



# Anomalous drainage of the right gonadal vein

Isadora Pedrão<sup>1</sup> · Maria Tereza Assunção Valeri<sup>1</sup> · Daniel Gregório Gonsalves<sup>1</sup> · Natália Magnabosco Afonso<sup>1</sup> · Amanda Geraldo Signori<sup>1</sup> · Renato Rissi<sup>2</sup>

Received: 4 June 2022 / Accepted: 6 September 2022 / Published online: 15 September 2022  
© The Author(s), under exclusive licence to Japanese Association of Anatomists 2022

## Abstract

The present research aims to present and describe an unusual and rare anatomical variation in relation to the drainage of the right gonadal vein. This anatomical knowledge is crucial as it assists in the work of surgeons and health professionals in general. The dissection occurred in the anterior wall of the abdomen and, through observational analysis, an anatomical variation was found in the drainage of the right gonadal vein in a human cadaver, obtained by anonymous donation, male gender and without predetermined clinical characteristics, ethnicity, and age, belonging to the Padre Albino University Center collection. This research was approved by the Research Ethics Committee under protocol 12923919.8.0000.5430. The drainage of right gonadal vein in this variant occurs anastomosed with an innominate venous trunk that empties into the inferior vena cava. Furthermore, the presence of an accessory right renal vein is also noticed, which anastomoses with the innominate venous trunk and with the right renal vein, through a vein suggestively called interrenal, differing from the anatomical normality described in the literature. This variation is supposed to occur due to flaws in the development of the embryo, which generate venous changes in the origins of the right gonadal vein. Acknowledging the existence of it is relevant when performing surgical procedures in the region, as it differs from the most frequent anatomy found in the human population. The rare drainage of the right gonadal vein through an innominate trunk to the inferior vena cava and its importance is highlighted in this article.

**Keywords** Anatomical variations · Case report · Drainage · Right gonadal vein

## Introduction

Gonadal veins are responsible for venous drainage of the gonads (testicles and ovaries) and, in men, such structures emerge posteriorly to the testicles and join the pampiniform plexus later. This plexus is formed by three or four veins that, when passing through the inguinal canal, turn into two veins, which present a path in the superior direction anteriorly accompanying the ureter and testicular arteries (Fernandes, et al. 2012).

The right gonadal vein (RGV) drains into the inferior vena cava (IVC) at an acute angle and inferiorly the right renal vein (RRV), while the left gonadal vein (LGV) drains into the left renal vein (LRV) at a right angle (90°) (Fernandes et al. 2012). As gonadal veins are anatomically asymmetric, there are several anatomical variations involving them, for instance: comprising the number, presence or absence of valves, angle, and drainage site (Favorito et al. 2007; Rosalino et al. 2011).

Anatomical variations are rare modification of some body structure (either in relation to size, shape, or number) without any impairment of function to the organism. In the case of gonad veins, these variations often occurs, as seen on Asala et al.'s (2001) study that documented the frequency of testicular veins variations about 21% in a sample of 150 cadavers and are usually discovered by chance during surgeries or in routine dissections in anatomy laboratories (Nalikulzhy et al. 2018). Furthermore, such conditions can be explained by errors in the embryological development of the venous system and changes in the anastomotic canals

✉ Isadora Pedrão  
isadora\_pedrao@hotmail.com

<sup>1</sup> Department of Medicine, Faculty of Medicine of Catanduva, Rua dos Estudantes, 225 - Parque Iracema, Catanduva, SP, Brazil

<sup>2</sup> Department of Anatomy, Faculty of Medicine of Catanduva, Rua dos Estudantes, 225 - Parque Iracema, Catanduva, SP, Brazil

between the posterior, subcardinal, and supracardinal veins (Phalgunan et al. 2012).

