ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

Anomalous Left Renal Vein Prevelence in Routinely Examnied Abdomen by Compoted Tomography Scans in Ejdabia City

[1]Faiza Mohamed Kutrani; [2]Ali A. Beheh; [3]Nadya Ben Geweref; [4]Mohamed H. Mohamed Buzgheia;
[5]Mohamed Farag Saleh Idris; [6]Abdalla M. Omran
[1,2,3,4,5,6]Department of Radiology, Benghazi University, Benghazi-Libya

Abstract:- The goal is to investigate the occurrence and manifestation of anomalies in the left renal vein during routine CT scans of the abdomen.

➢ ***Materials and Procedures:***

Retrospective analysis of the pictures from 100 patients who had abdominal CT scans between January 1 and December 31, 2021, with abnormalities in the patterns of their renal veins noted. Findings: of the one hundred patients who had imaging. Their ages ranged from one year old to ninety years old, with 52 males (52%) and 48 females (48%) comprising the group. There were no documented cases of circum-aortic left renal vein anomalies, but 96 patients (96%) had normal preaortic left renal veins. Four cases had retroaortic left renal vein anomalies. On the L1 vertebral level, 41% of patientshad a left renal vein, and 36% of displayed the right renal vein at the level of the L1. There was no statistically significant correlation found between abnormalities and gender. In conclusion, CT scans can reveal differences in the left renal vein's path, information that may be crucial for both clinical and surgical outcomes during procedures involving the abdomen and pelvis.

Keywords:- *Renal Vein, Anomalies and Abdominal CT Scans.*

I. INTRODUCTION

When it comes to the planning of vascular interventional procedures, retroperitoneal surgery, and the medical diagnosis of retroperitoneal lymphadenopathies, the presence of left renal vein (LRV) anomalies is crucial. Computed tomography scans (CT) can easily identify these anomalies with careful examinations (1, 2). Compared to the right renal vein, the left has a longer and more intricate embryological development. IVC development involves pairs of posterior cardinal, supra-cardinal, and sub-cardinal venous ducts (intrauterine 6 - 10 weeks). These venous channels are connected by anastomosis. Through the inter-subcardinal and inter-supracardinal anastomosis through the aorta, these connections form a circum-cortical venous loop through the sub-supracardinal ducts. Right sub-supra-cardinal anastomosis forms as the right renal vein, and unilateral right localized IVC results from the transformation of the bilateral symmetric cardinal system (3). Dorsal and ventral are the two parts of the left circulatortic venous ring that are involved in this transformation. The normal development process results in the atrophied dorsal arm, but the ventral arm continues to develop, and the normal left renal vein with preaortic shape takes shape.

Retro-aortic renal vein anomaly develops if the ventral episode experiences atrophy and the dorsal arm persists (4). The retro-aortic renal vein enters the IVC obliquely and descends. Atrophy and circulatortic left renal vein anomaly, through which the aorta passes, can occasionally occur in none of these arms. Renal vein anomalies typically drain into the IVC. On the other hand, there have also been reports that the left main iliac vein and left renal vein can be opened (5). Anomalies of the left renal vein are typically discovered by accident. In the literature, a small number of patients with non-pathologic hematuria and blunt side pain had renal venous anomalies despite the absence of clinical symptoms, and no pathology was found (6). It is easy to monitor the normal preaortic course of the renal vein during routine abdominal CT examinations. If it is not possible to monitor this course, it should be assessed for variations and documented in the report. Understanding renal vein anomalies is essential for performing successful retroperitoneal surgery. Retrograde peritoneal surgery can result in complications such as bleeding, nephrectomy, and even death, even though it is not the cause of this condition (8, 9). Given the length of the LRV, donors for renal transplants are favored. It is crucial to ascertain whether the LRV has a typical preaortic course because of this. When a renal vein sample is to be taken, it is crucial that these anomalies be present. Furthermore, patients with renal and testicular neoplasia may be misdiagnosed as retro-peritoneal lymph nodes, necessitating careful differential diagnosis (10).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

