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ORIGINAL RESEARCH

A comparative study of Bilateral Accessory Renal Artery in Male and Females with different parameters

Dr. Bhimsen Tyagi[1], Shaily Saxena[2], Dr.(Major)Vinay Kumar[3]

[1]Associate Professor, Department of Anatomy, Venkateshwar University, Gajraula, U.P.
[2]Tutor, Department of Anatomy, Venkateshwar University, Gajraula, U.P, India.
[3]HOD & Professor, Department of Anatomy, Venkateshwar University, Gajraula, U.P,India.

Correspondence:
Shaily Saxena
Tutor, Department of Anatomy, Venkateshwar University, Gajraula, Uttar Pradesh, India

ABSTRACT

Background- Accessory renal arteries are very common variant in humans, it may be or not bilateral, vestigial structure that develops during the ascent of the kidney from the pelvis to the lumbar region. The purpose of this study to evaluate and compare the frequency, Length, Diameter of Accessory renal artery in male and females of Western U.P. Population.

Method and Material- The data was collected by using CT Scan machine G.E 64 slice with software Syngo angiography of 100 patients was collected. CT angiography scan was made and thin slices (0.6 mm) axial images were obtained. The frequency of accessory renal arteries, Length and Diameter can be evaluated & compared in male and females subjects. A correlation is considered significant when $p < 0.05$. For comparing continuous variables, the t-test was applied. All the statistical analysis was done by SPSS software.

Result- In this study, Ct angiogram more than 50 males and 50 females subjects were included and 37 ARA out of 100 subjects is present. Accessory renal arteries are present in 31% of cases. 5% ARAs present at Rt side, 20% ARAs present at left side, and 6% ARAs present Bilaterally. The frequency of accessory renal arteries are present in male cases(21%) more than female(10%).

Mean length of ARA in RT side in case of male is 41.57±10.41mm and in case of female 39.32±11.7mm. and on LT side length of ARA in male is 48.36±15.44mm and female is 44.33±12.17mm. Diameter of ARA from origin in RT side in case of male is 2.30±0.40 mm and in case of female is 1.82±0.45mm and on LT side in case of male is 2.26±0.78mm and in case of female is 2.38±0.78mm.

Conclusion- This Publication highlights the importance of the recognition of the presence of renal artery variants if surgical procedures are indicated in Western UP. Moreover, CT Angiography can reveal pathologies of the renal arteries of the kidneys.

Keyword- Accessory Renal Artery, Diameter, Length, Abdominal Aorta.

INTRODUCTION

Kidney is supplied by renal artery which is branch of abdominal aorta. Right renal artery is longer than left renal artery, because abdominal aorta lies on the left side of vertebral column. Accessory renal arteries and their positions are common (30% of individuals), and usually arise from the aorta above or below (most commonly below) the main renal artery and follow it to the renal hilum. They are regarded as persistent embryonic lateral splanchnic arteries. Accessory vessels to the inferior pole cross anterior to the ureter and may, by obstructing the ureter, cause hydronephrosis. Rarely, accessory renal arteries arise from the coeliac or

superior mesenteric arteries near the aortic bifurcation or from the common iliac arteries. (1) The occurrence of accessory renal artery can be a problem for the surgeon because they do not anastomose intrarenally and each one nourishes only a segment of the kidney's parenchyma. (10) CT Angiography can reveal pathologies of the renal arteries of the kidneys.

CT ANGIOGRAPHY

The earliest CT scanner, developed by Sir Godfrey Hounsfield, and independently developed by Allen Cormack, was first used for brain imaging in 1972. Each single tomographic slice required hours of scan time and days of computation to render what was a truly revolutionary image of skull, brain, and cerebrospinal fluid. These early CT images were remarkable because for the first time, the soft tissues within the skull could be visualized with both contrast and spatial resolution that was not possible with other tomographic techniques. Advances during the next 2 decades led to scanners that were faster and could achieve even better contrast and spatial resolution. Nevertheless, by the mid-1980s, CT scanners still worked the same way, obtaining each image slice-by-slice, with incremental table movement followed by circular revolution of the x-ray tube/detector array gantry once around the patient for each image. CT scanning was slow and provided a series of relatively thick and discontinuous slices through the body.(4)

The early 1990s saw the introduction of the first helical CT scanners into clinical practice, using a slip-ring mechanism that allowed the x-ray tube/detector array gantry to rotate continuously while the patient was moved smoothly into the scanner. The image data set was therefore a continuous spiral through the patient. Because scanning was continuous, study times were much shorter than comparable studies obtained with nonhelical scanners. Still, early helical scanners were not fast enough for many CTA applications. .(4)

In the late 1990s with the advent of multiple rows of detectors so that many images could be acquired during a single helical revolution. Simultaneous acquisition of multiple slices not only led the way to improved Z-axis resolution, but also reduced the scan time and finally allowed scanning through long segments of the body using acceptable volumes of rapidly delivered intravenous contrast. CTA scanning had finally become a reality, although manipulation of the huge image data sets that resulted from these extensive, thin-collimated studies was relatively slow and required purchase of an expensive workstation that was dedicated to the sole task of three-dimensional (3-D) image manipulation. With ongoing workstation advances during the past 5 years (faster computers, increased random access memory, and improved 3-D software) and high-speed data transfer networks in most imaging environments, affordable and clinically useful CTA has finally been realized. (4)

AIMS AND OBJECTIVE- The purpose of this study to evaluate and compare the frequency, Length, Diameter of Accessory renal artery in male and females of Western U.P. Population.

