

Original Article

ANATOMICAL VARIATIONS IN THE ORIGIN OF GONADAL ARTERY-A COMPUTED TOMOGRAPHY ANGIOGRAPHIC STUDY

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ABSTRACT

Introduction: A sound knowledge of variations of gonadal artery is required during operative, diagnostic and endovascular procedures in the abdomen and pelvis especially with the advancement of newer intra-abdominal operative and laparoscopic techniques. The aim of this study was to analyze the normal anatomy of gonadal arteries and their variations by MDCT in the north Indian population.

Materials and methods: 500 patients (aged 18 to 70) referred to the department of Radio diagnosis at Subharti Medical College & Hospital, Meerut, and neighboring imaging centres in the NCR underwent the cross-sectional study (MDCT). From August 2019 to July 2022, MDCT scan images of the abdomen region were examined for the normal anatomy of the gonadal arteries.

Results: Variations were found in both sides gonadal arteries in males and females. The frequency of variations of gonadal arteries in terms of their origin was more commonly found in males.

Conclusions: Various morphological anomalies of gonadal arteries are reported. The possible embryological basis for this variation as well as its clinical significance, are discussed. The knowledge of this variation will help the radiologists and surgeons in avoiding clinical complications during uro-radiologic interventions and surgical procedures such as renal and gonadal surgeries.

Keywords: Gonadal artery, Testicular artery (TA), Ovarian artery (OA), Renal artery (RA).

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Date of Receiving: 22 Jan 2023

Date of Acceptance: 28 Feb 2023

ISSN: 0970-1842



INTRODUCTION

The gonadal arteries are two long slender vessels that usually arise from the anterolateral aspect of the abdominal aorta a little inferior to the renal arteries. The vertebral level of their origin varies from the level of first to third lumbar vertebrae [1]. Each artery passes inferolaterally under the parietal peritoneum on psoas major [2]. In addition to the normal pattern, several other sites of origin of the gonadal arteries have been described; among them the renal, accessory renal and suprarenal arteries are most commonly mentioned and more rarely the lumbar, common or internal iliac and superior epigastric arteries [3,4,5,6,7].

Anatomy of testicular artery has been well studied because of its importance in testicular physiology, and testicular and renal surgeries. Each testicular artery passes obliquely downwards and posterior to the peritoneum on the psoas major muscle and enters the inguinal canal through the deep inguinal ring. Along their course, the testicular arteries are accompanied by the testicular veins.

They pass through the deep inguinal ring of the corresponding side and then become constituents of the spermatic cord. Each ovarian artery descends behind the peritoneum and crosses the external iliac artery and vein to enter the true pelvic cavity. It enters in the suspensory ligament of ovary

and splits into a branch that supplies ovary and another branch supplies uterine tube. On each side, a branch passes lateral to the uterus to unite with the uterine artery, other branches accompany the round ligaments through the inguinal canal and supply the skin of the labium majus and inguinal region and terminate in the gonads, to which they supply [2].

Variations of gonadal arteries had been related to the embryological development from the lateral mesonephric branches of the dorsal aorta [8]. Such variations of the gonadal arteries have clinical and surgical significance with respect to their potential influence on the blood flow to the gonads and to the hemorrhagic complications following retroperitoneal operations. Awareness of the possible variations of gonadal arteries is necessary for adequate surgical management. [5, 6]. The goal of the present study is to analyze the variation in terms of their origin of testicular and ovarian arteries on either side by Multi detector Computerised Tomographic Angiography in the north Indian population.

MATERIALS AND METHODS

The present cross-sectional study was performed on the 500 patients (including both side males & females between 18-70 years of age) referred to the Department of Radio diagnosis, Subharti Medical College &

Hospital, Meerut and nearby Imaging Centres in the NCR for Multi detector Computerised Tomographic Angiography (MDCTA) for evaluation of various suspected abdominal pathologies. CTA scan images were reviewed for normal anatomy of gonadal arteries from August 2019 to October 2022.

A randomized sampling technique was used in the study. A proper ethical clearance was obtained from Ethical committee of the Subharti Medical College and Hospital Meerut.