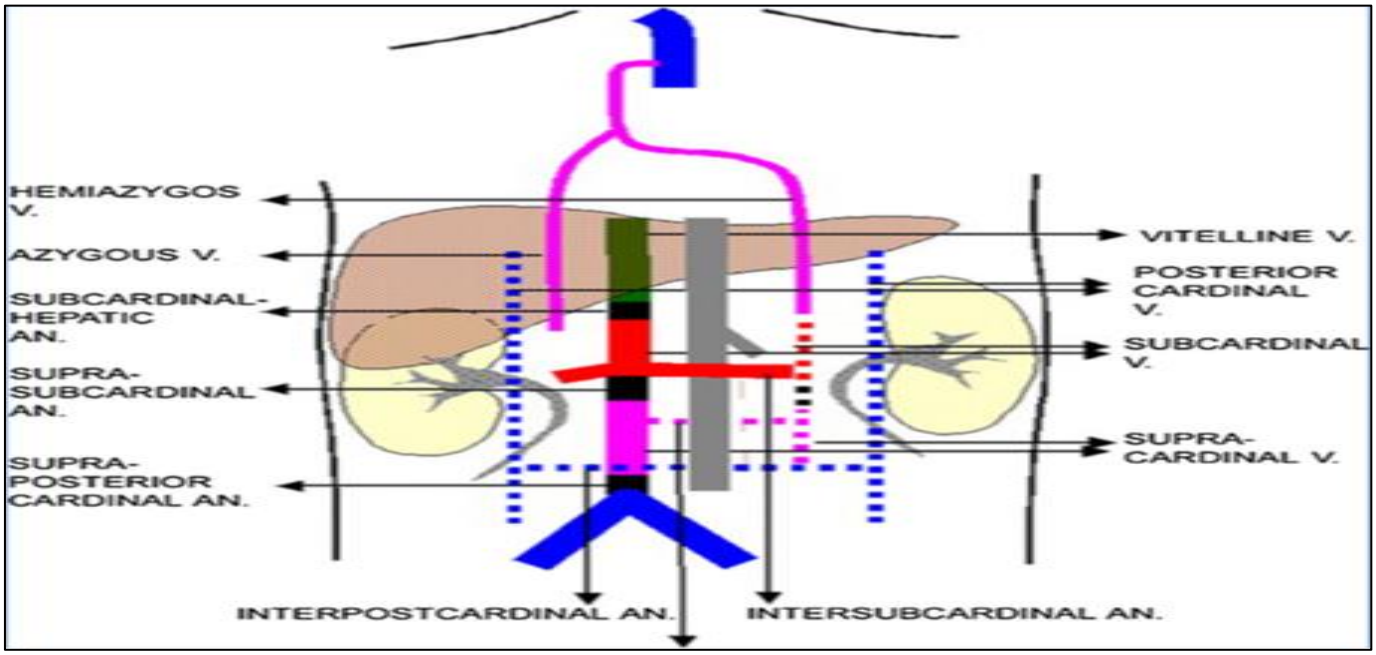

Fig 1: Drawing clarify the developmental embryology of the inferior vena cava. 3 pairs of veins: Posterior cardinal (blue), Supracardinal (purple), and Subcardinal (vertical red) veins that develop in chain on either side of the aorta (gray). Portions of these venous channels retrogress (dashed lines), however persist the others (solid lines) to form the infrahepatic part of the IVC. The right sided subcardinal vein makes the suprarenal segment of the IVC, and the right sided supracardinal vein makes the infrarenal segment. The vitelline vein (green) derived from the hepatic segment. Anastomotic chains (black) join the various segments of the IVC. An intersubcardinal anastomosis which is course anterior to the aorta forms the left renal vein (horizontal red line), while the intersupracardinal and interposterior cardinal anastomosis regress normally. The supracardinal veins run as the azygous and hemiazygos veins; the iliac veins are drawn from the persistent posterior cardinal veins. AN =anastomosis, V = vein.