MATERIAL AND METHODS

The data was collected by using CT Scan machine G.E 64 slice with software Syngo angiography of 100 patients was collected.

SAMPLE SIZE

Ct angiogram more than 50 male and 50 females subjects were included in the study.

INCLUSION CRITERIA

Subjects who was free of any signs & symptoms related to kidney pathology

EXCLUSION CRITERIA

- Subjects who have
- Hydronephrosis
- Renal calculi
- Arterial pathology such as aneurysm or tumors.

METHODOLOGY

CT angiography was randomly selected from the records of patients who were referred for the scan during the period between June 2014 to June 2015 to from-**Dr. O. P. Gupta Imaging center, Meerut**

MEASUREMENTS

To cover the whole abdominal aorta in each patient, spiral CT angiography scan was made and thin slices (0.6 mm) axial images were obtained.

- Both sagittal and coronal images were reconstructed. 3-D reconstruction was done from the data gained by the spiral CT examination.
- Manipulation of the 3-D images was done by rotation to get the correct planes and deletion of unnecessary anatomical details to clarify the renal artery away from superimposed structures.
- Data were saved to a portable hard disk. The 3-D CT angiography results were analyzed to study the various parameters such as: the frequency, Length and Diameter. The parameters used for evaluating the main RA are: a) length of ARA from origin b) diameter ARA and c) presence of an extra renal artery.

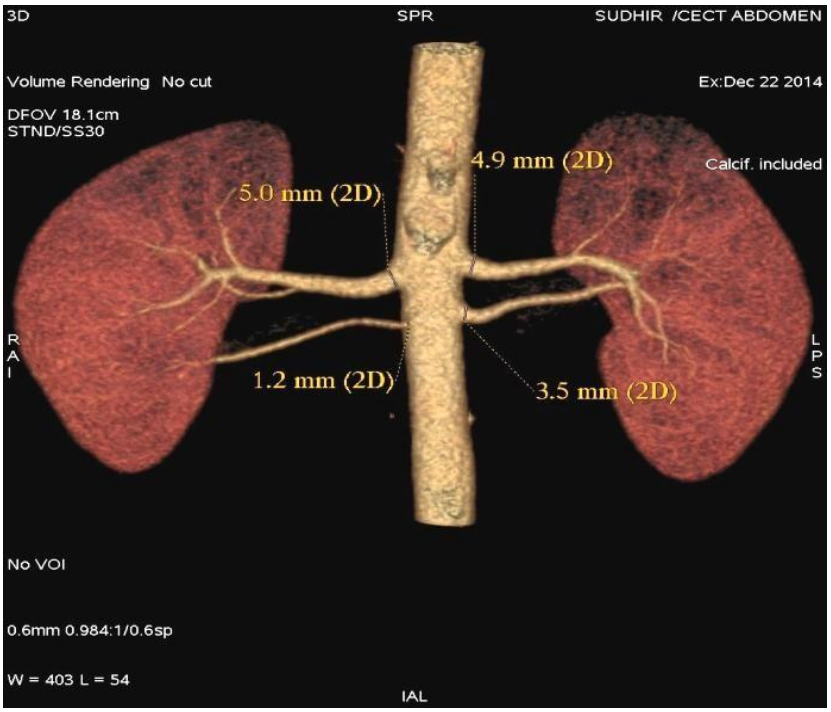

Fig.7- 3D CT angiographic image showing measurement of diameter of right, Left renal arteries, and accessory renal arteries at origin from abdominal aorta

STATISTICAL ANALYSIS

All the measured distances of the Accessory renal arteries were compared to one another and individual with the gender. A correlation is considered significant when $p < 0.05$. Most of the

possible correlations were examined. The results were recorded in the form of tables and then were subjected to statistical analysis with the purpose of calculating the mean, and SD and finally the correlations between the observed distances. In order to correlate the measured arterial distances and lengths, Pearson's correlation coefficient (r) was used. For comparing continuous variables, the t-test was applied. All the statistical analysis was done by SPSS software.

ACCESSORY RENAL ARTERIES

Total accessory renal arteries (ARA) in present study is 37 ARA out of 100 subjects. Accessory renal arteries are present in 31% of cases. 5% ARAs present at Rt side, 20% ARAs present at left side, and 6% ARAs present Bilaterally.

