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Research Article

Anatomical Variations of the Gonadal Veins

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Abstract

Introduction: Anatomical variations of the gonadal veins have been historically described but only a few studies have been conducted in Australia on the anatomical variations of the gonadal vessels. Anatomically, the gonadal veins are asymmetric and have different drainage pathways between the right and left sides.

Knowledge on the anatomical variations of the gonadal veins is important as unfamiliarity of the anatomy in the abdomen and pelvis may result in complications during and after surgery. Precise detailed information on the variations of gonadal vessels may further aid in safety guidelines for surgical techniques.

Objectives: This study aims to present an analysis of variations on the type of structure, number and locale of drainage.

Methods: Study samples were accessed from the Anatomy Department, The University of Melbourne, Melbourne, Australia. The human cadavers were routinely dissected for exposure of peritoneal and retroperitoneal structures. Adjacent connective tissues were separated from the vessels for proper exposure. Three anatomical aspects of gonadal vessels were considered:

1. Type of structure
2. Number
3. Locale of drainage

Results: Out of 17 cases with anatomical variations, 12 were females and remaining were males. According to the vessel structures, majority were veins (13) and only four (4) were arteries. For the gonadal veins, accessory/duplication structures were seen in eight (8) occasions and remaining five (5) veins were single. No variations were noted bilaterally. Less commonly the right gonadal vein enters the right renal vein instead of draining into the IVC. This type of variation was most commonly observed for the drainage of the sampled gonadal veins. Other variations observed were gonadal vein entering the left side of the IVC (instead of the right side of the IVC) and drainage into the external iliac vein.

Conclusion: Anatomical variations of the gonadal blood vessels were observed in this study. Findings from this study may aid in developing relevant surgical safety guidelines and imaging guidelines.

Keywords: *Anatomical Variations; Gonadal Veins; Inferior Vena Cava (IVC)*

Introduction

Anatomical variations of the gonadal veins have been historically described. In 1543, Andreas Vesalius mentioned a case of bilateral incomplete double right testicular veins draining into the right renal vein and Inferior Vena Cava (IVC) and the left testicular vein terminating at the left renal vein and lower portion of the IVC [1], which was different to its normal course. Anatomically, the gonadal veins are asymmetric. Usually, the testicular veins originate from the pampiniform plexus that condense to form four veins at the superficial inguinal ring level, two veins at the deep inguinal ring level and one vein at variable levels [2]. The drainage is also different between the right and left sides; the left testicular vein drains into the left renal vein at a straight angle, whereas the right testicular vein drains directly into the IVC at an oblique angle [3]. Frequent cases of left varicoceles have been considered to be resulting from relatively weak hemodynamics in the left testicular vein [4]. The ovarian veins have a similar course to the testicular veins. They originate from the plexus in the broad ligament near the ovary and fallopian tube, left ovarian vein drains into the left renal vein and right ovarian vein drains into the IVC [5].

Knowledge on the anatomical variations of the gonadal veins is important. There is a potential use of the gonadal veins for the lengthening of the renal vein in live donor kidney transplantation [6,7]. Access through gonadal veins are also required for performing newer techniques to treat varicocele (percutaneous retrograde varicocele occlusion and laparoscopic varicocelectomy) in males and pelvic congestion disease in females [8,9]. Unfamiliarity of the anatomy in the abdomen and pelvis may result in complications during laparoscopic

surgery [10]. Therefore, detailed information on the variations of gonadal vessels may further aid in safety guidelines for these techniques [11]. Only a few studies have be conducted in Australia on the anatomical variations of the gonadal vessels.

Aim of the Study

This study aims to present an analysis of variations on the type of structure, number and locale of drainage.

Materials and Methods

Study samples were accessed from the Anatomy Department, The University of Melbourne, Melbourne, Australia. The human cadavers were routinely dissected for exposure of peritoneal and retroperitoneal structures. Adjacent connective tissues were separated from the vessels for proper exposure. Three anatomical aspects of gonadal vessels were considered:

1. Type of structure
2. Number
3. Locale of drainage

Results

Out of 17 cases with anatomical variations, twelve were females and remaining were males.

Type of structure

According to the vessel structures, majority were veins (13) and only four (4) were arteries. Among the variations, right sided structures were more common in case of veins while both left and right sided structures were equally found for arteries.

Number

For the gonadal veins, accessory/duplication structures were seen in eight occasions and remaining five veins were single. No variations were noted bilaterally.

