Journal of
Anatomy and Physiological Studies

CASE REPORT

Circumaortic Left Renal Vein Origin: Clinical and Surgical Implications

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Abstract

Academic dissection of an embalmed 90-year-old female cadaver revealed a unilateral variant in renal vascular anatomy, specifically a circumaortic left renal vein. This type of anatomic variant has been limitedly described in literature; however, there is little documentation about circumaortic left renal veins that drain to both the azygos vein and inferior vena cava. This case report describes the cadaveric findings in detail, outlines the embryological origin, and examines both the clinical and surgical implications.

Keywords: Kidney, Nephrology, Circumaortic Left Renal Vein, Embryology, Cadaveric Dissection, Transplant Surgery, Vascular Surgery and Nutcracker Phenomenon

Introduction

The kidneys are retroperitoneal organs that receive 20-25% of cardiac output and function in blood filtration and maintenance of fluid homeostasis [1]. Normally, each kidney has a single pair of vessels that includes the renal artery and renal vein, both located at the L2 vertebral level. The renal artery branches directly off the abdominal aorta and enters the renal hilum. The right renal vein drains directly into the inferior vena cava while the left renal vein, which is three times longer and courses across the midline between the superior mesenteric artery and abdominal aorta, drains into the inferior vena cava. These vessels are often established within the first eight weeks of embryogenesis and errors can lead to the development of vascular abnormalities. Knowledge of renal vasculature abnormalities is vital both clinically and surgically, especially due to the risk of hemorrhage in the setting of retroperitoneal surgery and subsequent need for transfusion.

Supernumerary veins refer to the presence of two or more unilateral or bilateral renal veins and include retro-aortic left renal veins and circumaortic left renal veins. There is some discrepancy as to the prevalence, however, a 2019 study conducted by Hostiuc et al. suggested the prevalence of supernumerary renal veins is 16.6% on the right-side and 2.1% on the left-side. Further investigation revealed that, of the 2.1% of left-sided variants, circumaortic left renal vein constituted a prevalence of 3.5% [2]. The objectives of this study are to present the cadaveric findings of a circumaortic left renal vein, explore the embryological origins, and the importance in identifying these renal vasculature variants in the clinical and surgical setting.

Case Information

During routine academic dissection of a 90-year-old female cadaver, a circumaortic left renal vein was identified. The circumaortic left renal vein was located posterior to the left main renal vein and left renal artery and bifurcated approximately 1.2 cm from the renal hilum. The superior branch of the circumaortic left renal vein joined the azygos vein at the T12 vertebral level and measured 4.5 cm in length. The inferior branch of the circumaortic left renal vein passed posterior to the abdominal aorta prior to joining the inferior vena cava at the L3 vertebral level and measured 7.2 cm in length. The left main renal vein followed the typical path and terminated in the inferior vena cava. The communicating branch of the azygos vein was identified at the T8/9 vertebral level. The left kidney was noted to have a single renal cyst that measured 1.6 cm in diameter (Figure 1 and 2).

Discussion

The kidney develops during the 4th to 8th weeks of embryogenesis, during which errors may give rise to abnormal renal vascular variants. This process begins with a network

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Received: May 08, 2022; **Accepted:** May 10, 2022; **Published:** May 14, 2022

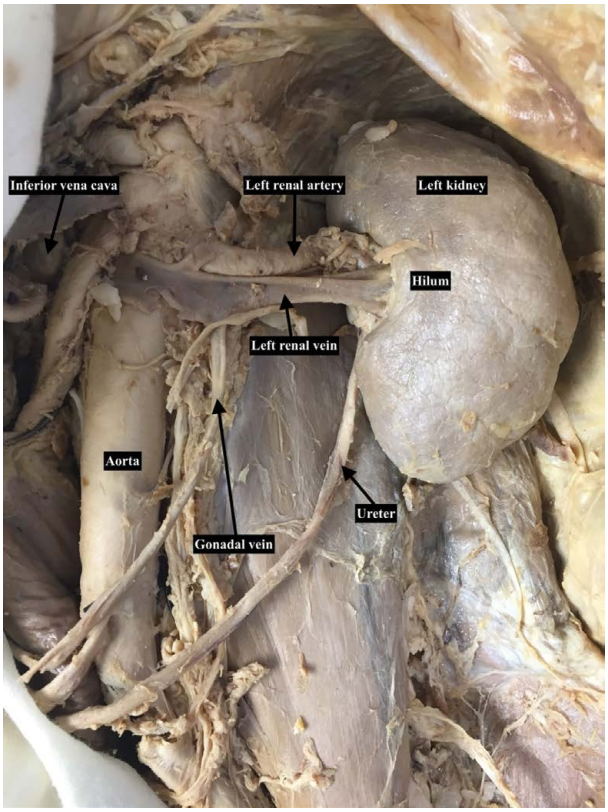

Figure 1: Cadaveric image of normal anatomy pertaining to the kidney and its vasculature.

