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Variations in the Origin and Draining Pattern of Gonadal Vessels with their Surgical Significance and Developmental Correlations

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Abstract

Variations are very commonly found in different vessels of the body. Gonadal vessels also show numerous variations which are important in surgeries of posterior abdominal wall. Also, these vessels are closely related to renal vessels, so, variable origins of these vessels are of utmost importance in renal surgeries. Present study was undertaken to observe the variations in the gonadal vessels.

Materials and Methods: 30 cadavers (26 males and 4 females) embalmed in 10% formalin were procured from the Anatomy Department of, D Y Patil Medical College, Pune. So, sixty gonadal vessels were dissected for this study. The variable levels of origin of gonadal arteries from abdominal aorta as well as variable origins of the same were noted down. Also, the variable draining pattern of gonadal veins were noted. Photographs of all the variations were taken.

Results: Numerous variations in origin, level and source of origin of testicular arteries and ovarian arteries were found. Common variation found was their origin from accessory renal arteries. Gonadal veins also showed, variable draining patterns with sometimes duplication of veins.

Conclusion: Variant origin and draining pattern of gonadal vessels are important in the surgeries of posterior abdominal wall, renal surgeries like renal transplant, surgical excision of tumors of posterior abdominal wall, surgeries on abdominal aorta etc. Also, these variations are important for radiologists and also, for surgeries of varicocoele and testicular tumors.

Keywords: Abdominal aorta; Inferior vena cava; Gonadal arteries; Gonadal veins.

Introduction

The testicular arteries arise anteriorly from the abdominal aorta inferior to the origin of renal arteries. Then they pass under the parietal peritoneum on psoas major muscle. The right testicular artery passes in front of the inferior vena cava while the left testicular artery passes behind the inferior mesenteric vein. Each artery then runs anterior to the genitofemoral nerve, ureter and the lower part of external iliac artery and enters the deep inguinal ring as a content of spermatic cord, passes *via* the inguinal canal to reach the testis.

Pampiniform plexus emerge on the posterior aspect of testis. In inguinal canal pampiniform plexus fuse to form four veins which travel towards abdominal cavity through deep inguinal ring. Within the abdomen these veins coalease into two veins, which ascend on each side of the testicular artery, anterior to ureter, psoas major while behind the peritoneum. Left vein is crossed by the colic vein and right vein is crossed by the root of mesentry. These veins join to form single testicular veins, the right testicular vein drains into inferior vena cava at an acute angle just inferior to the level of renal veins while the left testicular vein opens into the left renal vein at a right angle. Ovarian arteries are the

branches of abdominal aorta and originates below renal ateries. Each descends behind peritoneum, crosses the external iliac artery and vein at the pelvic brim to enter the true pelvis.

Ovarian plexus present in the mesovarium and suspensory ligament give rise to ovarian veins. They usually merge to form a single vein which drains into the inferior vena cava on the right side and the renal vein on the left side.[1]

The purpose of the present study was to know the different types of variations in gonadal vessels. These variations are important for surgeons as well as for radiologists. They are important in surgeries of posterior abdominal wall, renal transplant surgeries, surgical excision of tumors of posterior abdominal wall, surgeries on abdominal aorta etc.

Materials and Methods

Thirty cadavers (26 males and 4 females) embalmed in 10% formalin were procured from the Department of Anatomy, D Y Patil Medical College, Pune. So, sixty gonadal vessels were dissected for this study. The level of origin of gonadal arteries as well as variations in their origin were noted down. Also, the variable draining pattern of gonadal veins were noted down and photographed.

Steps of dissection were followed as per Cunningham's manual of practical anatomy volume 2.[2]

The steps of dissection were as follows:

- All the specimen were labeled with number;
- Anterior abdominal wall was already dissected as cadavers were dissected by undergraduate students;
- Abdominal organs were removed to expose the posterior abdominal wall;
- Abdominal aorta and inferior vena cava were dissected meticulously and variant origin of gonadal arteries, along with draining pattern of corresponding veins were observed;
- All the variations were noted down;
- Photographs of the variations were taken.