Right ARA	Left ARA	B/L ARA
5%	20%	6%

Table 1.9 - Percentage of frequency of Accessory renal arteries in Right and Left side

21% accessory renal arteries are present in male cases. 10% ARAs present in female cases

	Right	Left	B/L
MALE	3 %	14 %	4 %
FEMALE	2 %	6 %	2 %

Table 2.0- Percentage of frequency of Accessory renal arteries in males and females.

LENGTH OF ACCESSORY RENAL ARTERIES

Mean length of ARA in RT side in case of male is 41.57±10.41mm and in case of female 39.32±11.7mm.(total cases 11= 4 male n 7 female).

Mean length of ARA in LT side in case of male is 48.36±15.44mm and in case of female is 44.33±12.17mm.(total cases 26= 13 male n 13 female).

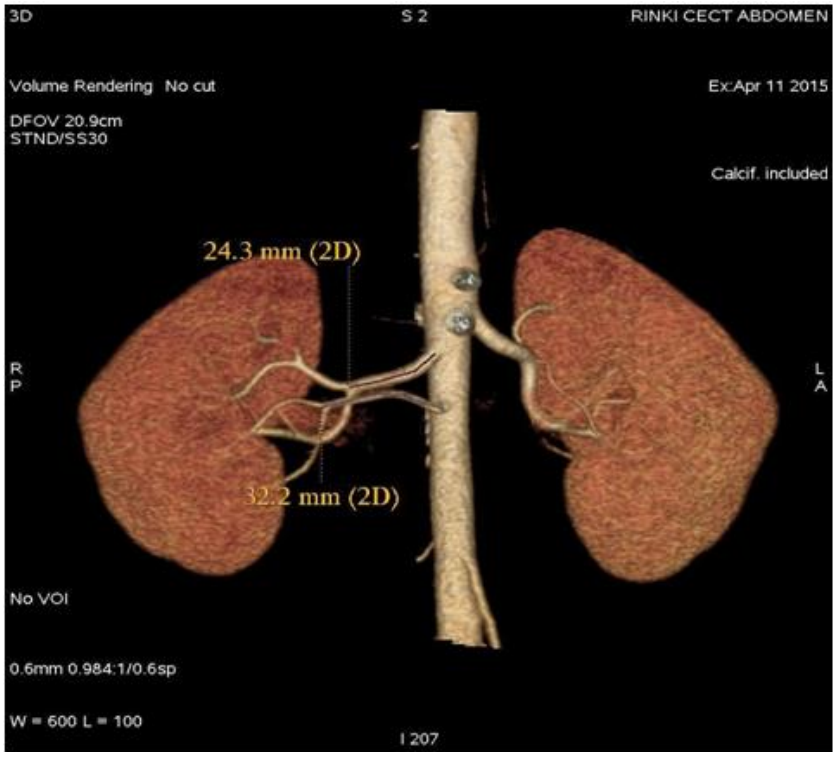

Fig.20: Right accessory renal artery.

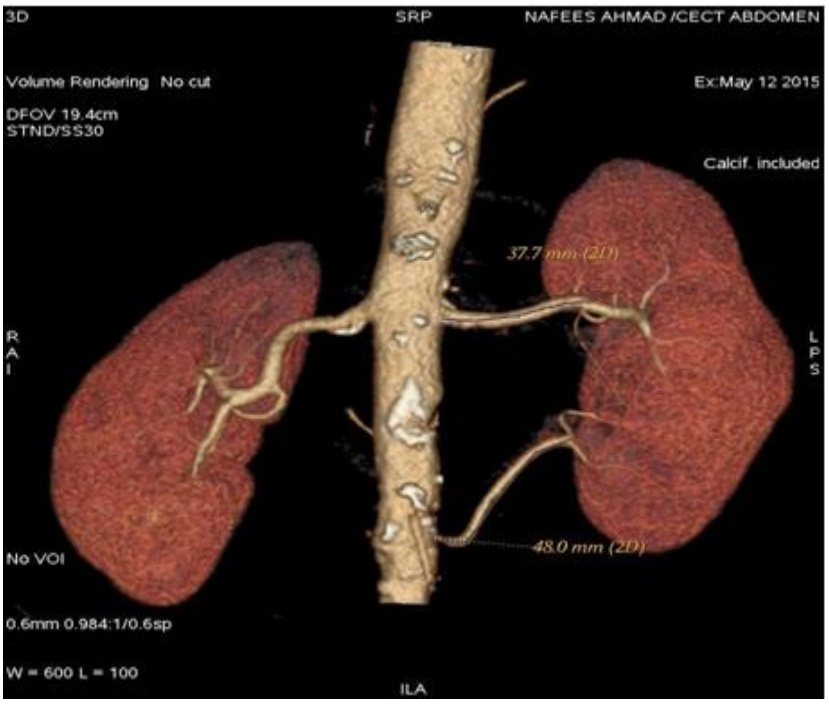

Fig.21: Left accessory renal artery.

