

Anomalous Right Testicular Artery and Vein: Embryologic Explanation and Clinical Implications

PUNITA SHARMA, SURINDER KUMAR SALWAN

ABSTRACT

The invasive interventions such as renal transplantation, interventional radiologic procedures and urologic operations increase awareness of the possible variations of the renal and gonadal arteries which is necessary for adequate surgical management in the aforementioned specialties. We have come across an anomalous origin of right testicular artery from right renal artery which is though not a rarity warrant attention because of the origin and course of the anomalous vessel. The origin

of right testicular artery from right renal artery was obscured by inferior vena cava. This vascular variation shows a major significance in renal surgery, in partial or total nephrectomy and in renal transplant. The presence of such variations may become a major risk when this type of gonadal artery represents the single blood supply of the gonad, without a second supply from the aorta or other arterial sources. Thus it becomes imperative to report this case and discuss its embryologic and clinical aspects.

Key Words: Right testicular artery, Anomaly, Renal transplantation, Nephrectomy

INTRODUCTION

Testicular arterial anatomy has been studied in detail because of its importance in testicular physiology, as well as testicular and renal surgery. Testicular arteries are paired vessels that usually arise from the antero-lateral surface of the abdominal aorta at the level of second lumbar vertebra, 2.5 to 5 cm caudal to the renal arteries. Each artery passes obliquely downwards and posterior to the peritoneum. Descending on the posterior abdominal wall, it reaches the deep inguinal ring where it enters the spermatic cord. The testicular vein drains into inferior vena cava on the right side and left renal vein on the left side [1].

Certain vascular and developmental anomalies of kidneys can be associated with variations in the origin and course of the gonadal arteries. These anomalies are explained by the embryological development of both of these organs from the intermediate mesoderm of the mesonephric crest. Further the vasculature of kidneys and gonads is derived from the lateral mesonephric branches of dorsal aorta [1].

As the invasive interventions such as renal transplantation, interventional radiologic procedures and urologic operations increase, awareness of the possible variations of the renal and gonadal arteries is necessary for adequate surgical management in the aforementioned specialties. So we are reporting here a clinically important variation of right testicular artery and vein with its embryologic explanation.

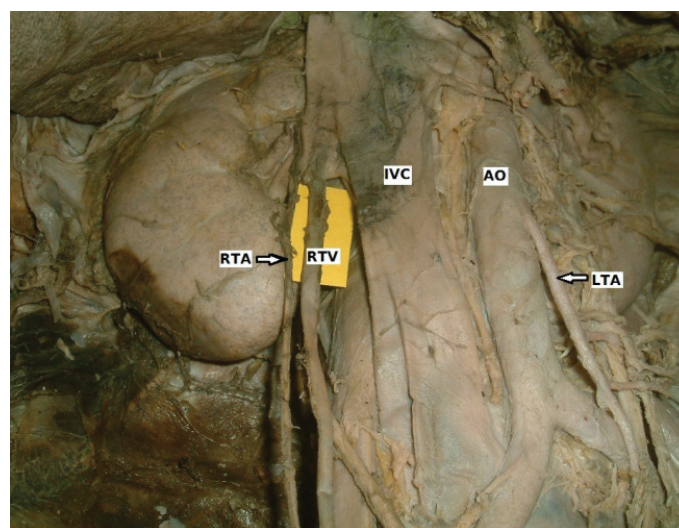
CASE REPORT

During the routine dissection for medical undergraduate teaching in the Department of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, we encountered variations of right testicular artery and vein.

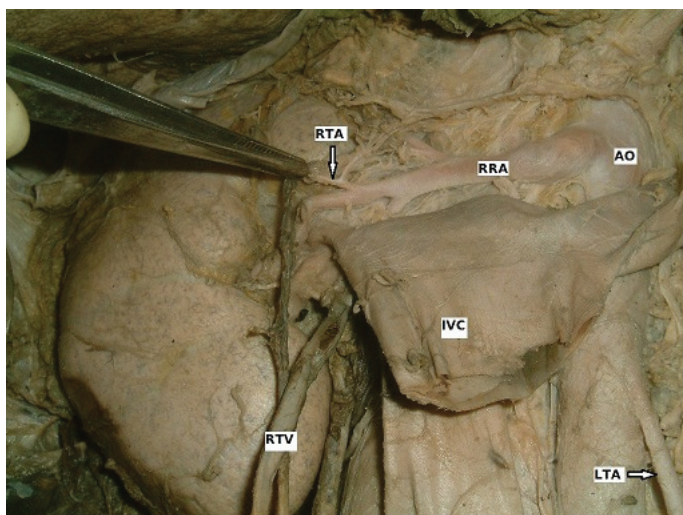
The right testicular artery (RTA) was not arising from abdominal aorta. The origin of right testicular artery was obscure and it