In addition, it is essential to be aware of variations in gonad veins because of their involvement with surgeries involving the kidneys and gonads, radiology, ultrasound with Doppler of gonadal vessels, other retroperitoneal diagnostic, and therapeutic procedures (Biswas et al. 2006; Fernandes et al. 2012). These variations should also be considered in any case of surgeries around the renal pedicle such as embolization and resection of renal tumors, and resection of tumors in the testicles and cryptorchidism (Nallikuzhy et al. 2018).

Thus, it is possible to understand the importance of gonadal veins, which in addition to serving as a material available for vascular reconstruction, play an essential role in testicular thermoregulation, which is fundamental for the efficient functioning of the testicles, since it helps to reduce the high mutation potential to which y chromosomes are predisposed (Asala et al. 2001; Gupta et al. 2015). In view of the above, this case report objects to present an unusual anatomical variation found in a cadaver during a routine dissection of the anatomy laboratory of the Faculty of Medicine of Catanduva—Padre Albino University Center, and with it will be possible to raise awareness about the anatomical and physiological repercussions inherent to the variation of the gonadal vessels investigated.

## Materials and methods

In a routine dissection for the improvement of anatomical parts, it was observed in a human cadaver, belonging to the collection of the Padre Albino University Center, an anatomical variation in the drainage of the right gonadal

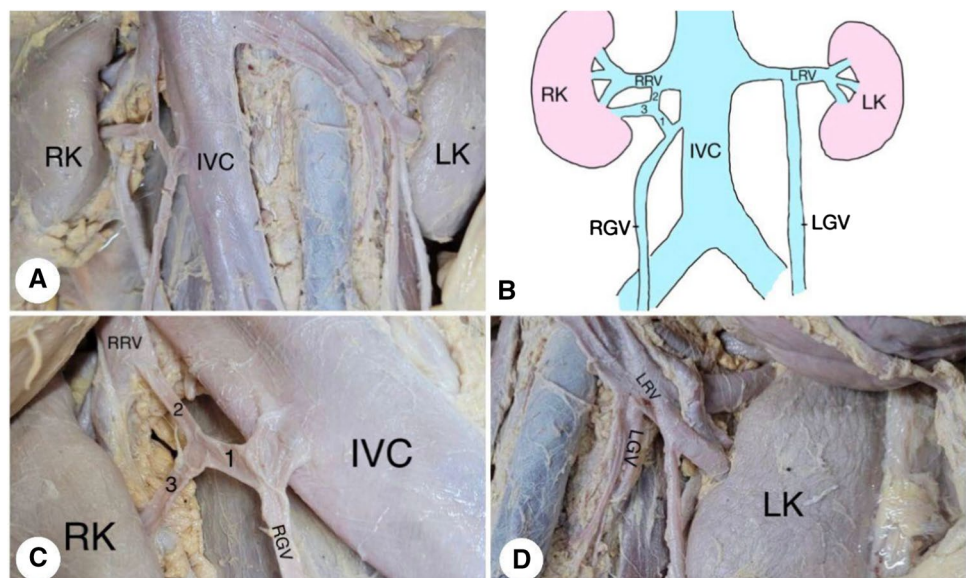
vein in the respective individual. The observed cadaver was obtained through an anonymous donation and is designated male; in addition, characteristics such as clinical history, ethnicity, and age cannot be determined, due to the absence of identification records in the institution. The authors hereby confirm that every effort was made to comply with all local and international ethical guidelines and laws concerning the use of human cadaveric donors in anatomical research and this analysis was approved by the Research Ethics Committee under protocol 12923919.8.0000.5430.

Dissection occurred in the anterior wall of the abdomen, and the vessels of the spermatic funiculus were located in the deep inguinal ring, advancing the cut in a cranial direction accompanying the two gonadal veins and their paths, noting the variation in drainage of the right gonadal vein. This case report was carried out based on a literature review in PUBMED, in which similar cases were not found, validating the rarity of anatomical variation reported in this study.