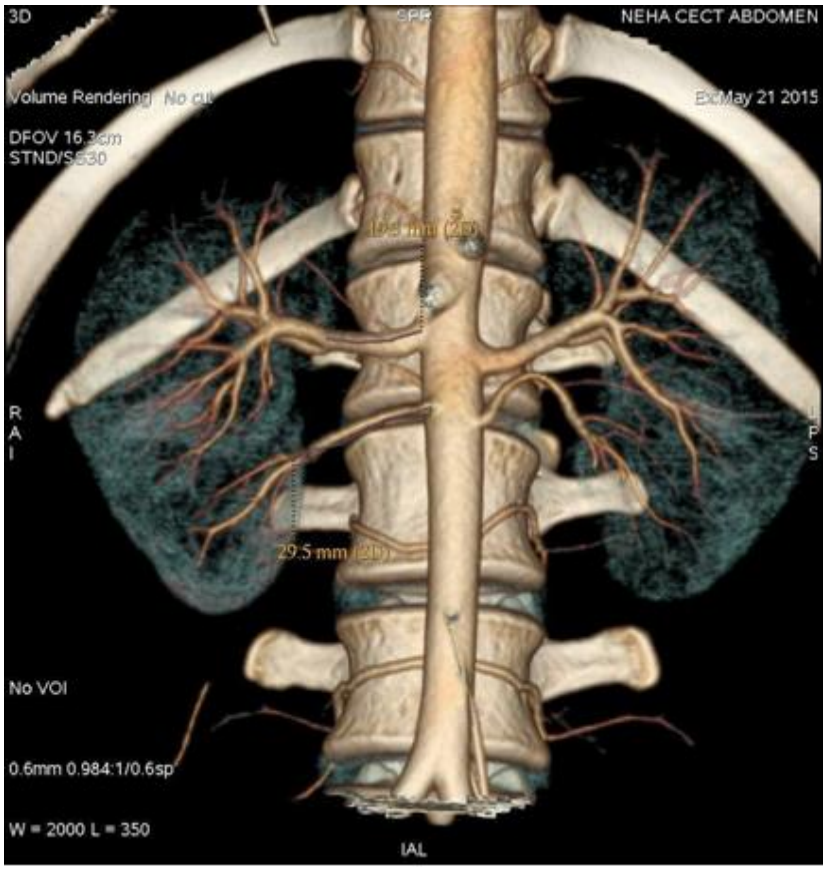

Fig. 22: Bilateral accessory renal artery.

DIAMETER OF ACCESSORY RENAL ARTERIES

Diameter of ARA from origin in RT side in case of male is 2.30±0.40 mm and in case of female is 1.82±0.45mm.

Diameter of ARA from origin in LT side in case of male is 2.26±0.78mm and in case of

female is 2.38±0.78mm.

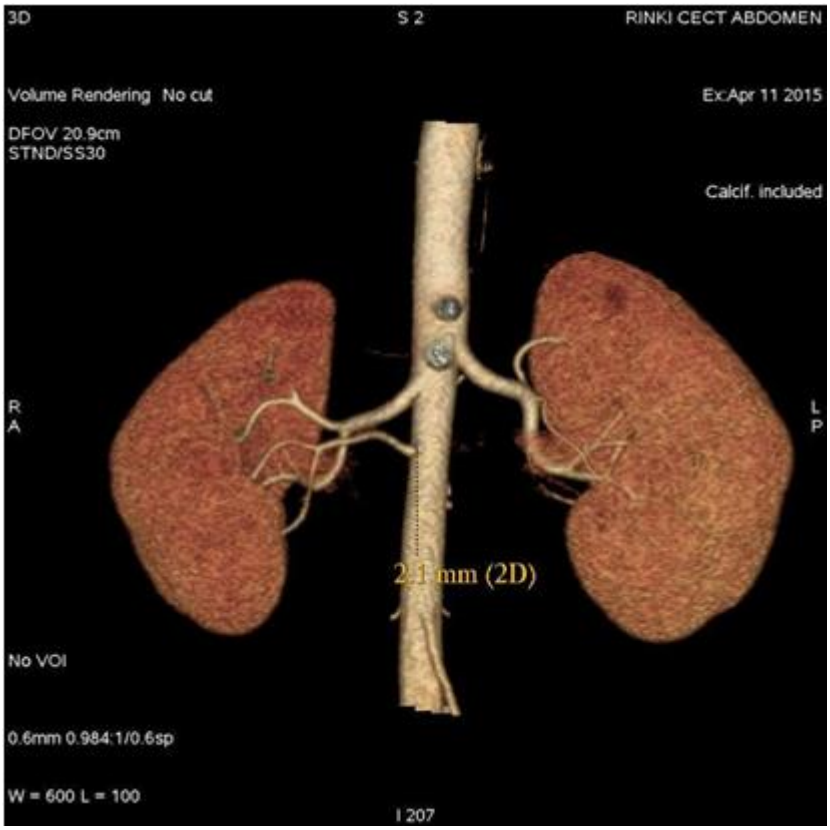

Fig. 23: Right accessory renal artery at origin from abdominal aorta.

