RESEARCH ARTICLE

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Renal Artery Variations and Clinical Implications: CT Angiography Study in Turkish Republic of North Cyprus Population

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Abstract

BACKGROUND/AIMS: Arteries of the kidneys [renal arteries (RA)] typically emerge from the sides of the abdominal aorta usually at the intervertebral disc level between the lumbar 1st and 2nd vertebrae. Due to the large quantity of renal surgeries and urological and radiological procedures, awareness of renal artery anomalies has gained importance. In this study, we aimed to examine the variations in RA within the Turkish Republic of North Cyprus (TRNC) population.

MATERIALS AND METHODS: Multidetector computed tomography angiography examinations of 108 patients were retrospectively analyzed to document the origins of the RA alongside the presence and quantity of the accessory RA.

RESULTS: RA variations were detected in 32 patients and classified into five categories. In type 1, a unilateral accessory renal artery on the right side (RaccRA) was observed in 13 patients (40.6%). In type 2, a unilateral accessory renal artery on the left side (LaccRA) was observed in 14 patients (43.8%). Type 3 was characterized by the bilateral accessory RA and was found in 3 patients (9.4%). Type 4 consisted of one case with 2 accRRA (3.1%). Type 5 was characterized by 2 RaccRA and 1 LaccRA, which reached the left renal hilum by ascending towards the left renal artery, and was encountered in only one case (3.1%).

CONCLUSION: Supernumerary RA should be considered during procedures such as vascular surgery, nephrectomy, kidney transplants, biopsies, and interventional radiology to prevent complications that could lead to kidney failure or ischemia. Further studies with larger sample sizes are needed to better understand the prevalence and clinical implications of supernumerary RA in the TRNC population.

Keywords: Renal artery, accessory renal artery, CT angiography, renal transplant

INTRODUCTION

Each kidney receives a substantial volume of blood from the heart: about 20% of cardiac output.¹ This large blood supply enables the kidneys to filter blood efficiently. The renal arteries (RA) supply blood to the kidneys and typically branch off from the abdominal aorta (AA).² They emerge just below the superior mesenteric artery, at the level of the intervertebral disc between the first and second lumbar vertebrae (L1-L2).^{13,4} In approximately 70% of the population, each kidney is supplied by a single RA.^{14,5} Each segmental branch supplies a distinct region of the kidney. Understanding RA variations is crucial

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Copyright[©] 2025 The Author. Published by Galenos Publishing House on behalf of Cyprus Turkish Medical Association. This is an open access article under the Creative Commons AttributionNonCommercial 4.0 International (CC BY-NC 4.0) License. for clinicians performing surgeries or other interventional procedures on the kidneys.³

Accessory RA, also known as supernumerary or multiple RA, emerge from the aorta (25% of cases) or from another source, such as one of the mesenteric, lumbar, or thoracic arteries.² The origin and number of accessory RA vary and are influenced by renal embryogenesis, as the failure to eliminate mesonephric arteries leads to supernumerary RA.^{1,4,6,7} With the increase in kidney transplants, renal laparoscopy, vascular reconstruction, and various surgical, urological, and radiological procedures, awareness of RA variations has become crucial.^{1,3,4}

Accessory RA occur unilaterally in 25% of cases (equally on each side) and bilaterally in 10% of cases, entering the kidney at the renal hilum, superior pole, or inferior pole.¹ The widespread use of multidetector computed tomography (CT) angiography (CTA) has enhanced knowledge about the deviations in the arterial blood supply to the kidneys.³

This study aims to investigate RA variations in the Turkish Republic of North Cyprus (TRNC) population using CTA and to compare the findings with existing literature. To our knowledge, this is the first study to investigate RA variations in the TRNC population.

MATERIALS AND METHODS

This study was piloted in collaboration with the Anatomy and Radiology departments of Near East University, Faculty of Medicine, Lefkosa, TRNC.

One hundred and eight CTA images of 25 female and 83 male patients in the population of the TRNC were retrospectively evaluated. In this study, the vertebral level where the RA originate from the AA as well as the numbers and branching patterns of the existing accessory arteries were taken into consideration.

The study received approval from the Near East University Ethics Committee (approval number: 2019/73-906, date: 24.10.2019).

Statistical Analysis

RA variations were detected in 32 of 108 patients and grouped in five categories (Table 1).