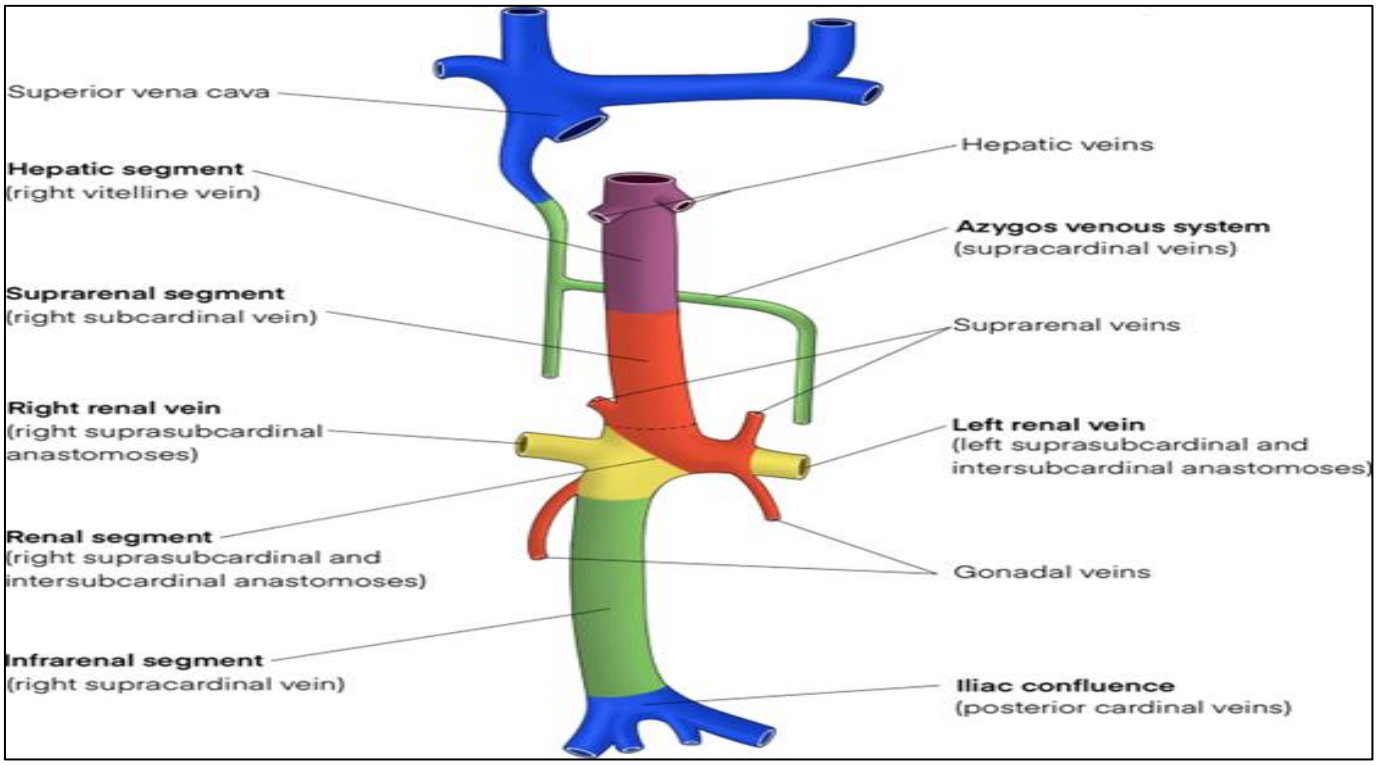

Fig 2: The adult inferior vena cava is composed of suprarenal (right subcardinal vein) renal (right suprasubcardinal and intersubcardinal anastomoses), infrarenal (right supracardinal vein), and hepatic (vitelline veins) segments. Renal and suprarenal segments are separated by the dashed line. Posterior cardinal veins continue as paired common iliac veins which join to form the iliac confluence, whilst supracardinal veins contribute to the azygos venous system draining into the superior vena cava. The gonadal and suprarenal veins are derived from subcardinal veins

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

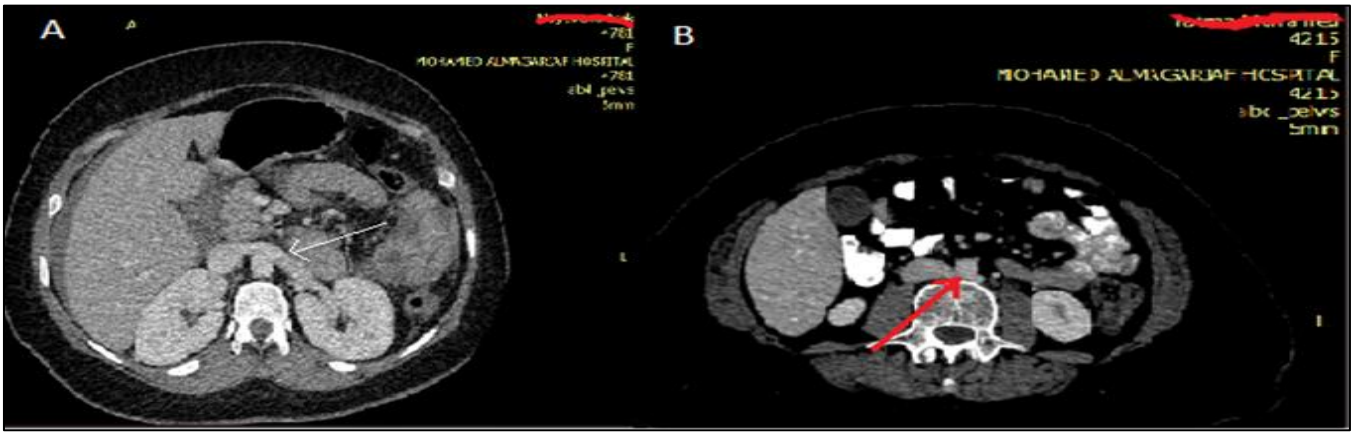

Fig 3: Patient with RLRV. Axial Image Contrast-Enhanced Computed Tomography Scans Reveals the Preaortic Type (A, White Arrow) and Retroaortic Components of Circumaortic Left Renal Vein (B, Red Arrow)

Fig 4: Three-Dimensional Reconstruction Computed Tomography Angiographic Image Show (White Arrows) the Circumaortic Left Renal Vein. Coronal Reformatted Image Shows Courses of the Retroaortic Left Renal Vein (White Arrows) Posterior to Aorta