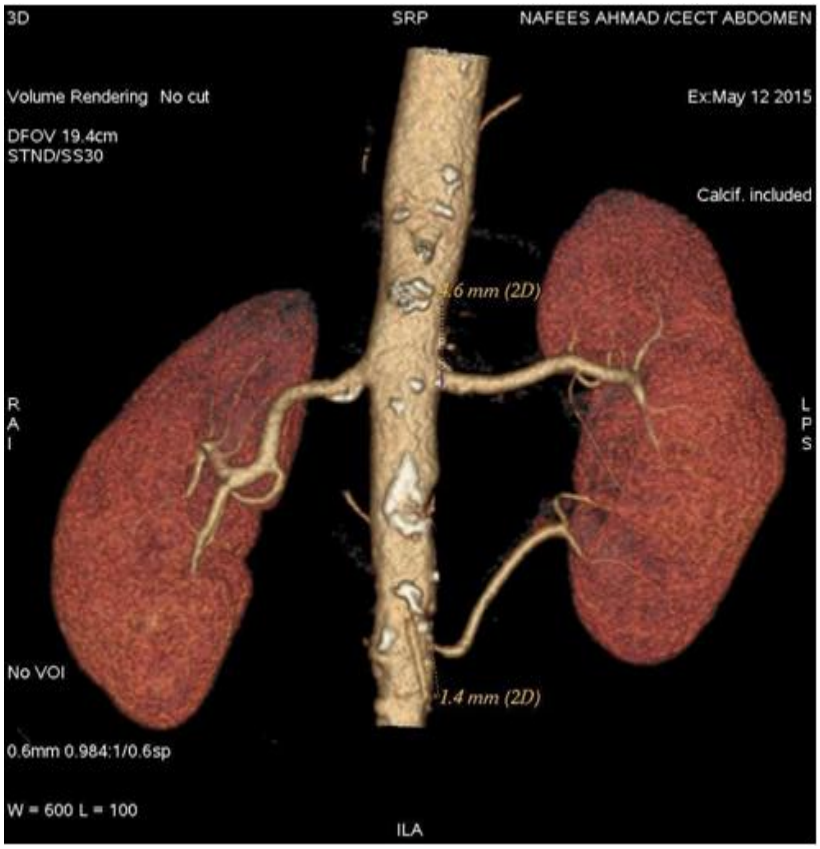

Fig. 24: Left accessory renal artery at origin from abdominal aorta.

	SEX	N	Mean	Std. Deviation	Std. Error Mean
LEN_ARA_RT	Male	4	41.575	10.4123	5.2061
	Female	7	39.329	11.7281	4.4328
LEN_ARA_LT	Male	13	48.369	15.4489	4.2847
	Female	13	44.338	12.1712	3.3757
DIA_ARA_ORIGIN_RT	Male	4	2.300	.4082	.2041
	Female	7	1.829	.4536	.1714
DIA_ARA_ORIGIN_LT	Male	13	2.269	.7889	.2188
	Female	13	2.385	.7830	.2172

Table 2.1: Length and diameter of main and accessory renal arteries

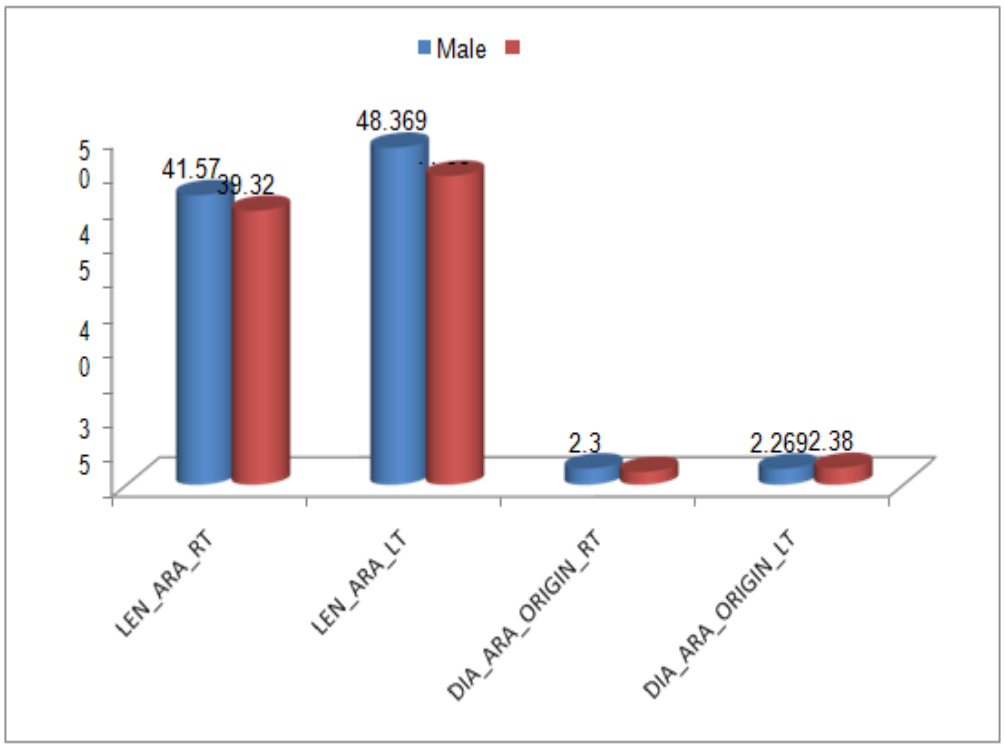

Fig. 25: Mean length and diameter of right and left accessory renal arteries.

