

Morphological Comparative Study Of Human Renal Arteries In Cadavers And In Computed Tomography Scans

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Abstract: Background: The kidneys are vital organs of urinary system. The primary function of the urinary system is removal of metabolic waste from the body. The blood supply of any organ reflects its functional importance. This is true with the kidneys and its blood supply too. The right and left kidneys receive their blood supply from the lateral branches of the abdominal aorta, that is respectively from the right and the left renal arteries. These renal arteries are known to exhibit variations. These variations are encountered routinely during the dissection of cadavers. The knowledge of such variations is important for the clinicians and the surgeons. The recent advances in radiological techniques (CT scan) allow study of arterial system with good precision. This study is therefore planned with an aim to study and compare morphology of human renal arteries in cadavers and using Computed tomography scans in living individuals. Material And Methods: The study was conducted on 36 formalin fixed cadavers and on 36 computed tomographic(CT) angiograms of renal arteries. The parameters measured included mode of termination and the branching pattern of renal arteries. Statistical analysis of the data was carried out to find out the mean and standard deviation (SD). Result: 68.5% to 86.1% peri hilar mode of termination and 13.8% to 31.4% hilar mode of termination was found in cadavers. While both type of mode of termination in CT angiograms was found to be around 44.4% to 55.5%. In cadavers as well as in CT angiograms 43.7% to 70% was P1 branching pattern. Conclusion: The mode of termination of renal artery in cadavers was peri hilar in 77.4% and hilar in 22.5% cases and in CT study mode of termination of renal artery was peri hilar in 50% and hilar in 50%. The branching pattern of renal artery in case of peri hilar division in majority of cases is P1 that is posterior artery was the first branch of renal artery. [Chowki P Natl J Integr Res Med, 2021; 12(2):18-21]

Key Words: Aorta, Cadavers, Computed Tomography Scans, Kidney, Renal artery.

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Introduction: The kidneys are vital organs of the urinary system. The primary function of the urinary system is removal of metabolic waste from the body¹. The blood supply of any organ reflects its functional importance. This is true with the kidneys and its blood supply too. The right and left kidneys receive their blood supply from the lateral branches of the abdominal aorta, that is respectively from the right and the left renal arteries. The variation of renal arteries is common findings in human anatomy. These variations are routinely encountered while studying gross human anatomy by dissection of cadavers. The recent advances in radiological techniques allow study of gross human anatomy in living individuals also. But unfortunately, there is scarcity of this data in an Indian population. Also, there is dearth of comparative studies done on cadavers and in living. This study was thus planned with an aim to study and compare the morphology of human renal arteries in Cadavers and in Computed Tomography Scans.

Materials and Methods: The study was conducted on 36 formalin fixed cadavers and on 36 computed tomographic angiograms of renal arteries. Thus, data of 71 formalin fixed kidneys (36 right and 35 left side, in one cadaver left kidney was absent) and 72 renal arteries on computed tomographic angiograms (36 right and 36 left side) were studied. The cadavers were dissected and studied in the Department of Anatomy of a teaching institute and CT scans data was obtained from the Department of Radiology of a tertiary care hospital. The data (reports) of computed tomographic scans were taken retrospectively from the medical records on DVD. The various parameters were measured using DICOM (Digital Imaging and Communications in Medicine) viewer software. Institutional ethics committee permission was taken. In cadavers, after manual dissection, the mode of termination of renal arteries is noted (Fig. 1).

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Peri Hilar: When the renal artery terminated by dividing into segmental branches before reaching the hilum of the kidney is recorded as peri hilar mode of termination. **Hilar:** When the artery crosses plane joining medial surfaces of both the poles of kidney is recorded as hilar mode of termination. To study branching pattern in peri hilar mode of termination, Fine and Keen (1966)² classification is used. Branching pattern in hilar mode of termination was not studied. Considering the upper, middle and lower

segmental arteries as primary branches, the branching pattern of renal arteries in cases of peri hilar termination is recorded as; **P1:** where the posterior artery was the first branch of renal artery. **L1:** where the lower artery was the first branch of renal artery. **U1:** where the upper artery was the first branch of renal artery. **Triple:** where the renal artery divides into three branches. Similar parameters were measured in computed tomography scans using tools in the DICOM viewer software (Fig.2).