Table 1. Renal artery variations were detected in 32 cases out of 108 CTA images (29.6%). Five types of cases were grouped according to the numbers, sides, and branching patterns of the accessory renal arteries. Blue lines represent the abdominal aorta and the main renal arteries, while yellow lines represent the right and/or left accessory renal arteries

	types of the RA variations	number of the cases (n)	branching patterns of the renal arteries coming out of the abdominal aorta				ę
	type 1	13	x3 📥	x7 🕂	x3		40,6
	type 2	14	x3 丰	x6 丰	×4 🕇	x1 🕂	43,8
	type 3	3	x2 丰	x1 냙			9,4
	type 4	1	×1 沣				3,1
	type 5	1	×1 🚶				3,1
	TOTAL	32					100
RA: Renal artery, CTA: Computed tomography angiography.							

RESULTS

RA variations were observed in 32 patients and categorized into five types (Table 1):

Type 1: Unilateral right accessory renal artery (RaccRA) in 13 patients (40.6%) (Figure 1).

Type 2 was found: Unilateral left accessory renal artery (LaccRA) in 14 patients (43.8%) (Figure 2).

Type 3: Bilateral accessory RA on each side in 3 patients (9.4%) (Figure 3).

Type 4: Two RaccRAs in 1 patient (3.1%).

Type 5: Two RaccRAs and one LaccRA ascending toward the left RA, reaching the left renal hilum, in 1 patient (3.1%) (Figure 4).



Figure 1. Type 1: the RaccRA runs inferior to the main renal artery. RRA: Right renal artery, LRA: Left renal artery, RaccRA: Right accessory renal artery.



Figure 2. Type 2: the early segmental branches originated from the short main RRA, while LaccRA originated from the lateral aspect of the AA superior to the LRA and crossed the main artery to enter the renal hilum.

RRA: Right renal artery, LaccRA: Left accessory renal artery, AA: Abdominal aorta, LRA: Left renal artery.





RRA: Right renal artery, LRA: Left renal artery, RaccRA: Right accessory renal artery, LaccRA: Left accessory renal artery.



Figure 4. Type 5: 2 RaccRAs one on the inferior and another on the superior to the main renal artery (RRA). LaccRA is reaching the left renal hilum by ascending towards the LRA.

RRA: Right renal artery, LRA: Left renal artery, RaccRA: Right accessory renal artery, LaccRA: Left accessory renal artery.

DISCUSSION

While a single RA supplies each kidney in 70% of cases, this study found RA variations in 32 of the 108 cases (29.6%), consistent with literature findings.^{1,4,5,8}

In our study, type 1 consisted of a unilateral RaccRA, while type 2 involved a unilateral LaccRA. All accessory RA in this sample originated from the AA, in line with other studies, although the literature notes rare cases where accessory RAs arise from other sources, like the inferior or superior mesenteric artery, lumbar, iliac arteries, or other visceral sources.^{1,4} Abba et al.⁴ in their case report, found an accessory right RA originating from the AA at the level of L3 vertebra in a male cadaver.

Prehilar branching was noted in 3.1% of cases in our study. In the study by Kornafel et al.⁵, prehilar branching was found in 24 (11.9%) patients.

Additionally, we observed bilateral accessory RAs in 3 cases (9.4%), which aligns with the literature. Kornafel et al.⁵ found bilateral accessory RAs in 20 (10%) patients.

Previous literature has documented cases with 2-6 RAs on one side (commonly the right). In this study, the maximum number of RA observed was 5, found in a case with 2 RaccRA, and 1 LaccRA (Figure 4). Interestingly, accessory RA were seen in 12% of female CTAs compared to 35% of male CTAs, a variation that has shown significant differences across populations.

Given the risk of anastomotic complications due to the presence and complicated branching patterns of accessory RA, patients with these deviations are generally not preferred as surgical donors.^{7,8}

Study Limitations

Our study has some limitations. The most important limitation is the small size of the study group. We believe that further studies with larger study groups may reveal new, previously unreported variations of CT. The second limitation is the low quality of some figures due to patient-related factors or technical issues.

CONCLUSION

Supernumerary RA should be considered during procedures such as vascular surgery, nephrectomy, kidney transplants, biopsies, and interventional radiology to prevent complications that could lead to kidney failure or ischemia. Further studies with larger sample sizes are needed to understand better the prevalence and clinical implications of supernumerary RA in the TRNC population.

MAIN POINTS

- About 30% of populations have accessory renal arteries (RA).
- The origin and number of accessory RA vary and are influenced by renal embryogenesis.
- The variations in renal vascularity should be considered during procedures to prevent complications that could lead to kidney failure or ischemia.

ETHICS

Ethics Committee Approval: The study received approval from the Near East University Ethics Committee (approval number: 2019/73-906, date: 24.10.2019).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Y.K., Concept: Y.K., M.T., Design: Y.K., M.T., Data Collection and/or Processing: Y.K., M.T., Analysis and/or Interpretation: Y.K., M.T., Literature Search: Y.K., M.T., Writing: Y.K., M.T.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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