Inclusion criteria :

- Good quality of reformatted contrast-enhanced MDCTA images of the gonadal arteries.
- Absence of morphological features of the gonadal arteries.

Exclusion criteria :

- Allergy to contrast
- Contraindication to radiation exposure (ex: pregnancy)
- MDCT images with artefacts, suboptimal post contrast arterial opacification.
- MDCT images of patients with abnormalities that could interfere with optimum evaluation of the gonadal arteries.

RESULTS

Present study was done on the 500 patients including 272 male and 228 female patients.

Out of 270 male patients, in 260 cases normal origin of right testicular arteries was found in present study while right testicular artery arising from right renal artery in 9 cases, 2 cases showed right testicular artery arising from right common iliac artery and in 1 case double right testicular artery was found (one arising from right renal artery and one arising from aorta). Similarly in left side testicular artery, in 262 cases normal origin of left testicular artery was found while in 9 cases left testicular artery arising from left renal artery and in 1 case it is arising from left common iliac artery tabulated in table 1 & 2.

Out of 228 cases of females, normal origin of right ovarian artery was found in 225 cases present study. In 2 cases right ovarian artery arising from right renal artery and in 1 case it is arising from right internal iliac artery. Similarly, on the left side, normal origin of left ovarian artery was found in 226 cases. In one case left ovarian artery arising from left renal artery and in one another case it is arising from left internal iliac artery tabulated in table 3 & 4.

In the present study the frequency of variations of gonadal arteries is more in males as compared to females on either side.

DISCUSSION

The variations of Gonadal arteries showed deviations in their origin, course and number

Variations of RT testicular artery	Number of patient (n-272)	% of variations
Normal	260	95.6%
Arising from Rt renal artery	9	3.3%
Arising from common iliac artery	2	0.7%
Double testicular artery one arising Rt renal artery and one from aorta	1	0.4%

Table 1. Frequency of RT testicular arteries in the present study.

Variations of Lt testicular artery	Number of patient(n-272)	% of variations
Normal	262	96.2%
Arising from common iliac artery	1	0.4%
Arising from Lt renal artery	9	3.4%

Table 2. Frequency of LT testicular arteries in the present study.

Variations of RT ovarian artery	Number of patient(n-228)	% of variations
Normal	225	98.7%
Arising from RT renal artery	2	0.9 %
Arising from RT internal iliac artery	1	0.4 %

Table 3. Frequency of RT ovarian arteries in the present study.

Variations of Lt ovarian artery	Number of patient(n-228)	% of variations
Normal	226	99.2%
Arising from Lt internal iliac artery	1	0.4%
Arising from Lt renal artery	1	0.4 %

Table 3. Frequency of LT ovarian arteries in the present study.

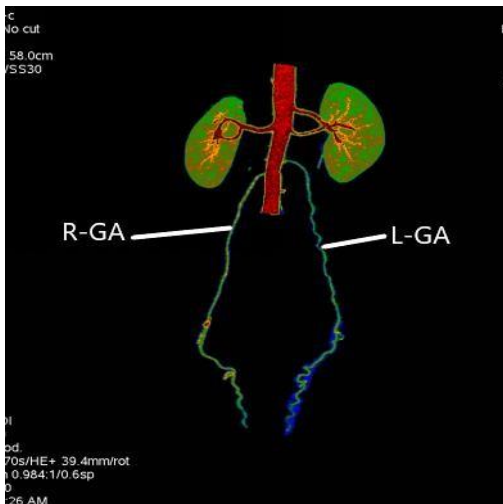


Fig. 1. Normal origin of right and left gonadal (testicular) artery and LT accessory renal artery.