Results

Following variations were noted in the gonadal vessels:

1. Circumaortic left renal vein was observed in four cases. Also, duplication of left testicular vein was seen in all the four cases of which one testicular vein was draining into left renal vein while the other was draining into circumaortic renal vein, shows (Fig. 1).
2. Accessory renal artery giving rise to accessory testicular artery on left side in 4 cases (Fig. 2), while in two cases it was seen bilaterally (Fig. 3).
3. Drainage of right testicular vein into right renal vein was seen in 3 cases (Fig. 4).
4. Level of origin of right testicular artery from abdominal aorta was seen at the level of origin of inferior mesenteric artery in 2 cases (Fig. 5).
5. Duplication of left ovarian vein with their drainage into left renal vein, while drainage of right ovarian vein was seen into right renal vein (Fig. 6). This was found in single case.

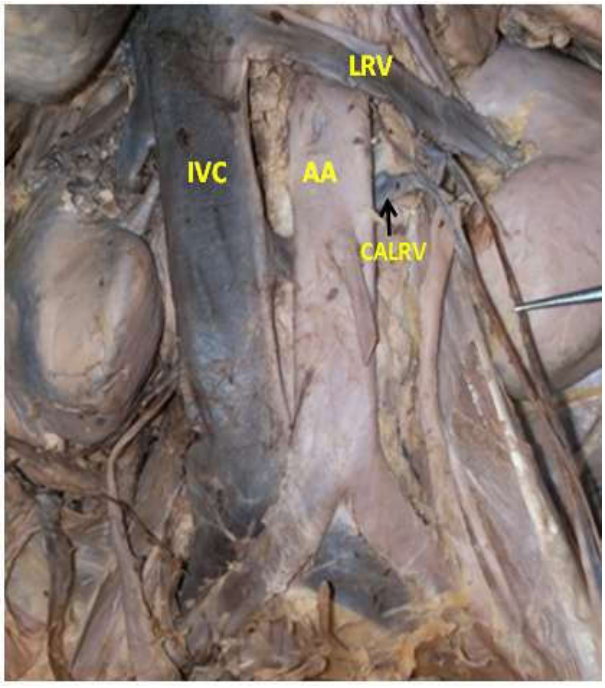

Fig. 1: Circumaortic left renal vein along with duplication of left testicular vein. One testicular vein was draining into left renal vein while the other testicular

Abbreviations

IVC - Inferior vena cava

AA - Abdominal aorta

LRV - Left renal vein

CALRV - Circumaortic left renal vein.

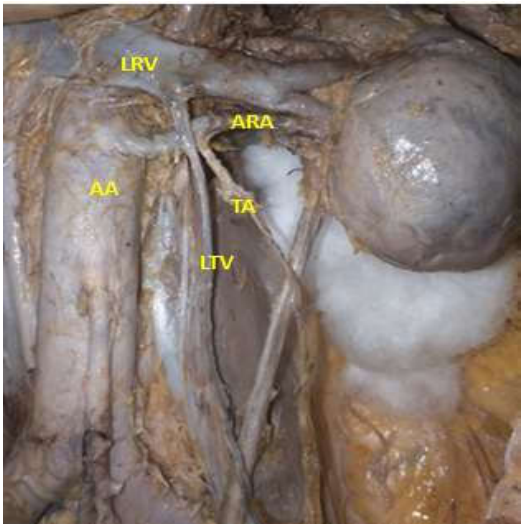

Fig. 2: Accessory renal artery giving rise to accessory testicular artery on left side