DISCUSSION

More than one renal artery (accessory renal artery) on either side was present in 32.07% subjects. Out of 106 renal arteries, 83.65% of kidneys were irrigated by single renal artery, 15.09% by two renal arteries and 2.8% by three renal arteries. Out of 106 renal arteries, 83.65% of kidneys were irrigated by single renal artery, 15.09% by two renal arteries and 2.8% by three renal arteries. Extra left (accessory) RA was found in 6 patients (4 male and 2 female), whereas, extra right RA was found in 8 patients (5 male and 3 female). Overall extra RA was found in 14% of all cases. It was situated at the level between lower L2 and lower L3. (35).

Except for the main RA, the presence of extra RAs seems to be the most common anatomic variation of these arteries (9), with an incidence ranging from 8.7% to 75.7% (25). The presence of an extra RA or short length of the RA may exclude the donor or present a challenge for the transplanting surgeons (45). Extra RA was found in 14% of all cases in the present study. The RA diameter in kidneys with extra renal artery in the present study was significantly lower than those without an extra R\A. The presence of extra RAs is very

probable when the main RA has a diameter of less than 0.42 cm. Kidneys presenting a main RA with diameter greater than 0.55 cm most probably do not present extra RA (46).
In our study we have find 31% (accessory renal artery) on either side. Out of 200 renal arteries, 69% of kidneys were irrigated by single renal artery, 31% by two renal arteries and we have not found any case of three renal arteries .In males, we have found 14% left side, 3% right side and 4% bilaterally while in females 2% Rt side, 6 % in Lt and 2% bilaterally. Male dominance is seen in sexual dimorphism.

CONCLUSION

This Publication highlights the importance of the recognition of the presence of renal artery variants if surgical procedures are indicated in Western UP. Moreover, CT Angiography can reveal pathologies of the renal arteries of the kidneys.
This study reveals that accessory renal artery present in 31 % 0f the cases, in which 20% present in left side, 5% right side, 6% bilaterally. In males, we have found 14% left side, 3% right side and 4% bilaterally while in females 2% Rt side, 6 % in Lt and 2% bilaterally. Male dominance is seen in sexual dimorphism. Mean Length of ARAs are usually noted greater than main renal arteries in present study.
To the best of our knowledge there is no similar study in the available literature, including data about the level and angle of origin, length, diameter and the metric relationships of accessory renal arteries or correlations between them in the human body using CT angiography. The present study adds to the significance and knowledge of surgical anatomy.

REFERENCES

1. Gray's anatomy 40th edition: Sujan standrings: Churchil Livingstone: Elsevier.
2. Brodel, 1911. Brodel M: The intrinsic blood-vessels of the kidney and their significance in nephrotomy. *John Hopkins Hosp Bull* 1911, 12:10-13.
3. Keith L. Moor, 6th edition, Clinical oriented anatomy, Lippincott Williams & Wilkins Philadelphia.
4. Bart L. Dolmatch, The history of CT Angiography, Endovascular today, july 2005:23-30.
5. Cicekcibasi, A.E., Ziylan, T., Salbacak, A., Seker, M., Buyukmumcu, M. and Tuncer, I.. An investigation of the origin, localization and variations of the renal arteries in human fetuses and their clinical relevance. *Ann Anat*, 2005,187: 421–427.
6. Mazzucchi, E., Souza, A., Nahas, W.C., Antonopoulos, I.M., Piovesan, A.C. and Arap, S. Surgical complications after renal transplantation in grafts with multiple arteries. *Int Braz J Urol*, 2005, 31: 125–130.
7. Ozkan, U., Oguzkurt, L., Tercan, F., Kizilkiliç, O., Koç, Z. and Koca, N. 2006 Renal artery origins and variations:angiographing evaluation of 855 consecutive patients. *Diagn Interv Radiol, 2006,*12: 183-6.
8. Khamanarong, K., Prachaney, P., Utaravichien, A., Tong-Un, T. and Sripaoraya, K. 2004. Anatomy of renal arterial supply, *Clin Anat,* 17: 334-6. . Khamanarong, K., Prachaney, P., Utaravichien, A., Tong-Un, T. and Sripaoraya, K. Anatomy of renal arterial supply, *Clin Anat,* 2004,17: 334-6.
9. Satyapal, K.S., Haffejee, A.A., Singh, B., Ramsaroop, L., Robbs, J.V. and Kalideen, I.M..Additional renal arteries incidence and morphometry. *Surg Radiol Anat,* 2001, 23: 33-8
10. Odman, P. and Ranniger, K., 1968. The location of the renal arteries an angiography and postmortem study. *Am. J. Roentgenol, 1968,*104:283-86.
11. Rubin, G.D., Alfrey, E.J., Dake, M.D., Semba, C.P., Sommer, F.G., Kuo, P.C., Dafoe, D.C.,Waskerwitz, J.A., Bloch, D.A. and Jeffrey, R.B. 1995. Assessment of living renal donorswith spiral CT. *Radiology 1995,*195(2):457-62.