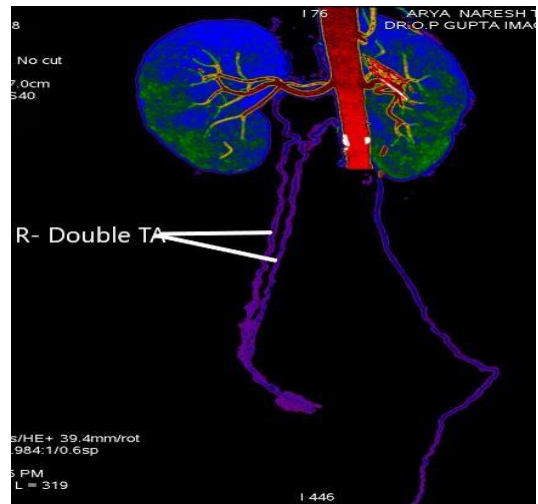


Fig. 2. Right double testicular artery (one arising from RT renal artery and one arising directly from aorta).

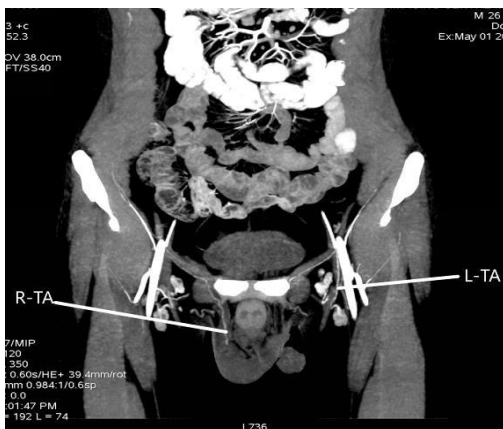


Fig. 3. Right and left testicular arteries arising from common iliac arteries.

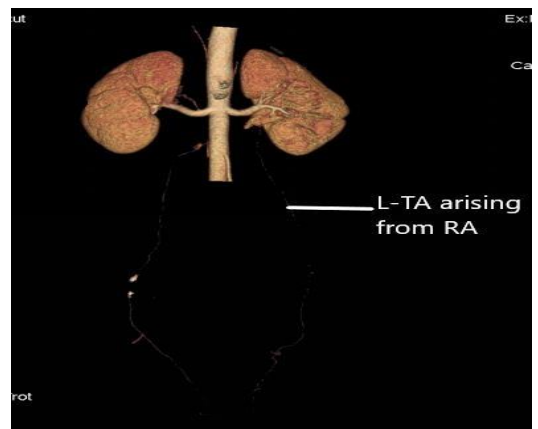


Fig. 4. Left testicular artery arising from left renal artery.



Fig. 5. Right testicular artery arising from right common iliac artery.

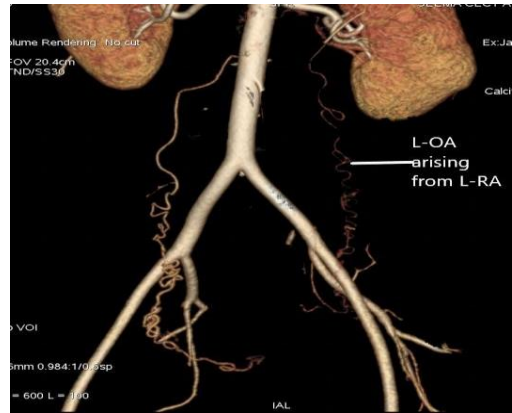


Fig. 6. Left ovarian artery arising from left renal artery.

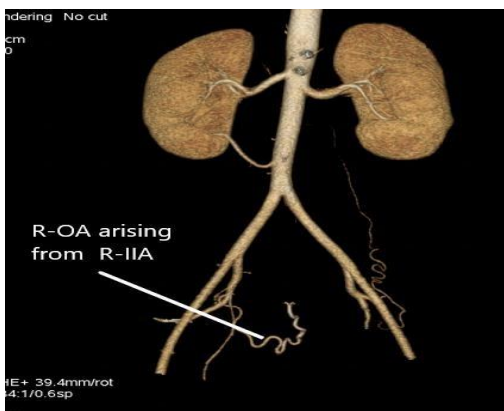


Fig. 7. Right ovarian artery arising from right internal iliac artery.

