Duplicated infra-renal inferior vena cava, right renal artery, absenteeism of right common iliac vein "All in one": A case report

Anjali Singal, Anju Choudhary, Priti Chaudhary

Department of Anatomy, All India Institute of Medical Sciences, Bathinda, 151001, India

SUMMARY

A duplicated inferior vena cava, along with a double renal artery and other vascular variations, is an infrequent finding and its thorough knowledge is significant in various vascular, urological and colorectal surgeries, as well as in treatment of thromboembolic disease. The present case reports a duplicated infra-renal inferior vena cava, presence of transverse intercaval channel, absence of right common iliac vein and double right renal artery, all in one case. Such a constellation of variations has rarely been reported, so the awareness of these deviations is crucial for accurate diagnosis, careful surgical planning, and prevention of potential complications.

Key words: Duplicated inferior vena cava – Duplicated renal artery

INTRODUCTION

A duplicated inferior vena cava (DIVC) was first reported by Lucas in 1916 at Anatomy laboratory in London (Lucas, 1916). The reported incidence of DIVC ranges from 0.3 to 3%, with a documented prevalence of 0.7% (Adachi 1940, Yano et al., 2000; Hostiuc et al., 2019). Though clinically silent and diagnosed incidentally, the thorough knowledge of this variant vessel is important in order to avoid inadvertent complications during retroperitoneal surgeries or interventional radiology (Chen et al., 2012). Major impact has been reported because of this duplicated venous channel in urological and surgical oncology (Hostiuc et al., 2019). A recent study has reported an accidental puncture of left inferior vena cava (IVC), as it was obscured from the view by the hypogastric nerve plexus and retroperitoneal adipose tissue layer, during robot-assisted low anterior resection (conventional five-port approach), while operating on to 72-year-old man with advanced lower rectal cancer. The authors informed that, although its presence was confirmed by computed tomography (CT) preoperatively, the difficulty in recognising and mobilizing tissue layers was an added risk factor. Therefore, preoperative imaging and meticulous surgical planning are essential to identify and manage such variations, thereby mitigating associated risks (Kawamura et al., 2023). The current case reports a duplicated infra-renal IVC, presence of transverse intercaval channel, absence of right common iliac vein, and a double right renal artery, all in one case. As per best literature search, these variations have rarely been reported collectively in one case. So, the pre-hand

Corresponding author:
Dr Anjali Singal, Associate Professor. Department of Anatomy, All India Institute of Medical Sciences, Bathinda (Punjab), India 151001. Phone: +91-8168498378. E-mail: anjali_singal@rediffmail.com - ORCID: 0000-0002-1798-4611

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knowledge of such variations may be of immense importance during radiological interpretations, urologic, gynaecologic, and colorectal surgeries. If overlooked, it can result in severe bleeding, increased operative time, and potential vascular injury.

CASE REPORT

During the routine dissection performed on a 76-year-old female cadaver, presence of DIVC, intercaval channel, absence of right common iliac vein, duplicated right renal artery, along with other variations, was noted. Different parameters were measured using digital vernier calliper (Mitutoyo, Japan, 0.02 mm) and measuring tape. The following observations were made

Infrarenal DIVC

DIVC below the opening of renal veins on each side of abdominal aorta was observed. The length and external diameter of right and left IVC before the joining of corresponding renal vein was 9. 5cm; 9 cm and 1.7 cm; 1 cm, respectively (Fig. 1a).

Left common iliac vein

The left common iliac vein (length 3.8 cm, external diameter 1cm) and transverse intercaval channel joined to form left IVC. Common channel (length 4 cm) of left IVC and left renal vein crossed the abdominal aorta, 1.2 cm below the origin of superior mesenteric artery and 3 cm above the origin of inferior mesenteric artery (Fig. 1a, 1b). The length of left renal vein was 4.5 cm. Left suprarenal vein drained into the common channel of left IVC and renal vein, immediately after their convergence. The left ovarian vein drained into the left renal vein at a point 1 cm proximal to left IVC and renal vein junction (Fig 1a, 1b).

Absence of right common iliac vein

There was no right common iliac vein as the right external and internal iliac veins continued with right IVC and the right end of transverse intercaval channel respectively. They had an H-shaped arrangement, i.e. right external and internal iliac veins fused at the level of sacral promontory temporarily (1.5 cm below the intercaval channel) and separated again (Fig. 1b).