Abbreviations

ARA - Accessory renal artery

TA - Testicular artery

LTV - Left testicular vein

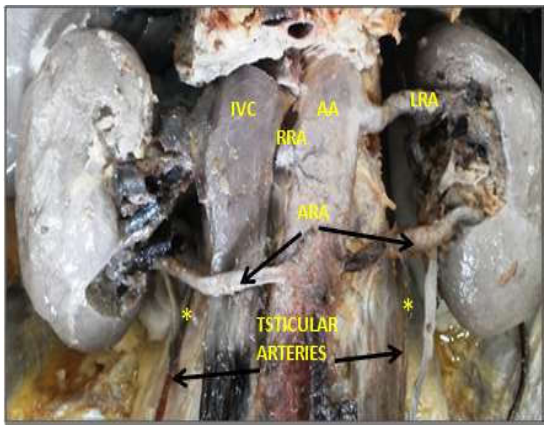

Fig. 3: Accessory renal artery giving rise to accessory testicular artery bilaterally

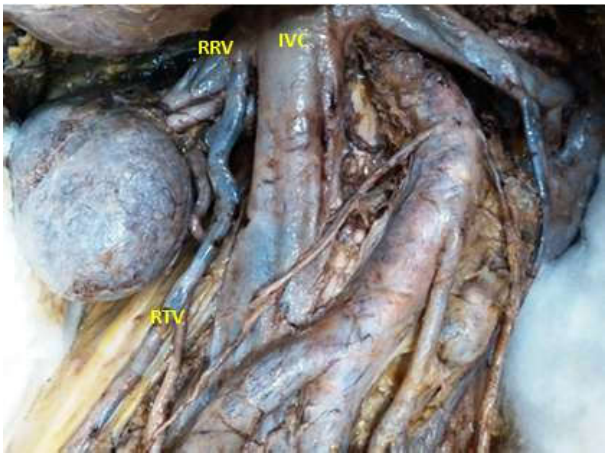

Fig. 4: Right testicular vein draining into right renal vein

Abbreviations

IVC - Inferior vena cava

RRV - Right renal vein

RTV - Right testicular vein

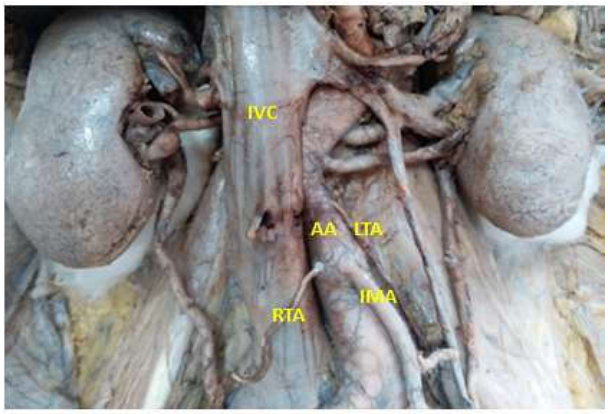

Fig. 5: Right testicular artery arising from abdominal aorta at the level of origin of inferior mesenteric artery

Abbreviations

IVC - Inferior vena cava

AA - Abdominal aorta

LTA - Left testicular artery

RTA - Right testicular artery

IMA - Inferior mesenteric artery

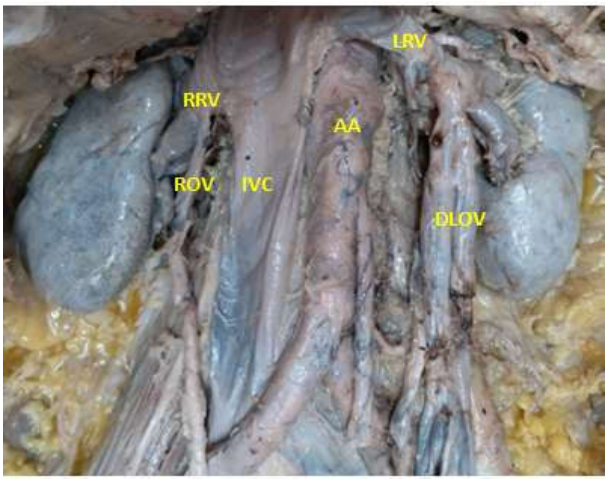

Fig. 6: Left ovarian vein was duplicated was draining into left renal vein, right ovarian vein was draining into right renal vein

Abbreviations

IVC - Inferior vena cava

AA - Abdominal aorta

RRV - Right renal vein

ROV - Right ovarian vein

LRV - Left renal vein

DLOV - Double left ovarian vein.

