterior Segmental Artery of the Single Renal Artery

Study on corrosion casts

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On a total of 150 renal corrosion casts were examined the posterior branch and the artery of renal posterior segment. For the origin of the posterior branch, there have been highlighted three morphological types, namely: Type I, bifurcation in anterior and posterior branches (92.67% of cases); Type II, trifurcation in anterior, posterior and superior or inferior branches (6.00% of cases); Type III, quadrifurcation in anterior, posterior, superior and inferior branches (1.33% of cases). Depending on the relations between this path and those with the posterior aspect of the renal pelvis, we highlighted four morphological types: Type I (62.67% of cases) with large extension of the posterior segmental artery, convex downward path and multiple subsegmentary branches; Type II (34.00% of cases) with large extension of the posterior segmental artery, that bifurcates or trifurcates in segmental branches and convex downward path; Type III (2.00% of cases) with small extension of the posterior segmental artery, with downward path in relation to the upper portion of the posterior surface of the renal pelvis upper portion; Type IV (1.33% of the cases) with small extension of the posterior segmental artery, with upward trajectory in relation to the lower portion of the renal pelvis. Knowledge of these aspects is important both to investigate morphological imaging and for performing partial resection of the renal parenchyma.

Keywords: kidney, corrosion casts, posterior segmental artery, variations

Of parenchymal organs provided with hil, which enter and leave vascular and ductal elements (elements of the vasculo-ductal pedicle), the kidney shows the greatest variability [1-6]. Terminologia Anatomica [7] homologates for the kidney a single renal artery; near the sinus the renal trunk artery divides into an anterior branch (which gives rise to four segmental arteries: artery of the superior segment, artery of the anterior-superior segment, artery of the anterior inferior segment and artery of the inferior segment), and the posterior branch that continues with the artery of the posterior segment.

At the level of abdominal cavity, the collateral branches of the aorta show four major categories of variations: variations of origin [8-11], variations of number [12-16], variations of trajectory [17-18] and variations of distribution [2-5]. For the renal arteries, the most common variations are the variation of number [12-19]. For the field of urologic surgery, the variations of the intraparenchymatous distribution are the most important.

The posterior abdominal approach of the kidney exposes the posterior aspect of the renal pelvis in contact with the posterior branch of the renal artery (that continues with the artery of the posterior segment). The purpose of this paper is to analyze the morphological variations of the artery of the posterior segment on corrosion casts preparations.

Experimental part

The study of the intraparenchymatous variations regarding the distribution of the artery of the posterior segment was conducted on a total of 150 pieces of corrosion casts, made in the Department of Anatomy at the University of Medicine and Pharmacy Victor Babes Timisoara during 2000-2012. For this study were used only anatomical pieces from cadaver that had no history of pathological medical or surgical conditions. Renal vascular-ductal systems were injected with plastic mass (nitrocellulose E 950 - AGO paste II) using the method described by Nanu, Corondan and Bejan [20]. Subsequently the kidney parenchyma was corroded with hydrochloric acid. After completing all preparation steps, the renal corrosion casts were individually photographed and categorized according to the morphological typologies of the artery of the posterior segment.

Results and discussions

The analysis of the spatial distribution of the posterior branch and the artery and posterior segment performed

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distinctly. For the posterior branch of the renal artery we analyzed the level of the origin point, and the branching pattern and put out a total of three morphological types:

Type I (modal) - most frequently (92.67% of the 139/150), the renal artery trunk bifurcates into anterior branch and posterior branch;

Type II (6.00% of the cases 9/150) with the trifurcation of the renal artery trunk, with two different sub-types: - Type IIA - (4.67% of cases, 7/150 cases) with trifurcation in: anterior, posterior and superior branches; - Type IIB - (1.33% of cases 2/150) with trifurcation in: anterior, posterior and inferior branches;

Type III (1.33% of cases, 2/150) with quadrifurcation of the renal artery trunk in: anterior, posterior, superior and inferior branches.

The artery of the posterior segment continues the path of posterior branch. Depending on the relations between this path and the relations with posterior aspect of the renal pelvis, we highlighted four morphological types:

Type I (modal) (in 62.67% of cases, 94/150) with large extension of the posterior segmental artery, that gives rise to multiple subsegmentary branches; the arterial path is convex downward, on the lateral border of the renal pelvis;

Type II (34.00% of the 51/150 cases) with large extension of the posterior segmental artery, that bifurcates or trifurcates in segmental branches the arterial path is convex downward, on the lateral border of the renal pelvis; the segmentary branches are located between the large renal calyces;

Type III (2.00% of the 3/150 cases) with small extension of the posterior segmental artery, with downward trajectory in relation to the upper portion of the posterior surface of the renal pelvis upper portion;