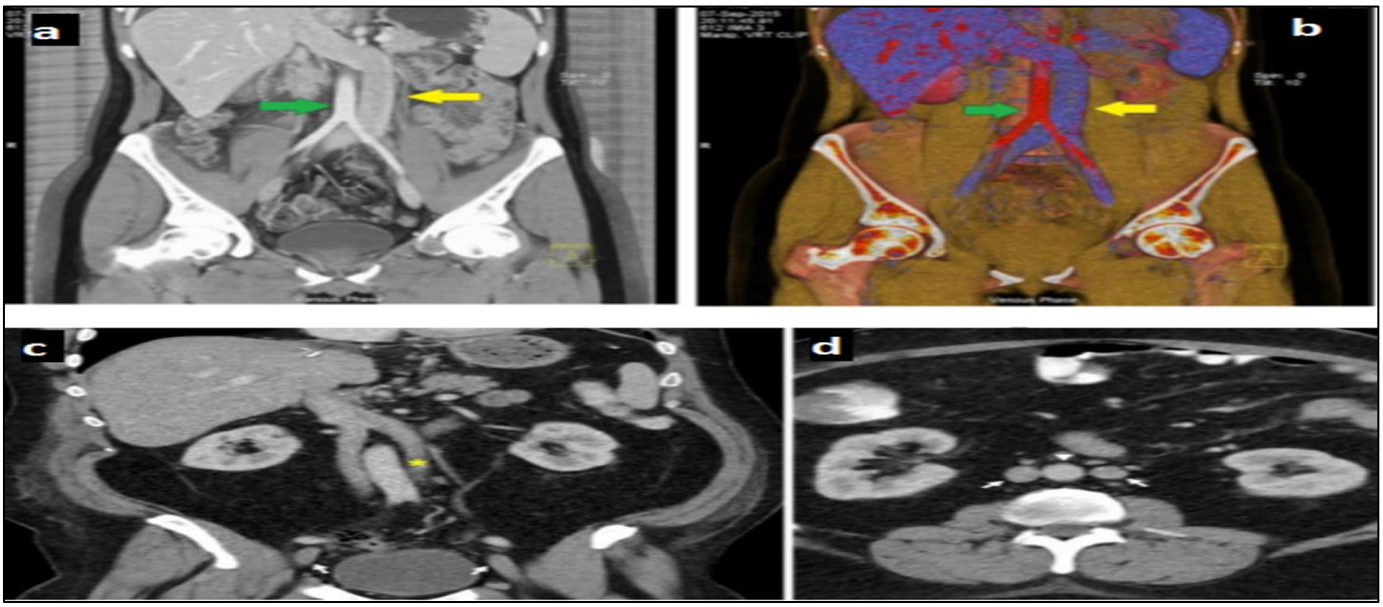

Fig 5: Coronal Reconstruction Contrast-Enhanced Computer Tomography Show thin MIP Reformatting in Axial Plane (a) the Corresponding Coronal VRT (b),Demonstrating Left Sided IVC Anomaly (Yellow Arrow) Crossing the Abdominal Aorta to the Left Side (Green Arrow). (c) IVC Duplication (Asterisk) Show Symmetrical Caliber Draining into the Suprarenal IVC. Bilateral External Iliac Veins (Arrows) both of them Drain into Cavae on their Respective Sides. (d) Axial Computer Tomography Image Demonstrate the Paired IVC Trunks (arrows) Stationed; on Each Side of the Abdominal Aorta (Arrowhead).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

➢ *Work Gols*

- To calculate the frequency of anomalies in the left renal vein in abdominal CT scans.
- To investigate the occurrence of anomalies in the left renal vein when doing CT scans of the abdomen.

II. METHODS AND MATERIAL

A. Imaging Data

Using a GE-CT machine, all CT scans were performed in accordance with standard abdominal protocol. The following parameters were used, based on the examination's characteristics: 120–140 kV, 140–200 mAs, pitch of 1-2, and collimation of 5–10 mm. In accordance with standard abdominal scan protocol, patients received 3-5 milliliters of intravenous contrast per second. Assessment of the venous structures in the abdomen obtained at portal phase images 50–60 seconds after an 80–100 mL intravenous contrast agent bolus. Accurate representation of different renal vascular anomalies can be achieved with great help from the three-dimensional volume rendered and MIP techniques.. Nonetheless, in addition to the standard axial plane at a workstation, the sagittal and coronal reconstruction planes were completed for each case. Between January 1, 2021, and December 31, 2021, a total of 100 CT scans were referred for contrast-enhanced MDCT of the abdomen and pelvis regions. These scans were retrospectively reviewed, and the CT scan image archives of the radiology department of Emhammed Al Megareef Hospital, Ajdabiya, Libya were used to record any anomalies in the IVC and iliac vein branching patterns that were found.

B. Inclusion/Exclusion Criteria:

Regardless of the indications and CT examination technique, every patient received a contrast CT study of the abdomen and pelvis, which involved enhancement of the IVC from the right atrium to the bifurcation of the common iliac vessels. Excluded patients included those who underwent abdominal surgery that altered the anatomy of the IVC and/or iliac veins, patients with renal masses infiltrating the IVC and/or iliac veins, and patients who did not receive IV contrast opacifying the IVC and iliac veins.

C. Statistical Analysis:

Version 26 of the SPSS statistical package (Statistical Package for Social Science) was used to computerize and analyze the gathered data. The Shapiro Walk test was utilized to verify if the data was normally distributed. Relative percentages and frequencies were used to depict qualitative data.

III. RESULTS

Table 1: Age Distribution of the Study Population

Age (years)	Cases (n=100)	Percentage
<30	14	14%
30-45	30	30%
45-60	30	30%
> 60	26	26%
Total	100	100%

Frequencies and relative percentages are used to depict qualitative data. We had one hundred participants in our research. Of the participants, 14 were under 30 years old, 30 were between 30 and 45 years old, 30 were between 45 and 60 years old, and 26 were older than 60.

In terms of gender distribution, the current study included 52 male participants and 48 female participants.

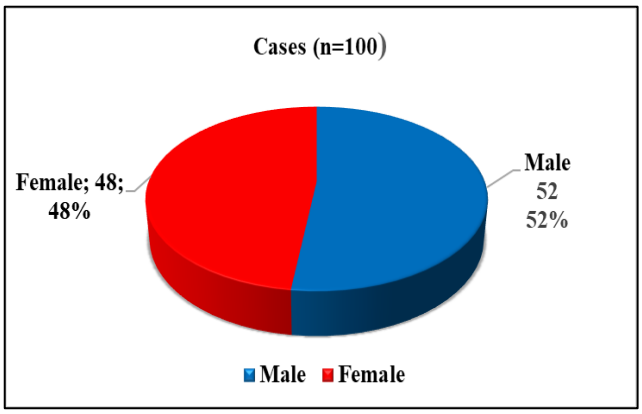

Fig 6: Sex Distribution of the Study Population

Table 2: Contrast Administration Distribution among Participants

Contrast administration	Cases (n=100)	Percentage
Yes	94	94%
NO	6	6%
Total	100	100%

A total of 94 individuals in our investigation received contrast medication.