12. Rawat, K.S. 2006. CT angiography in evaluation of vascular anatomy and prevalence of vascular variants in upper abdomen in cancer patients. *Ind Radiol Imag 2006,*16:457-61.2011, 4:12–14.
13. Keen EN. Origin of renal arteries from the aorta. Acta Anat (Basel) 1981, 110(4):285-6.
14. Kosinski H. Variability of places of origin of the human renal arteries. Folia Morphol 1994, 53(2):111-6.
15. Ajmani, ML and Ajmani K. To study the intrarenal vascular segments of human kidney by corrosion cast technique. Anat Anz 1983, 154(4):293-303.
16. Garti I, Nissenkorn I, Lerner M. Common origin of inferior mesenteric and main renal artery. Eur. Urol 1986, 12:215-6.
17. Ozan H, Alemdaroglu A, Sinav A, Gümüsalan Y. Location of the ostia of the renal arteries in the aorta. Surg Radiol Anat 1997, 19(4):245-7.
18. Yahel J and Arensburg B. The topographic relationships visceral branches of the aorta. Clin Anat 1998, 11(5):304-9.
19. Pennington N and Soames RW. The anterior visceral branches of the abdominal aorta and their relationship to the renal arteries. Surg Radiol Anat, 2005, 27(5):395-403.
20. Beregi JP, Prat A, Willoteaux S, Vasseur MA, Boularand V, Desmoucelle F. Covered stents in the treatment of peripheral arterial aneurysms:procedural results and midterm follow-up.
Cardiovasc. Intervent. Radiol 1999, 22(1):13-9.
21. Rao M et. al. Bilateral prehilar multiple branching of renal arteries: A case report and literature review, Kathmandu University Medical Journal 2006, Vol. 4, (15): 345-348
22. Turba UC, Uflacker R, Bozlar U, Hagspiel KD.Normal renal arterial anatomy assessed by multidetector CT angiography: are there differences between men and women?. Clin Anat, 2009,22(2):236-42.
23. El Fettouh HA, Herts BR, Nimeh T, Wirth SL, Caplin A, Sands M, Ramani AP, Kaouk J, Goldfarb DA, Gill IS. Prospective comparisson of 3-dimensional volume rendered computerized tomography and conventional renal arteriography for surgical planning in patients undergoing laparoscopic donor nephrectomy. J Urol 2003,170(1):57-60.
24. A.B. Shakeri F. Seyednejad et.al. Bipolar supernumerary renal artery, Surg Radiol Anat, 2006, 29: 89-92.
25. Tarzamni MK, Nezami N, Rashid RJ, Argani H, Hajealioghli P, Ghorashi S. Anatomical differences in the right and left renal arterial patterns. Folia Morphol, 2008, 67(2):104-10.
26. Julius A. Ogeng'o et. al. Variant anatomy of renal arteries in a Kenyan population, Ann Transplant, 2010, 15(1): 40-45.
27. Breno Jose Palmieri et. al. Study of arterial pattern of 200 renal pedicle through Angiotomography, Rev. Col. Bras. Cir. 2011, 38(2): 116-121.
28. Kimberly A. Addis et. al. CT Angiography: In Vitro Comparison of Five Reconstruction Methods, AJR, 2001, 177:1171-76.
29. Amudha Govindarajan et. al. Right ectopic kidney with rare vascular variations, International Journal of Anatomical Variations
30. Selma Uysal Ramadan et. al. Can renal dimensions and the main renal artery diameter indicate the presence of an accessory renal artery? A 64-slice CT study, Diagn Interv Radiol 2011,17:266–271
31. Chittapuram Srinivasan Ramesh BABU et.al. MDCT angiographic evaluation of multiple renal arteries – a case report, International Journal of Anatomical Variations 2012,5: 137–140
32. Raghavendra V. P et. al. Renal Apical Segmental Artery Variations and their surgical importance, Journal of Clinical and Diagnostic Research., 2012, 1-4.