## Results

As visualized in Fig. 1, there is a panoramic figure of the study region (Fig. 1A) and a representative diagram (Fig. 1B) presenting the anatomical variations of the right gonadal vein and the most frequently configuration detected in the left gonadal vein (Fig. 1D). The right gonadal vein is observed in an ascending course and anastomosing with an innominate venous trunk that drains into the inferior vena cava. The presence of an accessory right renal vein can also be seen, which anastomoses with the innominate venous trunk and with the right renal vein, through a vein suggestively called interrenal. Through this venous anastomotic network, it is suggested that the right gonadal vein may drain

**Fig. 1** Anatomic and schematic view of both kidney hilum: **A** panoramic view exhibiting a venous drainage of both kidneys, **B** representative diagram of venous drainage, **C** a closer view of the region of interest (right kidney hilum), and **D** a closer view of the left kidney hilum. *RK* right kidney, *IVC* inferior vena cava, *LK* left kidney, *RRV* right renal vein, *LRV* left renal vein, *RGV* right gonadal vein, *LGV* left gonadal vein, *I* innominate venous trunk, *2* interrenal vein, *3* accessory right renal vein



indirectly into the inferior vena cava, right renal vein, and accessory right renal vein (Fig. 1C). All identified vessels were evaluated through a careful observational assessment.

It should be noted that this study aimed to describe the anatomical characteristics of the aforementioned vessels, making it impossible to assess the hemodynamics to confirm the path of blood through the venous network studied.

## Discussion

Testicular vessels are essential in the thermoregulation of the testicles (a necessary condition for spermatogenesis), and thus, it is evident that the knowledge of its anatomy and its possible variations has assumed great clinical and surgical importance due to the development of new surgical techniques performed in the abdominal cavity for conditions, such as varicocele, cryptorchidism, and kidney transplants (Dahr and Lal 2005). During laparoscopic surgeries of the abdomen and pelvis, most complications are due to unknown anatomy in the operative field, although the anatomy of these variations can be recognized preoperatively by selective angiography (Brohi et al. 2001; Nayak 2008). The knowledge of the variations of the gonadal vessels can provide safety guidelines for these techniques to occur with greater dexterity in the region of interest (Sharma et al. 2011).

The anatomical variations found in the drainage of gonadal veins occur due to embryological development errors, which involve regression, anastomoses, and replacement of postcardinal venous canals, supracardinal and subcardinals, related to the embryological origin of the inferior vena cava (Alejandra et al. 2016; Gupta et al. 2015; Rudloff et al. 2006). The renal segment of the IVC is formed by bilateral anastomosis between the subcardinal and supracardinal veins, while the testicular veins are constituted from the caudal part of the subcardinal vein and drain into the anastomosis between these two veins. While on the left side, this anastomosis between the subcardinal and supracardinal veins form part of the left renal vein (which justifies the site of drainage of the LGV to the LRV), on the right side, this anastomosis is incorporated into the formation of the IVC, which explains the venous drainage of the RGV to normally be to the IVC, characterizing the asymmetry in the venous drainage of these vessels (Rudloff et al. 2006; Sharma and Salwan 2011).

In the studied cadaver, a variation was found in the right gonadal vein, which divides and drains initially into the inferior vena cava and through an innominate trunk into the accessory renal vein. The accessory renal vein drains through an interrenal trunk into the right renal vein, which ultimately empties into the inferior vena cava. In relation to the drainage site, most of the variations already described are found mainly in the RGV, which in 83% of cases drains

into the IVC, 5% drains to the RRV and 12% drains for both. While the LGV, in 95% of cases, drains directly to the LRV (Favorito et al. 2007). In relation to the number of vessels, duplicate testicular veins are more commonly found on the left side (Favorito et al. 2007; Rudloff et al. 2006).

Therefore, in this case report, an anatomical variation was described in the gonadal vessels related to their drainage site, in which the right testicular vein presents a triple drainage. This type of drainage has not been reported in previous studies, making it unique and rare. Thus, it is extremely important to know about the variations of gonadal veins to perform procedures in the retroperitoneal region and improve the safety of surgical interventions.