coursed down in front of right renal vein and hilum of right kidney and passed lateral to right testicular vein (RTV) throughout its course [Table/Fig-1]. The right renal vein and artery maintained normal relation at the hilum of kidney. To view the origin of right testicular artery, the inferior vena cava (IVC) was sectioned above the entry of renal veins and reflected downwards. The testicular artery was observed to arise along the superior aspect of right renal artery hidden behind inferior vena cava. A kink at the origin of the testicular artery was observed and it curved downwards to course in front of renal vein [Table/Fig-2].

The right testicular vein (RTV) also drained into right renal vein instead of inferior vena cava. The left testicular artery and the left testicular vein had the normal size and course. No other anomalies were found in the abdomen.



[Table/Fig-1]: Dissection demonstrating right testicular artery and vein
IVC – inferior vena cava, AO – abdominal aorta, RTV – right testicular vein, RTA – right testicular artery, LTA – left testicular



[Table/Fig-2]: Dissection demonstrating the origin of right testicular artery after sectioning inferior vena cava

IVC – inferior vena cava, AO – abdominal aorta, RTV – right testicular vein, RTA – right testicular artery, LTA – left testicular artery, RRA – right renal artery

DISCUSSION

Variant anatomy of gonadal arteries has been reported in number of cases. High origin of the gonadal arteries from the abdominal aorta have been reported in two individuals by Ozan H et al. [2] Anomalous origin of the testicular artery from the inferior polar artery of the kidney and its surgical importance has been reported by Ravery V et al [3]. Cicekcibasi et al [4]. classified the gonadal artery originated from the renal artery as type II, with the frequency of 5.5%. In their study, all five cases in type II had inferior polar origin, while in our case the left testicular artery had a lower hilar origin.

Bordei et al [5] found four cases of a single gonadal artery originating from double renal arteries but did not give any information regarding laterality. In their study, Asala et al found testicular arterial variations only on the right side in 4.7% (n = 150) of the cadavers. In 4 (2.6%) of these cases, testicular arteries branched from the renal artery. [6] Onderoglu et al. reported the right testicular artery giving rise to the inferior phrenic and the superior suprarenal arteries [7].

Considering the arching of the testicular artery, Ranade et al [8] reported an unusual origin and course of a left renal testicular artery arching over the left renal vein along with double renal arteries. They proposed that not only the compression of the left renal vein between the abdominal aorta and the superior mesenteric artery usually induces left renal vein hypertension, resulting in varicocele, but the arching of left testicular artery over the left renal vein could be an additional possible cause of left renal vein compression. Rusu (2006) encountered bilaterally double renal arteries and bilaterally double testicular arteries where in on the right side the medial testicular artery emerged from the abdominal aorta while the lateral testicular artery left the superior renal artery. On the left side the lateral and medial testicular arteries emerged as a common trunk from the abdominal aorta. This trunk originated from aorta behind the left renal vein and arched over that vein to descend and to divide in front of it [9]. Sarita et al (2009) reported about the occurrence of bilateral variant testicular arteries and double renal arteries. Both the testicular arteries were arising from the renal arteries close to the hilum of the kidneys [10].

In a study of 34 cadavers (68 sides), Pai et al (2008) [11] observed that testicular artery emerged as a branch of the inferior polar artery in 7.4% cases. But they observed only 1 case of testicular artery arising from the upper part of right renal artery and arching down onto the front of right renal vein, a case similar to the one mentioned here. Also, in the present case report the corresponding right testicular vein showed a variant termination in right renal vein instead of inferior vena cava [Table/Fig-1 and 2].