We discovered that 2 cases were in the level of the T12 vertebra, 18 were in the T12-L1 Disc space, 36 were in the L1 vertebra, 29 were in the L1-L2 Disc space, and 15 participants were in the L2 vertebra based on the distribution of right renal vein levels among our participants.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

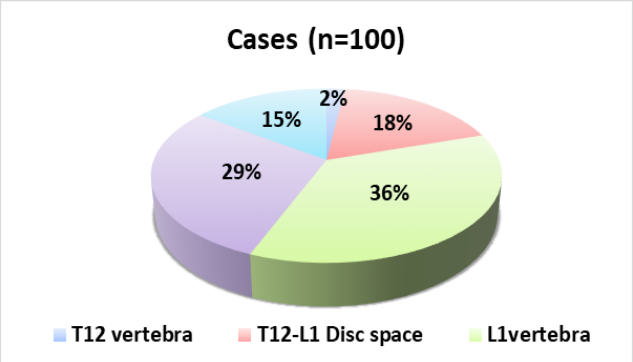

Fig 7: Right Renal Vein Level Distribution among Participants

Table 3: Left Renal Vein Level Distribution among Participants

Left Renal Vein Level	Cases (n=100)	Percentage
T12 vertebra	2	2%
T12-L1 Disc space	20	20%
L1vertebra	41	41%
L1-L2 Disc space	28	28%
L2 vertebra	7	7%
L2-L3 Disc space	1	1%
L3-L4 Disc space	1	1%
Total	100	100%

We discovered that 2 cases were in the level of the T12 vertebra, 20 were in the T12-L1 Disc space, 41 were in the L1 vertebra, 28 were in the L1-L2 Disc space, 7 participants were in the L2 vertebra, 1 was in the L2-L3 Disc space, and 1 was in the L3-L4 Disc space, based on the distribution of left renal vein levels among participants.

Table 4: Renal Vein Anomalies Distribution among Participants

Renal Vein Anomalies	Cases (n=100)	Percentage
Preaortic	96	96%
Retro-aortic	4	4%
Circum-aortic	0	0%
Total	100	100%

Variations in venous structures can occur because of their intricate embryological development. When preparing surgical interventions involving such anatomic regions, it is essential to comprehend these variations. Furthermore, these images could be mistakenly identified as retroperitoneal and abdominal lymphadenomegalies if one is not aware of these variations (16). In the first six to ten weeks of pregnancy, the inferior vena cava (IVC) develops into a complex structure. Large anatomical variations, such as duplication, transpositioning, retro-aortic, or circum-aortic left renal vein (LRV), can occur in the form of one or more abnormalities when the stage of development is inappropriate (22). For the accurate but invasive imaging of the inferior vena cava and IVC, cathography and venography are used. A helpful diagnostic method is ultrasonography, a non-invasive procedure. Colored Doppler ultrasonography in particular is useful. When it comes to assessing the vascular nature, measuring the waveform and index through spectral analysis, and figuring out the direction of vascular blood flow, colored Doppler ultrasonography is crucial (49). However, new understanding of the examination of vascular structures has been brought about by spiral and multidetector computed tomography (CT) angiographic studies as well as magnetic resonance imaging (MRI) angiography techniques. When performing a laparoscopic donor nephrectomy, surgeons must have a comprehensive preoperative understanding of the renal vascular anatomy in order to select the best kidney and to plan the surgical procedure. Preoperative imaging that shows the vascular variants makes it easier to dissect these vessels and reduces the risk of vascular damage (42). The purpose of our study was to evaluate the prevalence and appearance of anomalies of the left renal vein in abdominal CT scans. We had one hundred participants in our research. Of the participants, 14 were under 30 years old, 30 were between 30 and 45 years old, 30 were between 45 and 60 years old, and 26 were over 60. In our study, there were 48 female participants and 52 male participants. The administration of contrast was done on 94 study participants. We discovered that 2 cases were at the level of the T12 vertebra, 18 were in the T12-L1 Disc space, 36 were in the L1 vertebra, 29 were in the L1-L2 Disc space, and 15 participants were in the L2 vertebra based on the distribution of right renal vein levels among our participants. We discovered that 2 cases were in the level of the T12 vertebra, 20 in the T12-L1 Disc space, 41 in the L1 vertebra, 28 in the L1-L2 Disc space, 7 participants in the L2 vertebra, 1 in the L2-L3 Disc space, and 1 in the L3-L4 Disc space, based on the distribution of left renal vein levels. We discovered that 96 of the anomalies were preaortic and 4 were retroaortic based on the distribution of renal vein anomalies; we did not find any cases that were circumaortic. When compared to the right renal vein, the LRV's embryological developmental process is longer and more intricate. During the sixth through tenth intrauterine weeks, pairs of posterior cardinal, sub-cardinal, and supra-cardinal venous channels are crucial for the development of the IVC. The venous channels are represented by anastomotic links (12). The aorta travels through this circum-aortic venous circle, which is made up of inter-subcardinal anastomosis and sub-supracardinal channels. The right sub-supra-cardinal anastomosis forms the right renal vein, while the bilateral symmetric cardinal system becomes the unilateral right-sided IVC. There are two parts to the left circumaortic venous circle: the ventral and dorsal. The ventral arm grows and forms the normal LRV with a pre-aortic course while the dorsal arm atrophies during normal development. A retro-aortic renal vein abnormality appears when the ventral portion atrophy and the dorsal arm continues to grow. The retro-aortic renal vein enters the IVC by taking an oblique downward path. Occasionally, one or both of these arms do not atrophy, creating a CLRV anomaly that the aorta passes through. In cases of renal vein abnormalities, the vein typically empties into the IVC (13). However, in addition to the IVC, it is reported that the LRV drains into the left common iliac vein. Although relatively uncommon, congenital venous abnormalities in the retroperitoneal space