33. Krunal Chauhan et. al.VARIANT ORIGIN OF RENAL ARTERIES AND ITS CLINICAL IMPLICATION, *CIBTech Journal of Surgery, 2013, Vol. 2 (2):7-12*
34. Alia Amin et. al. Aberrant Renal Arteries And Their Clinical Significance, Biomedica , 2013,Vol. 29:108-11.
35. Mohamed Atif A Said Ahmed, et al., morphometric Study of the Renal Arteries in Saudi Population from Aseer Region Using 3-D MDCT Angiography, Scince and Nature, 2013, 2(2): 41-45.
36. Dr. Padmaja Vasi et.al. A Case Report On Accessory Renal Artery and Accessory Renal Vein in Right Kidney, *IOSR Journal of Dental and Medical Sciences,* 2013 Volume 7 (4):29-31
37. Chandragirish S et. al. STUDY ON VARIATIONS OF POSTERIOR DIVISION OF RENAL ARTERY, *Int J Anat Res* 2014, Vol 2(4):709-11.
38. Anshu Mishra et.al., Variation in Number and Vertebral Level of Origin of Renal Artery in North Indian Population, J. Biol. Chem. Res., 2014, Vol 31(1): 182-191.
39. Sharma M et. al. Accessory Renal Artery –A Case Report, *Sch JMed Case Rep 2014, 2(4):294-296.*
40. Kishor Bhandari et. al. Study on Variation in the Origin of Renal Artery, *IOSR Journal of Dental and Medical Science, 2014, Volume 13(2): 55-57.*
41. Konstantions Natsis et. al. A morphometric study of multiple renal arteries in Greek population and a systematic review, *Rom J Morphol Embryol* 2014, 55 (3):1111–1122.
42. Petru Matusz et. al. Single ectopic thoracic renal artery associated with a normal kidney position and renal artery stenosis: a case report and review of literature, *Rom J Morphol Embryol* 2015, 56(2):557–562
43. Gollamandala Syamala et. al.Morphology and Variations of Renal Artery Pattern: A Case Report, *OSR Journal of Dental and Medical Sciences, 2015Volume 14(4) :29-31*
44. Zhang, J., Hu, X., Yin, X., Huang, T., Ren, L. and Yin, H. The role of multi-detector row CT in evaluation of living renal donors. Chin J Organ Transplant (Chin), 2009,30: 419-421.
45. Flechner SM. Renal transplantation. In Tanagho EA, McAninch JW (eds): Smith's General Urology.New York: McGraw-Hill 2007 :546.
46. Aytac SK, Yigit H, Sancak T. Correlation between the diameter of the main renal artery and the presence of an accessory renal artery. J. Ultrasound Med, 2003, 22:433-9.
47. Raman S.S. Pojchamarnwipath S.M. and Mvangsomboon K. Surgically relevant Normal and variant Renal Parenchymal and vascular Anatomy in Pre-operative 16-MDCT Evaluation of potential Laparoscopic Renal Donors. AJR, 2007, 188: 105–14.
48. Saldarriaga B. Pinto S.A. and Ballesteros L.E. Morphological expression of the renal artery. A direct Anatomical study in a Colombian half-caste population. Int J Morphol, 2008, 26: 31– 38.
49. Ogeno J.A. Masaki C.O. Sinkeet S.R. Muthoka J.M. and Murunga A.K. Variant anatomy of renal arteries in a Kenyan population. Ann Transplant, 2010, 15(1):40-45.
50. Palmieri BJ, Petroianu A, Silva LC, Andrade LM, Alberti LR. Study of arterial pattern of 200 renal pedicle through angiotomography. Rev Col Bras Cir 2011, 38(2):116-21.
51. Prakash, Mokhasi, V., Rajini, T. and Shashirekha, M. The abdominal aorta and its branches: anatomical variations and clinical implications, Folia Morphol. 2011, 70(4): 282–286.
52. Gümüş, H., Bükte, Y., Ozdemir, E., Cetinçakmak, M.G., Tekbaş, G., Ekici, F., Onder, H. and Uyar, A. Variations of renal artery in 820 patients using 64-detector CT-angiography. Epub 2012,34(3):286-90.
53. Janschek EC, Rothe AU, Holzenbein TJ, Langer F, Brugger PC, Pokorny H. Anatomic basis of right renal vein extension for cadaveric kidney transplantation. Urology 2004, 63:

660-4.
54. Ramadan SU, Yigit H, Gokharman D, Tuncbilek I, Dolgun NA, Kosar P, Kosar U. Can renal dimensions and the main renal artery diameter indicate the presence of an accessory renal artery? A 64-slice CT study. Diagn Interv Radiol 2011, 17(3):266-71.
55. Panagouli E, Lolis E, Venieratos D. A morphometric study concerning the branching points of the main arteries in humans: relationships and correlations. Ann Anat 2001, 193(2):86-9.
56. Bates MC, Crotty B, Kavasmaneck C, Campbell JR. Renal artery angiography: "the right ipsilateral oblique" myth. Catheter Cardiovasc Interv. 2006, 67(2):283-7.
57. Wozniak WT. Origin of the renal arteries from sides of aorta. Folia Morphol (Warsz) 2000, 58(4):259-61.
58. Kim PA, Khilnani NM, Trost DW, Sos TA, Lee L. Fluoroscopic Landmarks for Optimal Visualization of the Proximal Renal Arteries .J Vascular and Interventional Radiology.1999, 10(1):37–9.
59. Dhar P and Lal K. Main and accessory renal arteries-a morphological study. Ital. J. Anat. Embryol 2005, 110(2):101- 10.