Discussion

Testicular vessels variations are not uncommon. As per previous studies testicular artery variations are more common on right side as compared to left side. Cicekcibai et al.[3] in his study mentioned 5.5% of cases showing the origin of the gonadal arteries from the renal arteries.

Rusu[4] and Mamatha et al.[5] observed high origin of testicular artery in their study. Kumar N[6] found variation of testicular vein in 21.3% of cases which were more common on the left side along with termination of the right testicular vein into right renal vein and accessory renal vein were also observed.

Knowledge of the origin and course of the testicular artery is surgically important as its ligature during operative procedures will lead to testicular atrophy. So, unusual course and origin of the testicular artery are surgically important and should not be neglected.[7] Sushma R Kotian et al.[8] classified the gonadal vessels according to their level and source of origin, as follows:

Type I: Origin of testicular artery from the abdominal aorta inferior to the renal artery (Normal pattern);

Type II: Origin of testicular artery from the abdominal aorta superior to the renal artery;

Type III: Testicular artery originating from the renal artery;

Type IV: Origin of testicular artery from the abdominal aorta at the level of origin of the inferior mesenteric artery. Normally testicular artery originates from the abdominal aorta inferior to the origin of renal artery but studies have also reported their origin posterior or superior to the renal artery.

Cases of the origin of right testicular artery from the renal artery have been reported. The testicular artery may originate from an accessory renal artery.[9] Rarely origin of the testicular artery may be seen from other arteries like suprarenal, phrenic, superior mesenteric, lumbar, common iliac, or internal iliac arteries.[10] In the present study, origin of the testicular artery was observed either from the renal artery or the accessory renal artery.

Arching of the testicular artery in front of the renal vein has been observed in previous studies which was named as the artery of Luschka.[2] Such arched artery may get compressed leading to testicular degeneration. Similar finding was observed in present study, where left testicular artery was arching over the left renal artery and the vein.

Because of advanced surgical techniques for the treatment of varicocoele and undescended testis the anatomy of gonadal arteries has assumed great importance. Unfamiliar anatomy of gonadal vessels during laparoscopic surgery of abdomen and pelvis may lead to vascular troubles of gonads.[11]

Variable arrangements of renal and gonadal veins are of immense surgical importance. The incidence of additional renal vein may contribute to the selection criteria adopted for a donor kidney suitable for transplantation.

Presence of additional renal vein may act as an alternate collateral route if the portion of inferior vena cava is interrupted between these veins. It has been also reported that the right renal vein rarely received tributaries, whereas left renal vein regularly had complex connections with other venous channels, which formed the basis of collateral pathways after caval interruption. Asala et al. (2001)[12] found 2 cases in which right gonadal vein was draining into right renal vein, out of 150 cadavers dissected while variations of gonadal veins were more frequent on the left side, as observed by him. In the present study, right testicular vein was seen draining into the right accessory renal vein.

Embryological Basis

During development of inferior vena cava, the "renal collar" forms a circular aortic venous ring, which is formed anteriorly by subcardinal veins and anastomosis between them, posteriorly by supracardinal veins and their anastomosis, while on each side it is formed by supracardinal-subcardinal anastomosis. Once the definitive position of metanephros is attained, permanent venous pattern begins to appear. At this time, bilaterally symmetrical cardinal venous system forms unilateral right-sided inferior vena cava. Inferior vena cava is thus formed in the right of aorta. At this stage, two renal veins are present on each side, one on the ventral plane while another dorsal to it. In the right side, one renal vein opens into the lateral portion of the renal collar and the other opens more dorsally towards cranial part of the supracardinal vein. During further development, there is confluence of the two tributaries forming a single vessel that connects with the lateral portion of renal collar. The persistence of these two veins will form the additional renal vein of right side.