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

are clinically significant for urologists, general, vascular, and transplant surgeons as well as interventional radiologists (23). Radiological techniques like contrasted CT scanning, angiography, Doppler ultrasonography, and MRI can identify abnormalities during the LRV. Renal venography and inferior vena cavography are two straightforward but invasive methods for assessing anatomical structures. Although Doppler ultrasonography can be used to identify the retro-aortic renal vein, obese patients may not benefit from this technique (49). Renal vein evaluation is successfully accomplished with methods like MR angiography and MRI. Still, in terms of duration, cost, and patient compliance, CT appears to be more favorable.The normal pre-aortic LRV and any anomalies can be precisely determined with contrast-enhanced CT scanning. In light of recent developments in CT technology, including spiral and multidetector angiography, CT appears to be a more useful technique for quickly and accurately identifying abnormalities in the renal vein (46). Specifically, a widely recognized approach for the assessment of renal vessels is CT angiography, which is a less invasive method than traditional angiography. In terms of predicting the variations of the renal vessels, CT angiography is a technique that is safe, quick, minimally invasive, and reasonably priced. It also shows excellent agreement with both catheter angiography and surgery (48). Preoperative information regarding arteriovenous malformation, stenosis, and aneurysms, among other renal vascular diseases, can also be obtained through it. Most often, the anomalies of the left renal vein are discovered by accident. While most abnormalities of this kind are asymptomatic, some papers describe cases of blunt side pain and intermittent haematuria in the absence of any other pathology other than renal vein abnormality (18). There is variation in the rate of LRV abnormalities across studies. According to Reed et al., 433 cases had CT scanning with a frequency of 1.8% for RLRV abnormality and 4.4% for CLRV abnormality (47). In a different study by Trigaux et al. with 1014 cases, 3.7% and 6.3%, respectively, of the cases had abnormal CLRV and RLRV after CT scanning (20). In 250 abdominal CT scans, the rate of RLRV abnormality was 0.4% and the rate of CLRV abnormality was 1.2% in a study by Oyar et al. In the autopsy series, the frequencies of retro-aortic and circumaortic renal vein abnormalities were 1.16.8% and 1.5–3.4%, respectively (50). In their combined series of cadaver and clinical cases, Satyapal et al. looked at 1008 cases and found that 0.3% and 0.5% of the cases had CLRV abnormalities (8). The difficulty of imaging is indicated by the reported incidence of venous anomalies of the renovascular pedicle and the IVC by Aljabri, which was significantly lower in a CT-based study compared with autopsy results. The frequency of RLRV in this study was 0.5% (29/4520 CT studies), with more, albeit somewhat disparate, studies for IVC transposition (0.04%), IVC duplication (0.02%), and circum-aortic renal collar (0.08%) (5). In 1003 abdominal CT scans, the rate of RLRV abnormality was 0.9% and the rate of CLRV abnormality was 2.3% in another study by Yeflilda. Our rates of renal vein abnormalities, which are 2.3% and 0.8% of retro-aortic and circum-aortic veins, respectively, are within the ranges found in other studies. Regular abdominal CT scanning can easily identify the renal vein's normal pre-aortic course (51). In the event that no such course can be identified, the case should be assessed for variations, and the results should be shared. When it comes to surgery, it is important to report any abnormalities in the renal vein because failing to do so could lead to complications that could cause death, a nephrectomy, or bleeding (17). Because of the length of the LRV, the left side of kidney transplant donors is favored. It is crucial to ascertain whether the LRV has a typical pre-aortic course. When renin is sampled from the renal vein, this information is also crucial. Furthermore, in patients with testicular and renal neoplasms, caution should be exercised in distinguishing the anomaly from a retroperitoneal lymph node (19). Furthermore, a relatively rare condition known as "posterior Nutcracker phenomenon" or LRV hypertension syndrome can be brought on by an RLRV anomaly. It presents as left side and abdominal pain, either alone or in combination with unilateral hematuria. "Pelvic Congestion syndrome," which manifests in females as emotional disturbances, vulval and proximal lower tract symptoms, dysmenorrhea, dyspareunia, and lower abdominal pain, is another common presentation. In lower limb varices [(16)].). Similar to this, compression of the left renal vein can result in reflexes from the vein to the gonadic vein, which can cause lower limb varicose veins and varicocels in men. Surgically, these anomalies can influence the choice of CVI ligature site for thromboembolic disease, which in turn can influence the choice of potential kidney transplant donors. fixing aortic aneurysms and carrying out additional retroperitoneal procedures. Before abdominal surgery was routinely performed with CT, the majority of venous anomalies were discovered during the procedure. Pre-recognition of injuries is common in many of these cases (20). Today, patients scheduled for abdominal surgery typically receive a preoperative CT scan, which allows for an accurate diagnosis to be made. Prior to surgery, the surgeon should thoroughly review the CT scan and take into account each venous anomaly (46). Knowing about this anomaly angiographically is crucial for adrenal venography, renal vein sampling, and spermatic vein embolization, as well as for preventing the mistaken belief that the inferior displacement of the RLRV is due to a mass lesion (47).