Fig. 1: Illustration Showing Dissected Kidneys In A Cadaver

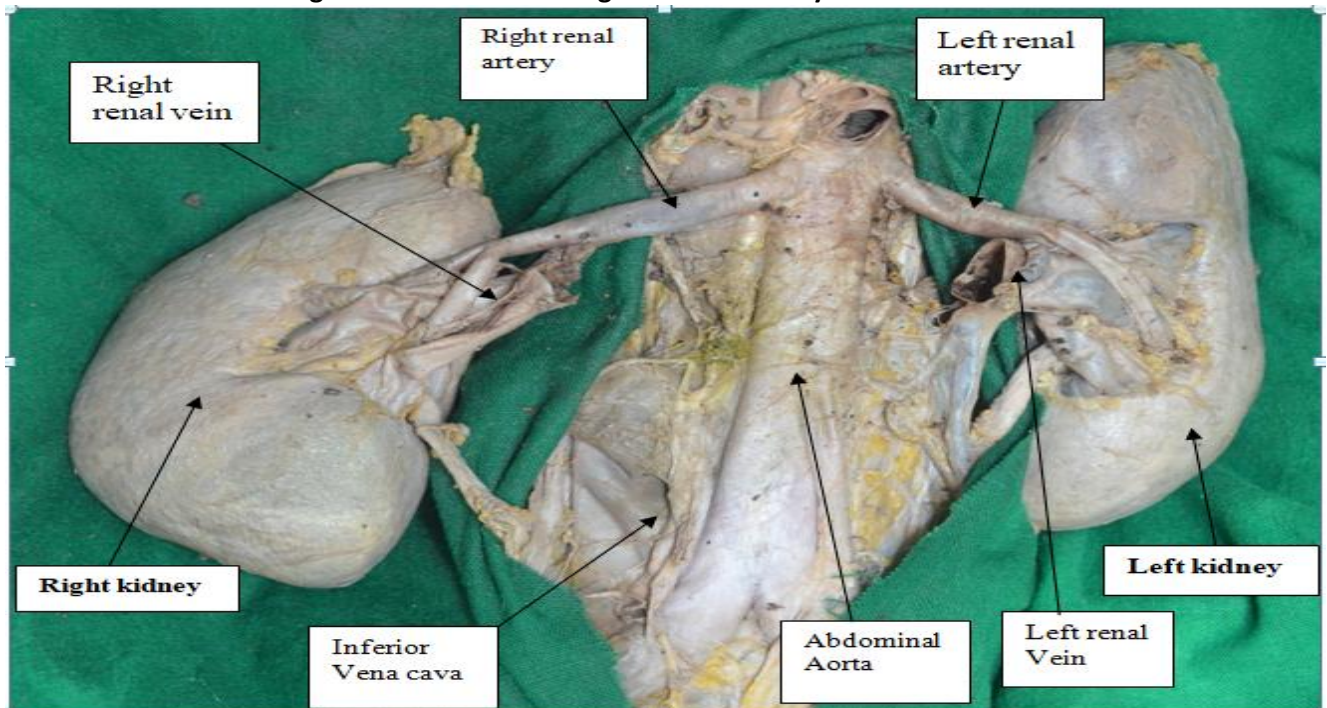
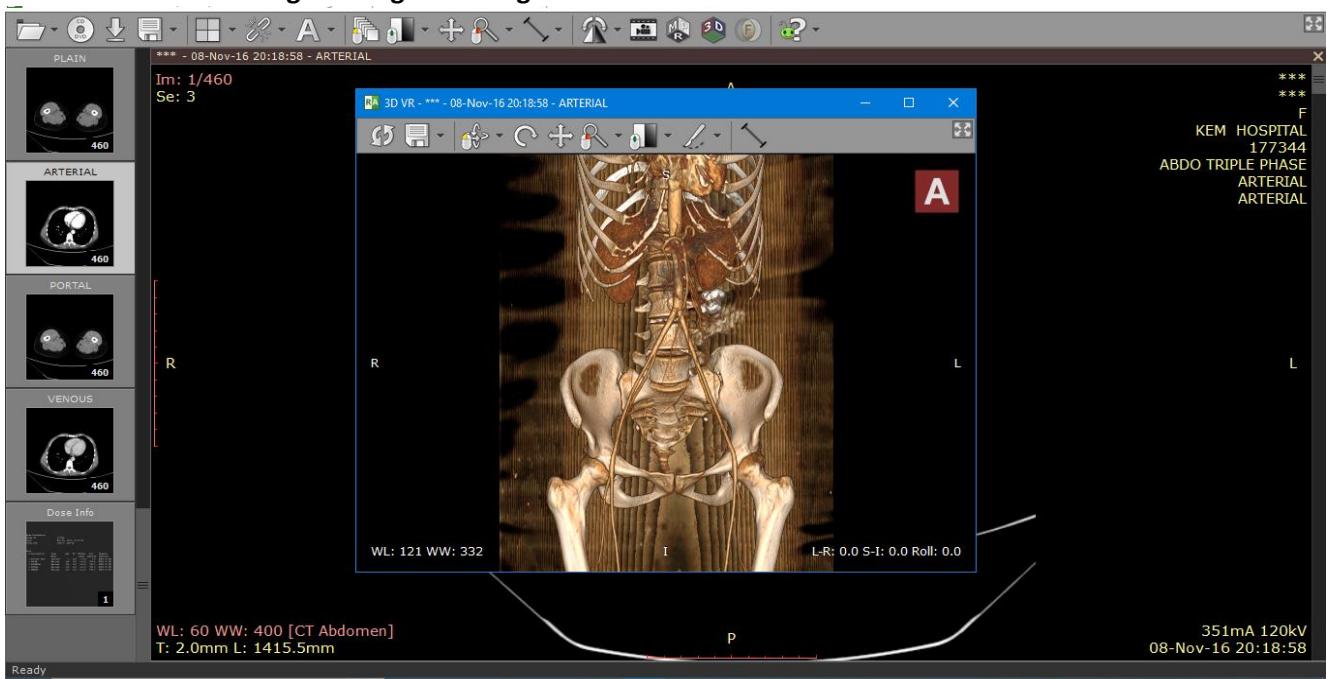


Fig. 2: Image Showing Screen Shot Of DICOM Viewer Software



Results: Results are as follows.

