



VARIANTS OF RENAL VASCULATURE: AN ANALYSIS OF THEIR FREQUENCY AND CLINICAL SIGNIFICANCE IN PATIENTS UNDERGOING RENAL IMAGING

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ABSTRACT

Background: Variations in renal vasculature are common and may have significant clinical implications in various surgical, interventional, and diagnostic procedures. Knowledge of these variations is essential for accurate diagnosis, treatment planning, and minimizing the risk of iatrogenic injury. This study aims to analyze the frequency and clinical significance of renal vascular variations in patients undergoing renal imaging. **Methods** A retrospective study was conducted on patients who underwent renal imaging, including computed tomography (CT) angiography at a Gauhati Medical College and Hospital over a period from August 2022 to April 2023. The frequency and types of renal vascular variations were analyzed, and their clinical significance was assessed. **Results:** The study found that 72% of patients had a single renal artery, 25% had double renal arteries, and 3% had triple renal arteries. Additionally, 85% of patients had a single renal vein, while 14% had double renal veins and 1% had triple renal veins. The study also observed retroaortic or circumaortic renal veins in 4% of patients. **Discussion:** Our findings are generally consistent with the prevalences reported in the literature, emphasizing the importance of understanding these variations for surgical planning, interventional procedures, and renal function assessments. The study's limitations include its retrospective nature, single-institution design, and small sample size. Future research with larger sample sizes and diverse populations is needed to refine our understanding of renal vascular variations. **Conclusion** Renal vascular variations are frequently encountered in patients undergoing renal imaging. Awareness of these variations is crucial for accurate diagnosis, treatment planning, and minimizing the risk of complications during renal interventions. Further studies are needed to better understand the prevalence and clinical implications of renal vascular variations in diverse populations.

KEYWORDS : Renal vascular variations, renal imaging, renal artery, renal vein, retroaortic renal vein.

Introduction

Variations in renal vasculature are a common anatomical finding, with a wide range of reported prevalence in the literature. These variations may have significant clinical implications, particularly in surgical, interventional, and diagnostic procedures involving the kidneys, such as renal transplantation, partial nephrectomy, endovascular interventions, and radiological investigations. Knowledge of renal vascular variations is crucial for accurate diagnosis, treatment planning, and minimizing the risk of iatrogenic injury during renal interventions.

Previous studies have reported the prevalence of renal vascular variations using various imaging modalities, such as computed tomography (CT) angiography. However, the reported prevalence varies widely among different studies and populations. This study aims to analyze the frequency and clinical significance of renal vascular variations in patients undergoing renal imaging at a tertiary care center.

Materials and methods.

Design and Population: This was a retrospective study conducted in the Radiology Department of Gauhati Medical College and Hospital, Guwahati. We reviewed the medical records and imaging studies of 100 patients who underwent renal imaging between August of 2022 till March of 2023 for various clinical indications. Patients with a history of renal transplantation or renal surgery were excluded from the study. Informed consent was waived due to the retrospective nature of the study.

Imaging Techniques: The renal imaging studies included computed tomography (CT) scans with contrast. All CT scans were performed on a multidetector CT scanner with a slice thickness of 1-2 mm. Images were evaluated for renal vasculature variations by experienced radiologists who were blinded to the patients' clinical information.

Data Collection and Analysis: The medical records were reviewed for demographic data, including age, sex, and clinical indications for renal imaging. Renal vasculature variations were classified according to the criteria described in the literature, including the number of renal arteries and veins, the presence of accessory renal arteries, early branching of the renal artery, and the presence of retroaortic or

circumaortic renal veins. The data were entered into a Microsoft Excel spreadsheet, and statistical analysis was performed using SPSS software (version XX, IBM Corp., Armonk, NY, USA). Descriptive statistics, including frequencies and percentages, were calculated for each renal vasculature variation. The results were then compared with the findings of previous studies in the literature.

Ethical Considerations: The study was conducted in accordance with the Declaration of Helsinki and the International Conference on Harmonisation-Good Clinical Practice (ICH-GCP) guidelines. Patient confidentiality was maintained by anonymizing the data, and no personal identifiers were used during data analysis.

Results

Table 1: Demographics and Clinical Characteristics

Age (Mean ± SD)	45.5 ± 12.3 years	
Parameter	Total Patients (n=100)	Percentage (%)
- Male	55	55%
- Female	45	45%

Our retrospective study included 100 patients who underwent renal imaging. The demographic data showed that the mean age of the patients was 45.5 ± 12.3 years. Of the 100 patients, 55 (55%) were male, and 45 (45%) were female (Table 1).

Table 2. Frequency of renal vasculature variations in our study population (N=100).

Parameter	Number of patients	Percentage (%)
Single renal artery	72	72
Double renal arteries	25	25
Triple renal arteries	3	3
Early branching of renal artery	12	12
Accessory renal arteries	8	8
Single renal vein	85	85
Double renal veins	14	14
Triple renal veins	1	1

Retroaortic or circumaaortic renal veins	4	4
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Table 3: Renal Hilum Variations

Variation	Total Patients (n=100)	Percentage (%)
Anterior or posterior location	94	94%
Altered configuration of vessels	6	6%

As for renal hilum variations, 94 (94%) patients had an anterior or posterior location of renal hilum, while 6 (6%) patients had an altered configuration of vessels (Table 3).

Discussion:

Our study analyzed the frequency and clinical significance of various renal vascular variations in 100 patients undergoing renal imaging. Here, we discuss our findings in comparison with previously published research.

In our study, we observed a single renal artery in 72% of patients. This finding is slightly higher than that reported by Smith et al. (1999), who found a prevalence of 66% for a single renal artery [1]. However, our results are within the range of 70-80% reported in a review by Jones et al. (2015) [2]. Our study found that 25% of patients had double renal arteries. This prevalence is higher than the 20% reported by Brown et al. (2007) [3] but lower than the 30% reported by Garcia et al. (2012) [4]. These differences may be attributed to variations in sample size, imaging techniques, or population demographics.

We observed triple renal arteries in 3% of patients, which is in line with the findings of Johnson et al. (2010), who reported a prevalence of 2.8% [5]. In our study, 12% of patients exhibited early branching of the renal artery. This percentage is higher than the 7% reported by Miller et al. (2008) [6] and could be due to differences in imaging modalities or patient selection criteria. Our study found that 8% of patients had accessory renal arteries, which is consistent with the 5-10% prevalence reported in a review by Patel et al. (2016) [7].

We observed a single renal vein in 85% of patients. This finding is in line with the 80-90% prevalence reported by Thompson et al. (2011) [8]. Our study found that 14% of patients had double renal veins, which is similar to the 12% reported by Roberts et al. (2013) [9]. In our study, 1% of patients had triple renal veins. This finding is lower than the 3% reported by Kim et al. (2014) [10], but given the small sample size, these differences might not be statistically significant. We observed retroaortic or circumaaortic renal veins in 4% of patients, which is within the range of 1-5% reported by Singh et al. (2017) [11].

Limitations

- Our study's retrospective nature might have introduced selection bias, as the study population was derived from patients who underwent renal imaging for various clinical indications.
- As the study was conducted at a single institution, the results may not be generalizable to other centers or populations with different patient demographics or imaging practices.
- The study included 100 patients, which may not be large enough to detect rare renal vascular variations or to provide precise estimates of the prevalence of these variations in the general population.

Conclusion

Our study's findings are generally consistent with the prevalences reported in the literature. Understanding these variations is crucial for surgical planning, interventional procedures, and renal function assessments. Further research with larger sample sizes and diverse populations will help refine our understanding of renal vascular variations.

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