IV. CONCLUSION

The left renal vein underwent a complex and long developmental process during empyrological period more than the right renal vein. So, regarding to this difference, detection the congenital left renal vein variation and abnormalities playing an important condition for the surgeon, vascular surgeon and the Radiologist in differentiation these condition from any retroperitoneal masses or lymph nodes. To avoid any complications may happen when any retroperitoneal surgery or vascular procedure needed. Recognition of left renal vein abnormalities can be detected when it’s anatomical region examined with good concentration to find the variation and abnormalities of left renal while examined the abdomen routinely by computed tomographic scan.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

REFERENCES

[1]. Parikh SJ, Peters JC, Kihm RH. The anomalous left renal vein: CT appearance and clinical implications. J ComputTomogr 1981; 5:529-533.

[2]. Kumar D, Kumar S. Case report. Circumaortic left renal vein. J Comput Assist Tomogr 1981; 5:914-916.

[3]. Chuang VP, Mena CE, Hoskins PA. Congenital anomalies of the left renal vein: angiographic consideration. Br J Radiol 1974; 47:214-218.

[4]. Cuellar iCalàbria H, Quiroga Gómez S, SebastiàCerqueda C, Boyé de la Presa R, Miranda A, Àlvarez-Castells A. Nutcracker or left renal vein compression phenomenon: multidetector computed tomography findings and clinical significance. European radiology. 2005 Aug;15:1745-51.

[5]. Aljabri B, MacDonald PS, Satin R, Stein LS, Obrand DI, Steinmetz OK. Incidence of major venous and renal anomalies revelant to aortoiliac surgery as demonstrated by computed tomography. Ann VascSurg 2001; 15:615-618.

[6]. Lee CM, Ng SH, Ko SF, Tsai CH, Tsai CC. Circumaortic left renal vein: report of a case.JFormos Med Assoc 1992; 91:356-358.

[7]. Gibo M, Onitsuka H. Retroaortic left renal vein with renal vein hypertension causing hematuria. Clin Imaging 1998; 22:422-424.

[8]. Satyapal KS, Kalideen JM, Haffejee AA, Singh B, Robbs JV. Left renal vein variations. SurgRadiolAnat 1999; 21:77-81.

[9]. Mitty HA. Circumaortic renal collar. A potentially hazardous anomaly of the left renal vein. Am J Roentgenol Radium TherNucl Med 1975; 125:307-310.

[10]. Turner RJ, Young SW, Castellino RA. Dynamic continuous computed tomography: study of retroaortic left renal vein. JComput Assist Tomogr 1980; 4:109-111.

[11]. Bowdino CS, Owens J, Shaw PM. Anatomy, abdomen and pelvis, renal veins. InStatPearls. 2022 Jan 7. StatPearls Publishing.

[12]. Dhar P. An additional renal vein. Clinical Anatomy. 2002 Jan;15(1):64-6.

[13]. Heidler S, Hruby S, Schwarz S, Sellner-Zwieauer Y, Hoeltl W, Albrecht W. Prevalence and incidence of clinical symptoms of the retroaortic left renal vein. Urologiainternationalis. 2015;94(2):173-6.

[14]. Hoeltl W, Hruby W, Aharinejad S. Renal vein anatomy and its implications for retroperitoneal surgery. The Journal of urology. 1990 Jun 1;143(6):1108-14.

[15]. Mathews R, Smith PA, Fishman EK, Marshall FF. Anomalies of the inferior vena cava and renal veins: embryologic and surgical considerations. Urology. 1999 May 1;53(5):873-80.

[16]. Nam JK, Park SW, Lee SD, Chung MK. The clinical significance of a retroaortic left renal vein. Korean journal of urology. 2010 Apr 1;51(4):276-80.

[17]. Reed NR, Kalra M, Bower TC, Vrtiska TJ, Ricotta II JJ, Gloviczki P. Left renal vein transposition for nutcracker syndrome. Journal of vascular surgery. 2009 Feb 1;49(2):386-94.

[18]. Satyapal KS. Classification of the drainage patterns of the renal veins. Journal of anatomy. 1995 Apr;186(Pt 2):329.

[19]. Satyapal KS. The renal veins: a review. European Journal of Anatomy. 2003;7:43-52.

[20]. Trigaux JP, Vandroogenbroek S, De Wispelaere JF, Lacrosse M, Jamart J. Congenital anomalies of the inferior vena cava and left renal vein: evaluation with spiral CT. Journal of vascular and interventional radiology. 1998 Mar 1;9(2):339-45.

[21]. Shindo S, Kubota K, Kojima A, Iyori K, Ishimoto T, Kobayashi M, Kamiya K, Tada Y. Anomalies of inferior vena cava and left renal vein: risks in aortic surgery. Annals of vascular surgery. 2000 Jul;14:393-6.

[22]. Barnes RW, Fleisher III HL, Redman JF, Smith JW, Harshfield DL, Ferris EJ. Mesoaortic compression of the left renal vein (the so-called nutcracker syndrome): repair by a new stenting procedure. Journal of vascular surgery. 1988 Oct 1;8(4):415-21.