**Acknowledgements** The authors thank the institution UNIFIPA for the availability of cadaveric parts to carry out the research and the professor responsible, Teacher Dr. Renato Rissi. In addition, the student Daniel Gregório Gonsalves, responsible for the scientific initiation of the Academic League of General Anatomy of the Faculty of Medicine of Catanduva, for their teachings and support during the development of the work. The authors sincerely thank those who donated their bodies to science, so that anatomical research could be performed. Results from such research can potentially increase humankind's overall knowledge that can then improve patient care. Therefore, these donors and their families deserve our highest gratitude.

**Author contributions** IP: medical student—writing, manuscript editing, and information collection. MTAV: medical student—writing, manuscript editing, and information collection. DGG: medical student—writing, manuscript editing, information collection, and project development and management. NMA: medical student—writing, manuscript editing, and information collection. AGS: medical student—writing, manuscript editing, and information collection. RR: professor—project development, data collection, and data analysis.

**Funding** The study has no financial or personal relationship with any third party whose interests could be influenced positively or negatively by the article's content. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

## References

- Alejandra M, Sofia M, Crihstian Juan P, Alejandro R, Eduardo O (2016) Rare termination of the right gonadic vein. *MOJ Anat Physiol* 2(6):177–178
- Asala S, Chaudhary SC, Masumbuko-Kahamba N, Bidmos M (2001) Anatomical variations in the human testicular blood vessels. *Ann Anat* 183(6):546–549
- Biswas S, Chattopadhyay JC, Wechalekar H, Anbalagan J, Ghosh SK (2006) Variations in renal and testicular veins –a case report. *Sharmistha Biswas, J.C.Chattopadhyay, H. Panicker, J. Anbalagan & S.K.Ghosh. 55:69–71*

- Brohi RA, Sargon MF, Yener N (2001) High origin and unusual suprarenal branch of a testicular artery. *Surg Radiol Anat* 23(3):207–208
- Dhar P, Lal K (2005) Main and accessory renal arteries - a morphological study. *Ital J Anat Embryol* 110(2):101–110
- Favorito LA, Costa WS, Sampaio FJB (2007) Applied anatomic study of testicular veins in adult cadavers and in human fetuses. *Int Braz J Urol* 33(2):176–180
- Fernandes JR, Strufaldi MB, Machado BDS, Nascimento SRR, Wafae N, Ruiz CR (2012) Bilateral duplication of gonadal veins: a case report. *Int J Morphol* 30(4):1487–1489
- Gupta R, Gupta A, Aggarwal N (2015) Variations of gonadal veins: embryological prospective and clinical significance. *J Clin Diagn Res* 9(2):8–10
- Nallikuzhy TJ, Rajasekhar SSSN, Malik S, Tamgire DW, Johnson P, Aravindhan K (2018) Variations of the testicular artery and vein: a meta-analysis with proposed classification. *Clin Anat* 31(6):854–869
- Nayak BS (2008) Multiple variations of the right renal vessels. *Singapore Med J* 49(6):168–170
- Phalgunan V, Mugunthan N, Rani DJ, Anbalagan J (2012) A study of renal and gonadal vein variations. *Natl J Clin Anat* 01(03):125–128
- Rosalino UAC, Latorre GC, Pinto AC, Toscano MP (2011) Uncommon drainage of the gonadal vein: case report. *J Morphol Sci* 28(2):135–136
- Rudloff U, Holmes RJ, Prem JT, Faust GR, Moldwin R, Siegel D (2006) Meso-aortic compression of the left renal vein (nutcracker syndrome): Case reports and review of the literature. *Ann Vasc Surg* 20(1):120–129
- Sharma P, Salwan SK (2011) Anomalous right testicular artery and vein: embryologic explanation and clinical implications. *J Clin Diagn Res* 5(8):1631–1633

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.