Locale of drainage

Uncommonly the right gonadal vein enters the right renal vein instead of draining into the IVC. This type of variation was most commonly observed for the drainage of the sampled gonadal veins. Other variations observed were gonadal vein entering the left side of the IVC (instead of the right side of the IVC) and drainage into the external iliac vein.

Figure

Number	Sex	Section	Region	Side	Structure	Description
1	F	Abdomen	Peritoneum	Right	Vein	Accessory gonadal vein coming off Right renal vein when it should come off only from IVC; joining gonadal vein (that comes off IVC)
2	F	Abdomen	Posterior abdominal wall	Right	Vein	There are two gonadal vein supplying right ovary
3	M	Abdomen	Posterior abdominal wall	Right	Artery	Presence of Accessory Gonadal artery from aorta on R) side in addition to the right gonadal artery
4	F	Abdomen	Posterior abdominal wall	Left	Vein	Left gonadal vein is giving a branch to the peritoneum
5	F	Abdomen	Peritoneum	Right	Vein	Right gonadal vein coming off IVC, bifurcates when it should be single
6	F	Abdomen	Posterior abdominal wall	Right	Vein	Right Gonadal vein empties into right renal vein instead of IVC
7	F	Abdomen	Posterior abdominal wall	Right	Vein	Right gonadal vein enters the right renal vein instead of into the IVC
8	F	Abdomen	Posterior abdominal wall	Right	Vein	Right gonadal vein enters into the left side of the inferior vena cava. It enters into the right side normally
9	M	Abdomen	Posterior abdominal wall	Right	Veins	Gonadal vein drains directly into renal vein on the right (should go into IVC)
10	F	Pelvis	Posterior pelvic wall	Left	Vein	Anastomosis between left gonadal vein and left external iliac vein
11	F	Abdomen	Posterior abdominal wall	Right	Vein	Gonadal vein coming off origin of R) renal vein
12	M	Abdomen	Posterior abdominal wall	Left	Vein	2 gonadal veins draining into (L) renal v.
13	M	Abdomen	Renal	Left	Vein	Duplicated gonadal vein draining into renal vein
14	F	Abdomen	Posterior abdominal wall	Left	Vein	Duplication of left gonadal vein
15	F	Abdomen	Peritoneum	Left	Artery	Left gonadal artery comes off aorta just beneath renal artery, goes over Left renal vein, and goes down into pelvis
16	M	Abdomen	Abdominal aorta	Right	Artery	Right testicular (gonadal) artery arises from a branch of a common trunk (alongside suprarenal artery) which joins aorta superiorly to renal artery
17	F	Abdomen	Retroperitoneum	Left	artery	Left gonadal artery arising from inferior mesenteric artery

Table: *Variations of gonadal vessels.*

Discussion

There is an embryological basis of the anatomical variations of the gonadal vessels [12]. The development of the gonadal vein, renal vein and IVC are closely related. The embryogenesis of these veins involves anatomical transformations of three pairs of venous channels, namely posterior cardinal, sub-cardinal and supra-cardinal [12]. The renal segment of the IVC is formed by bilateral anastomosis between the supra-cardinal and sub-cardinal veins [13]. For Gonadal veins, these develop from the caudal part of the subcardinal veins and drains into the supra-sub cardinal anastomosis [2]. On the right side, supra-subcardinal anastomosis and a small portion of the subcardinal vein are united into the development of IVC; as this suggests the usual drainage of the right gonadal vein into the IVC [2]. On the left, supra-sub cardinal anastomosis generates part of the left renal vein, which is the destination for the left gonadal veins [14].

Number of veins

Accessory gonadal veins were frequently noticed in this study. Duplication of the right sided testicular veins were more common in the study while other studies indicated duplicated testicular veins more common on the left side [3,13]. Male infertility may result from recurrence of varicocele due to the inappropriate ligature of accessory gonadal veins [15].

Locale of drainage

Drainage of the right gonadal vein into the right renal vein instead of IVC was commonly found in this study. Vettivel., *et al.* [16] suggesting that while the right supracardinal vein replaces the subcardinal vein, it forms a large part of the IVC. For that reason, part of the right subcardinal vein instead of forming the IVC form the right renal vein. So ultimately the right renal suprarenal vein and the right gonadal vein are drained into the right renal vein instead of the IVC. Variations in the drainage may cause confusions in assessing radiological findings or during retroperitoneal surgeries [2].

Conclusion

Anatomical variations of the gonadal blood vessels were observed in this study. Findings from this study may aid in developing releva

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