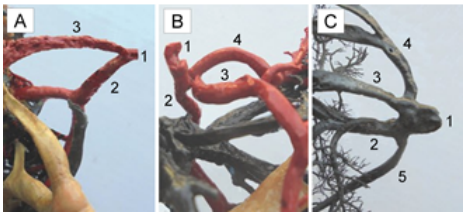

Fig.1. Renal corrosion casts highlighting the morphological types of the posterior segmental artery origin. Posterior view. A – Type I (modal); B – Type II; C – Type III. 1. Renal artery trunk; 2.Anterior branch; 3. Posterior branch; 4 .Superior branch; 5. Inferior branch.(Color figure can be viewed in the online issue, which is available at www.revmaterialeplastice.ro)

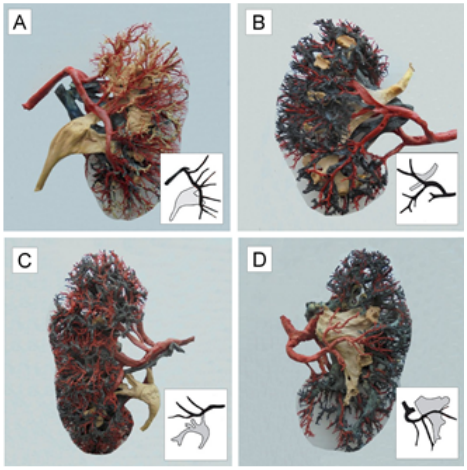

Fig.2. Renal corrosion casts highlighting the four morphological types of the posterior segmental artery path and distribution. Posterior view.A – Type I (modal); B – Type II; C – Type III; D – Type IV. (Color figure can be viewed in the online issue, which is available at www.revmaterialeplastice.ro)

Type IV (1.33% of the 2/150) with small extension of the posterior segmental artery, with upward trajectory in relation to the lower portion of the renal pelvis lower portion.

In a study on renal corrosion casts Zãhoi [2] highlights four types of single renal artery branching pattern: (i) in 1.90% of cases, continuing only with anterior branch; (ii) in 86.71% with bifurcation in anterior and posterior branches; (iii) in 10.76% of cases with trifurcation in anterior, posterior and superior or inferior branches; (iv) in 0.63 of cases quadrifurcation in anterior, posterior, superior and inferior branches. In the present study, the posterior branch arises by bifurcation of the renal artery trunk (92.67%); this is the modal aspect present in almost all anatomical and surgical studies.

Usually the posterior segmental artery continues the path of the posterior branch in contact with the posterior aspect of the renal pelvis. In our study the modal type of the posterior segmental artery is represented by the situation in which this artery has a large extension and convex downward path at the level of lateral margin of the renal pelvis and gives rise to multiple subsegmentary branches.

On the studied material, this morphological type is highlighted in 62.67% of cases. In literature his prevalence has variations between 27.00% [21] and 63.20% of cases [22]. The bifurcation or trifurcation of the posterior segmental artery trunk was detected in 34.00% of studied cases. In literature, the prevalence of this morphologic type varies between 38.77% [22] and 56.32% of cases [2]. Type III was highlighted in 2.00% of cases. In literature the reduced anatomical extension of the artery of the posterior segment trunk, with downward path was highlighted between 0.64% [2] and 25.00% of cases [21]. The situation with small extension of the posterior segmental artery, with upward trajectory in relation to the lower portion of the renal pelvis lower portion (type IV, 1.33%) is a new acquisition, not covered in the literature.

In recent years, were correlated data of anatomical studies with some specific issues of pathology [23] and on the other hand with aspects of embryology, pathogenesis, natural history, diagnosis, current treatment options and clinical implication [24-26].

The evidence of the tridimensional distribution of anatomical structures is emphasized by modern imaging methods [8-10] and morphological methods of dissection, plastination [27-31] or corrosion casts [32, 33]. The corrosion casts highlighting the vascular spatial distribution of elements has a superior value for students and residents training in medicine.

In medical literature are presented more frequently aspects of nervous [34, 35], neuromuscular [34], and vascular-bone interconnections [28]. The renal vasculo-pyelo-calyceal interconnections stand out more rarely [21, 32, 33].

Conclusions

This study demonstrated the origin of the posterior branch of the renal artery in three distinct ways (by: bifurcation, trifurcation and quadrifurcation). The most frequently (92.67% of the studied cases) the single renal artery trunk splits in the anterior and posterior branches. Depending on the quantitative development of the posterior segmental artery trunk, branching and intraparenchymatous distribution were highlighted in four morphological types. The most frequently (62.67% of cases) the posterior segmental artery has a convex downward path on the lateral border of the renal pelvis and gives rise to multiple subsegmentary branches. Knowledge of these

investigated apects is important both to morphological imaging and for performing partial resection of the upper renal parenchyma.

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