[23]. Dilli A, Ayaz UY, Kaplanoğlu H, Saltas H, Hekimoglu B. Evaluation of the left renal vein variations and inferior vena cava variations by means of helical computed tomography. Clinical imaging. 2013 May 1;37(3):530-5.

[24]. Karaman B, Koplay M, Özturk E, Basekim CC, Ogul H, Mutlu H, Kizilkaya E, Kantarci M. Retroaortic left renal vein: multidetector computed tomography angiography findings and its clinical importance. ActaRadiologica. 2007 Jan 1;48(3):355-60.

[25]. Koc Z, Ulusan S, Oguzkurt L, Tokmak N. Venous variants and anomalies on routine abdominal multi-detector row CT. European journal of radiology. 2007 Feb 1;61(2):267-78.

[26]. Pandya VK, Patel AS, Sutariya HC, and Gandhi SP. Evaluation of renal vascular anatomy in live renal donors: Role of multi detector computed tomography. Urology annals. 2016 Jul;8(3):270.

[27]. Cantatore A, Müller P. Introduction to computed tomography. Kgs. Lyngby: DTU Mechanical Engineering. 2011 Mar.

[28]. Brenner DJ, Hall EJ. Computed tomography—an increasing source of radiation exposure. New England journal of medicine. 2007 Nov 29;357(22):2277-84.

[29]. De Chiffre L, Carmignato S, Kruth JP, Schmitt R, Weckenmann A. Industrial applications of computed tomography. CIRP annals. 2014 Jan 1;63(2):655-77.

[30]. Brooks SL. Computed tomography. Dental Clinics of North America. 1993 Oct 1; 37(4):575-90.

[31]. Fleischmann D, Boas FE. Computed tomography—old ideas and new technology. European radiology. 2011 Mar;21:510-7.

[32]. Budinger TF, Gullberg GT, Huesman RH. Emission computed tomography. InImage reconstruction from projections. Implementaton and applications 1979.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUN592

[33]. Hathcock JT, Stickle RL. Principles and concepts of computed tomography. Clinics of North America: Small Animal Practice. 1993 Mar 1;23(2):399-415.
[34]. Buzug TM. Computed tomography. Springer Berlin Heidelberg; 2011.
[35]. Kalender WA. X-ray computed tomography. Physics in Medicine & Biology. 2006 Jun 20;51(13):R29.
[36]. Natterer F. The mathematics of computerized tomography. Society for Industrial and Applied Mathematics; 2001 Jan 1.
[37]. Samei E, Pelc BJ. Computed Tomography. Springer; 2020.
[38]. Garvey CJ, Hanlon R. Computed tomography in clinical practice. Bmj. 2002 May 4;324(7345):1077-80.
[39]. Hsieh J. Computed tomography: principles, design, artifacts, and recent advances. 2003.
[40]. Sera T. Computed tomography. Transparency in Biology: Making the Invisible Visible. 2021:167-87.
[41]. Smith-Bindman R. Is computed tomography safe. N Engl j Med. 2010 Jul 1;363(1):1-4.
[42]. Townsend DW. Positron emission tomography/computed tomography. InSeminars in nuclear medicine 2008 May 1 (Vol. 38, No. 3, pp. 152-166). WB Saunders.
[43]. Withers PJ, Bouman C, Carmignato S, Cnudde V, Grimaldi D, Hagen CK, Maire E, Manley M, Du Plessis A, Stock SR. X-ray computed tomography. Nature Reviews Methods Primers. 2021 Feb 25;1(1):18.
[44]. Yeşildag A, Adanir E, Köroğlu M, Baykal B, Oyar O, Gülsoy UK. Incidence of left renal vein anomalies in routine abdominal CT scans. TanısalGirişimselRadyoloji: TibbiGörüntülemeVeGirisimselRadyolojiDernegiYayinOrgani. 2004 Jun 1;10(2):140-3.
[45]. Zhu J, Zhang L, Yang Z, Zhou H, Tang G. Classification of the renal vein variations: a study with multidetector computed tomography. Surgical and Radiologic Anatomy. 2015 Aug;37:667-75.
[46]. Atalar MH, Kosar MI, Salk I, Isleyen M. Left renal vein abnormalities detected during routine abdominal computed tomography imaging: clinico-radiological significance. Folia Morphologica. 2012;71(3):168-72.
[47]. Reed MD, Friedman AC, Nealey P. Anomalies of the left renal vein: analysis of 433 CT scans. Journal of computer assisted tomography. 1982 Dec 1;6(6):1124-6.
[48]. Royal SA, Callen PW. CT evaluation of anomalies of the inferior vena cava and left renal vein. American Journal of Roentgenology. 1979 May 1;132(5):759-63.
[49]. Ashley DW, Gamblin TC, Burch ST, Solis MM. Accurate deployment of vena cava filters: comparison of intravascular ultrasound and contrast venography. Journal of Trauma and Acute Care Surgery. 2001 Jun 1;50(6):975-81.
[50]. Oyar O, CalC, Ozyurt C, Sevinc E. BT ilesaptanan sol renal venanomalileri. BilgisayarlıTomografiBülteni. 1997;4(3):141-5.
[51]. Yeflilda A. Rutin abdomen BT'de sol renal van anomalileriningörülme. 2004; 10: 140-143.