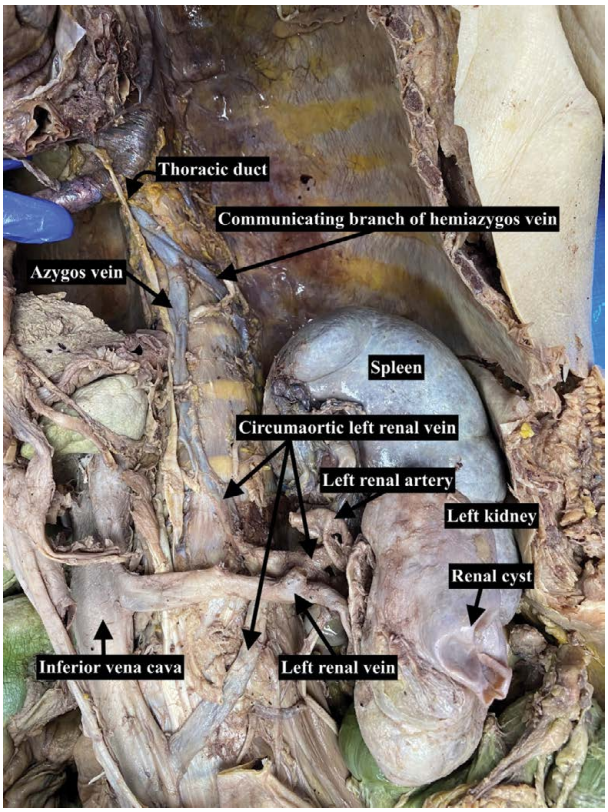

Figure 2: Cadaveric image depicting the presence of circumaortic left renal vein that bifurcates and the inferior branch drains directly into the inferior vena cava and superior branch drains into the azygos vein. Communicating branch of the hemiazygos vein is indicated.

composed of three pairs of parallel veins – posterior cardinal, subcardinal, and supracardinal veins. An anastomosis between the subcardinal and supracardinal veins give rise to the pre-aortic (ventral limb) and post-aortic (dorsal limb) segments of the renal collar. Ultimately, the post-aortic segment degenerates and the persistence of the pre-aortic segment gives rise to the main renal vein. When both the pre-aortic and post-aortic segments persist throughout embryogenesis, supernumerary renal veins may develop [3,4].

According to Gillot, there are three main types of circumaortic left renal veins – 1) presence of partial distal bifidity, in which the retro-aortic branch receives the root of the hemiazygos; 2) presence of partial proximal bifidity, in which the origin is separated, and the two branches join together in front of the aorta; and 3) presence of two distinct, thick trunks exiting the hilum and remain separated until the ending in the inferior vena cava [5]. The circumaortic left renal vein identified in this cadaver did not follow the three main types described by Gillot in that it presented with a distal bifidity, in which the retro-aortic branch received the root of the azygos vein.

There are several clinical correlates that correspond with abnormal renal vasculature, including nutcracker phenomenon, hemorrhage involving retroperitoneal surgery, and other clinical syndromes. The nutcracker phenomenon is characterized by decreased space between the aorta and vertebrae, which can cause compression of the renal vein or supernumerary renal vein resulting in hematuria and left renal vein hypertension. In fact, it is important to incorporate circumaortic left renal veins in the list of differentials for microscopic hematuria [6]. In surgical cases that require retroperitoneal access, including nephrectomy, abdominal aortic aneurysm repair, and transplant surgery, it is important to visualize and clamp any supernumerary veins due to risk of avulsion during mobilization of the kidney that will result in hemorrhage. Computed tomography and computerized tomographic venography are tools essential for identify vascular anomalies such as circumaortic left renal veins and other supernumerary renal veins [4]. The aforementioned clinical and surgical scenarios illustrate the importance of identifying circumaortic left renal veins, which can be done using advanced radiographic imaging, in order to properly work up the microscopic hematuria and minimize adverse outcomes in the surgical setting.

Acknowledgements

The students and faculty of the University of North Texas Health Science Center would like to express their gratitude to the donors of our Willed Body Program. Their gifts have made countless research and educational opportunities possible, and for this, we thank them.

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Citation: Vo R, Norris A, Fisher CL (2022) Circumaortic Left Renal Vein Origin: Clinical and Surgical Implications. J Anat Physiol Stud 6(1): 001-003.