Gonadal vein develops from caudal part of

subcardinal vein and drains into the supracardinal and subcardinal anastomosis. In the right side, this anastomosis and also a small portion of subcardinal vein are incorporated into the formation of inferior vena cava, resulting into the drainage of right gonadal vein into the inferior vena cava. If this fails part of right renal vein is formed by right supracardinal veins.[13]

Multiple renal veins are seen in about 14 percent of kidneys. The common anomaly of the left renal vein occurs when it divides and passes on both the sides of aorta to reach the inferior vena cava. The portion of the left renal vein associated with the aorta develops from anastomoses between the cardinal systems of the two sides, which is known usually known as the renal collar, with preaortic and retroaortic limbs. Commonly ventral pat of renal collar is retained, so, that the left renal vein passes anterior to the aorta; but if ventral part disappears and dorsal pat persists, it will form retro aortic left renal vein. In case if both the dorsal and ventral parts persists a circumaortic venous ring is formed [14] which is found in four cases in the present study.

Conclusion

The detailed knowledge of the variations in gonadal vessels is of utmost importance to the urologist, surgeons dealing with renal transplant surgeries, and radiologists for diagnostic procedures. While performing surgical procedures for the treatment of varicocele and undescended testes within abdominal cavity, anatomical knowledge of testicular artery is very essential in order to prevent testicular atrophy.[15]

References

1. Gray Henry. The anatomical basis of clinical practice, 39th edition. Susan Standring, Elsevier Churchill Livingstone; 2005.
2. Romanes GJ. Cunningham's manual of practical anatomy, 15th edition. Oxford Medical Publications; 1986.pp.169–72.
3. Cicekcibai AE, Salbacak A, Peker M, et al. The origin of gonadal arteries in human fetuses: Anatomical variations. Annals of Anatomy 2002;184(3):275–79.
4. Rusu MC. Human bilateral doubled renal and testicular arteries with a left testicular arterial arch around the left renal vein. Romanian Journal of Morphology and Embryology 2006;47(2):197–200.
5. Mamatha Y, Prakash BS, Latha PK, et al. Variant course of left gonadal artery. International Journal of Anatomical Variations 2010;(3):132–33.
6. Kumar N, Swamy R, Patil J, et al. Presence of Arteriovenous Communication between Left Testicular Vessels and its clinical significance. Case Reports in Vascular Medicine 2014;2014:3.
7. Gupta A, Singal R, Singh D. Variations of gonadal artery: Embryological basis and clinical significance. Int J Biol Med Res 2011;2(4):1006–10.
8. Sushma R Kotian, Pandey AK, Supriya P, et al. A cadaveric study of the testicular artery and its clinical significance. J Vasc Bras. 2016 Oct-Dec; 15(4):280–286.
9. Singh R, Jaiswal A, Shamal SN, et al. Variation in the origin of the testicular arteries and drainage of the right testicular vein. Int J Morphol 2011;29(2):614–16.
10. Bergman RA, Thompson SA, Afifi AK. Compendium of human anatomic variation: Text, atlas, and world literature. Baltimore: Urban and Schwarzenberg 1988.p.83.
11. Hussein M, Deep V, Gupta P, et al. Variable origin of Testicular Artery from Renal Artery and its clinical significance in North Indian population. Scholars Journal of Applied Medical Sciences (SJAMS) 2014;2(1D):407–41.
12. Asala S, Chaudhary SC, Masumbuko-Kahamba N, Anatomical variations in the human testicular blood vessels. Annals of Anatomy 2001;183(6):545–49.
13. Biswas Sharmistha, Chattopadhyay JC, Panicker H, et al. Variations: In Renal and Testicular Veins–A Case Report. J Anat Soc, India 2006;55(2)69–71.
14. Henry Hollinshead W. Anatomy for surgeons. Vol. 1, 5th edition. Harper and ROW Publishers; 461–535.
15. Xue HG, Yang CY, Ishida S. Duplicate testicular veins accompanied by anomalies of the testicular arteries. Ann Anat 2005 Sep;187(4):393–98.