Table 1: Mode Of Termination Of Renal Artery

Type Of Study	Side	Peri Hilar	Hilar	Total (N)
Cadaveric	Right	31 (86.1%)	05 (13.8%)	36
	Left	24 (68.5%)	11 (31.4%)	35
CT Angiogram	Right	16 (44.4%)	20 (55.5%)	36
	Left	20 (55.5%)	16 (44.4%)	36

In the cadaveric study out of the 36 right renal arteries studied, 31 arteries terminated in peri hilar region of kidney and 5 renal arteries were seen to terminate in hilar region. While out of the 35 left renal arteries that were studied 24 renal arteries were seen to terminate in peri hilar region and 11 in hilar region.

Out of total 72 CT studies of renal arteries it was found that on the right side 16 renal arteries terminated in peri hilar region and 20 in hilar region. While on the left side, 20 renal arteries terminated in peri hilar region and 16 in hilar region.

Table 2: Branching Pattern Of Renal Artery

Type Of Study	Side	P1	L1	U1	Triple	Total
Cadaveric	Right	15 (48.3%)	07 (22.5%)	09 (29.0%)	00	31
	Left	12 (50%)	06 (25%)	05 (20.8%)	01(4.1%)	24
CT Angiogram	Right	07 (43.7%)	05 (31.2%)	04 (25%)	00	16
	Left	14 (70%)	03 (15%)	03 (15%)	00	20

Discussion: In the present study on cadavers, 86.1% of both renal arteries each show peri hilar termination while 13.8% of right and 31.4% of left renal artery shows hilar termination. While in CT Angiography, no much difference is seen in hilar and peri hilar termination of renal artery percentage wise.

There were very few studies similar to the present study in the literature. The studies with similar parameters were segregated, compared and analysed. The following are the comparative findings.

Table 3: Comparison Of Mode Of Termination Of Renal Artery

Study	Type	Sample size (N)	Peri Hilar		Hilar	
			Right	Left	Right	Left
Budhiraja V ³	Cadaveric	84	33.3%	28.5%	66.7%	71.5%
Sampaio and Passos ⁴	Cadaveric	266	53.3%		46.7	
Ozkan et al. ⁵	DSA*	855 patients	8%		92%	
Ephraim V K ⁶	Cadaveric	64	33%		67%	
P. Sasikala ⁷	Cadaveric	50	44%		56%	
	CT	50	48%		52%	
Present study	Cadaveric	71	86.1%	68.1%	13.8%	31.4%
	CT Angiogram	72	44.4%	55.5%	55.5%	44.4%

*DSA: Digital subtraction angiography

In the current study, on the CT Angiogram analysis, the percentage of renal arteries with peri hilar and hilar termination is almost similar to the study done by P. Sasikala⁷. The similarity could be attributed to the similar study

population (Indian origin). In the cadavers, percentage of the renal arteries with peri hilar termination is greater than other studies mentioned in above table. This can be attributed to diversity of variations routinely present in renal system.

Table 4: Comparison Of Branching Pattern Of Renal Artery

Study	Type	Sample size (N)	P1	L1	U1	Tripple
Fine and Keen ²	Cast	107	53.3%	38.3%	4.7%	12%
Sampaio and Passos ⁴	Cadaveric	266	-	5.3%	6.8%	-
R. Shalini ⁸	Cadaveric	60	38.3%	23.3%	10%	3.7%

Present study	Cadaveric	55	38%	18.3%	19.7%	1.4%
	CT Angiogram	36	29.1%	11.1%	9.7%	0%

The above table shows the branching pattern of renal artery with peri hilar termination. In the present study in 38% of cadavers and 29.1% of CT Angio studies, the perihilar termination is recorded as P1 that is posterior artery was the first branch of renal artery. This finding is almost in a line with study done by R. Shalini⁸. The similarity here could be again attributed to the similar study population (Indian origin).

The remaining types of branching pattern i.e L1, U1 & Triple pattern were also compared with similar studies, but there was no comparison seen. This could be attributed to the relatively small sample size in the present study.

Conclusion: The mode of termination of renal artery in cadavers was peri hilar in 77.4% and hilar in 22.5% cases and in CT study mode of termination of renal artery was peri hilar in 50% and hilar in 50%. The branching pattern of renal artery in case of peri hilar division in majority of cases is P1 that is posterior artery was the first branch of renal artery.

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