Recently the anatomy of the gonadal arteries has assumed importance because of the development of a new operative techniques within the abdominal cavity for operations such as varicocele and undescended testes [12]. During laparoscopic surgery of the male abdomen and pelvis many complications occurred due to unfamiliar anatomy in the operative field [13]. Awareness of variations of the testicular arteries and veins, such as those shown in this case report, becomes important during such surgical procedures.

If overlooked, renal origin of the testicular arteries might have dramatic clinical consequences as reported by Siniluoto et al. about a case who suffered from left testicular infarction due to palliative transcatheter ethanol embolization for intermittent gross haematuria. Later, the re-evaluation of the patient's arteriography showed that the left testicular artery originated from the lower of two renal arteries that supplied the kidney [14]. All these indicate the importance of the arteriography or Doppler ultrasound examination of the renal hilum, prior to any surgical procedure within the region [15].

Regarding the embryologic basis, explanation for individual or combined variations of renal and gonadal arteries has been related to the embryological development of both vessels from the lateral mesonephric branches of the dorsal aorta. The embryologic explanation of these variations has been presented and discussed by Felix [16]. In an 18 mm fetus, the developing mesonephros, metanephros, suprarenal glands and gonads are supplied by nine pairs of lateral mesonephric arteries arising from the dorsal aorta. Felix divided these arteries into three groups as follows: the 1st and 2nd arteries as the cranial; the 3rd to 5th arteries as the middle, and the 6th to 9th arteries as the caudal group. The middle group gives rise to the renal arteries. Persistence of more than one arteries of the middle group results as multiple renal arteries. Felix also stated that although anyone of these nine arteries may become the gonadal artery, it usually arises from the caudal group.

Gonadal vein develops from caudal part of sub-cardinal vein and it drains into the supra-subcardinal anastomosis. In the right side, this supra-subcardinal anastomosis and also a small portion of Sub-cardinal vein are incorporated into the formation of inferior vena cava, so right gonadal vein usually drains into the inferior vena cava. In this present case this failed and a part of right renal vein was formed by right supra-subcardinal anastomosis and hence received the right testicular vein. In the left side, this suprasubcardinal anastomosis forms part of left renal vein where the left gonadal vein drains, and the pre-aortic part of the vein is formed by inter-subcardinal anastomosis. In the present case proximal part of the two original metanephric veins persisted. In present case, the right testicular artery is arising from right renal artery so we believe that they have been derived from the middle group as well.

CONCLUSION

Eventually, our findings have to be kept in mind during surgical procedures in the posterior abdominal wall. This kind of anomaly may cause confusions during renal transplants. The vessels can also be involved in the orthopaedic procedures of lumbar spine. The testicular artery may get compressed between the renal artery and vein, which may lead to degeneration of the testis. If overlooked, renal origin of the testicular arteries might have dramatic clinical consequences. Therefore, the knowledge of variations of vessels in the renal hilar region and retroperitoneal region may greatly contribute to the success of surgical, invasive and radiological procedures of this area.

Also, knowledge of these variations may also provide safety guidelines for endovascular procedures like therapeutic embolisation and angioplasties. Multiple vascular variations near the hilum of the kidney are present in seemingly normal patients and a sound knowledge of possible variations is very useful for radiologists, urologists and surgeons.

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AUTHOR(S):

1. Dr. Punita Sharma
2. Dr. Surinder Kumar Salwan

PARTICULARS OF CONTRIBUTORS

1. Associate Professor, Dept. of Anatomy, Sri Guru Ram Das Institute of Medical Sciences and Research, Vallah, Amritsar, India.
2. Lecturer, Dept. Of Medicine, Government Medical College, Amritsar, India.

NAME, ADDRESS, TELEPHONE, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Punita Sharma
242, Medical Enclave, Circular road, Amritsar, 143001
Telephone: 9888034321, 0183-2421508
E-mail: punitasalwan@gmail.com

DECLARATION ON COMPETING INTERESTS:

No competing Interests.

Date of Submission: **Nov 19, 2011**
Date of peer review: **Dec 05, 2011**
Date of acceptance: **Dec 10, 2011**
Date of Publishing: **Dec 25, 2011**