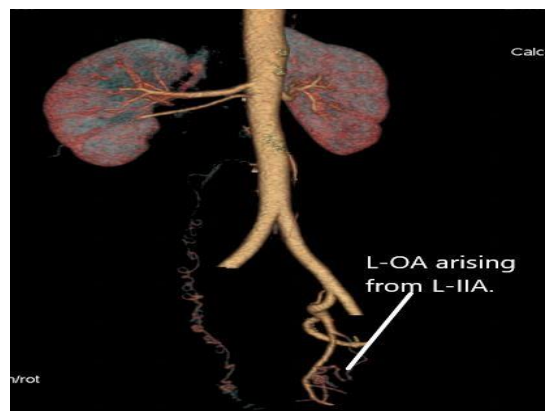


Fig. 8. Left ovarian artery arising from left internal iliac artery.

unilaterally or bilaterally. They may be doubled, tripled, or even quadrupled and may arise from a common stem with the suprarenal arteries [1,6]. The normal pattern according to classical anatomical textbook is followed in the 83% of the cases [3], while several studies report anomalies in their origin with an incidence, which ranges from 4.7% to 75% [4,9]. More specifically, the gonadal arteries are reported to arise from the main renal arteries with a frequency, which varies from 1.47% to 17% [3,9], while their origin from an accessory renal artery ranges from 5.5% to 31.25% [5,9].

The latter is recorded to occur bilaterally only in 1.1% of the total cases [5]. The origin of gonadal artery from accessory renal artery was present in 6.67% cases. The testicular arteries tend to present anomalous origin more often (15.5%), than the ovarian arteries (2.2%) [5]. In respect to above mentioned studies the present study also showed a similar finding (anomalous origin of testicular artery was found in 4.4% on right side and 3.8% on left side while anomalous origin of ovarian artery was found in 1.3% on the right side and 0.8% on the left side).

An accessory left testicular artery from the descending aorta has been reported by Loukas and Stewart [10]. Left testicular artery originating behind the left renal vein at the level of the left renal artery from the abdominal aorta, and getting entrapped between the two divisions of the left renal vein, has been reported by Satheesha [11].

The persistence of cranial lateral mesonephric artery results in a high origin of the gonadal artery, probably from suprarenal or from a more superior aortic level studied by Salve et al. [12]. Variations of gonadal vessels have an embryological basis. The developing mesonephros, metanephros, suprarenal glands and gonads are supplied by nine pairs of lateral mesonephric arteries arising from the dorsal aorta. These arteries are divided into three groups viz: the first and second arteries, the third to fifth and the sixth to ninth arteries constitute the cranial, middle and caudal group respectively.

The middle group gives rise to the renal arteries. Persistence of more than one artery of the middle group results in multiple renal arteries [13,14]. The accessory renal artery could therefore be a result of a persistent lateral mesonephric artery from the middle group. Gonadal arteries can arise from any of these nine mesonephric arteries though they usually arise from the caudal group [14]. In the present study, the origin of the left testicular artery from the lower polar accessory renal artery suggests the

embryologic origin of this vessel from the middle group.

The anatomy of gonadal arteries has assumed importance because of development of new operative techniques within abdominal cavity for operations like varicocele and undescended testis. During laparoscopic surgery of abdomen and pelvis many complications occur due to unfamiliar anatomy in operative field. Thus, it becomes imperative to carefully preserve the gonadal artery to prevent any vascular insults to gonad, as the gonadal artery is its unique source of blood supply.

DISCUSSION

Knowledge of variations of gonadal arteries is important during operative, diagnostic and endovascular procedures in the abdomen. Variations of the renal and testicular artery should be considered due to the increased demand for living donor graft in renal transplants, the knowledge of such variant anatomy of the renal and gonadal arteries is an important prerequisite to successful renal transplantation and comprehensive arteriography of these vessels before surgery is recommended. The origin of the testicular artery from the renal artery should be noted as injury to this vessel may result in testicular infarction [15,16].

The knowledge of variations is of utmost importance to the urologist, surgeons dealing with kidney retrieval and transplantation,

radiologists, persons performing endourologic procedures and various interventional techniques. Anatomical knowledge of testicular artery is essential for performing operative techniques to treat varicocele and undescended testes within the abdominal cavity.

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