Transverse intercaval channel

Transverse intercaval channel was observed between two venae cava at their commencement be-

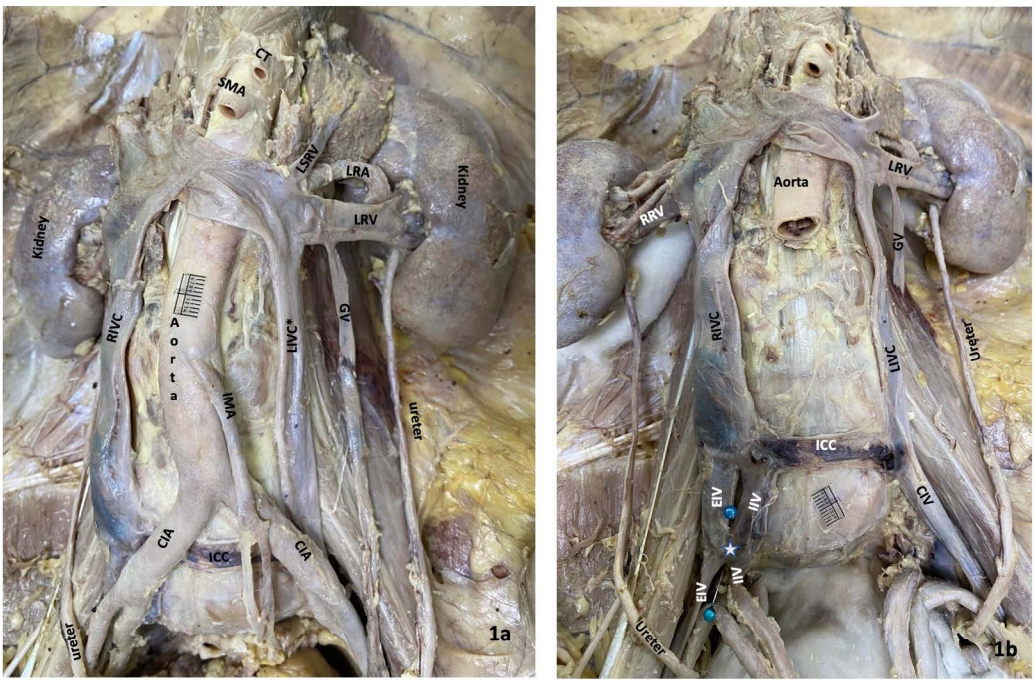

Fig. 1.- Dissected posterior abdominal wall showing duplicated infrarenal inferior vena cava and other variations. 1a) Duplicated infrarenal inferior vena cava, LIVC* (left inferior vena cava). 1b) Aorta withdrawn to expose transverse intercaval channel (ICC) connecting two vena cava and drainage of right EIV and IIV, star indicates, H- shaped fusion between EIV and IIV. CT, coeliac trunk; SMA, Superior mesenteric artery; IMA, Inferior mesenteric artery; CIA, Common iliac artery; ICC, intercaval channel; RIVC, right inferior vena cava; LIVC, left inferior vena cava; GV, Gonadal vein; LSRV, left suprarenal Vein; LRA, left renal artery; LRV, left renal vein, RRV, Right renal vein; CIV, Common iliac vein.

hind the aorta at the level of disc between L4 and L5. The length and external diameter of this channel was 4.5 cm, and 0.8 cm, respectively (Fig. 1b).

Duplicated right renal artery

Two right renal arteries (RRA1 and RRA2- hilar arteries) directly originated from abdominal aorta at the level of L1 & L2 vertebrae (Fig. 2), with a gap of 0.4cm between them. The upper right renal artery (RRA1) was the main artery with diameter and length of 0.5 cm and 7.5 cm respectively. A hilar upper polar artery originated from RRA1 before its entrance into hilum (Fig. 2). The external diameter and length of lower right renal artery (RRA2) was 0.35 cm and 8 cm respectively. Both RRA1 and RRA2 coursed anterior to the corresponding renal vein. The left renal artery (length 6 cm, external diameter 0.5 cm) originated from the abdominal aorta at the level of RRA1. Bilateral osteophytes at first and third lumbar levels were also observed.

DISCUSSION

DIVC is typically asymptomatic, as it is exposed incidentally during diagnostic imaging for unrelated disease or intraoperatively (Kawamura et al., 2023). To avoid any confusion, the left gonadal vein must be differentiated from DIVC by confirming its commencement (Chen et al., 2012). It must be kept in mind that DIVC is typically used for infra-renal segment of IVC (Sharma et al., 2024). The complete DIVC involving both the infrarenal and suprarenal segments is extremely rare (Petik, 2015; Shaheen et al., 2022). Recently, rarest complete IVC and superior vena cava duplication has been reported (Sharma et al., 2024). The authors suggest the use of precise terminology, distinguishing infra-renal DIVC, as observed in the current case from complete DIVC (including both suprarenal and infrarenal) to ensure greater anatomical clarity and clinical communication. In a study conducted on the development of IVC in the domestic cat in 1920, the authors proposed a theoretical classification system for IVC anomalies, suggesting the existence of 14 possible variations (Huntington and McLure, 1920).

Gupta et al. (2023) classified DIVC into complete (left IVC receives the left renal vein, continues as

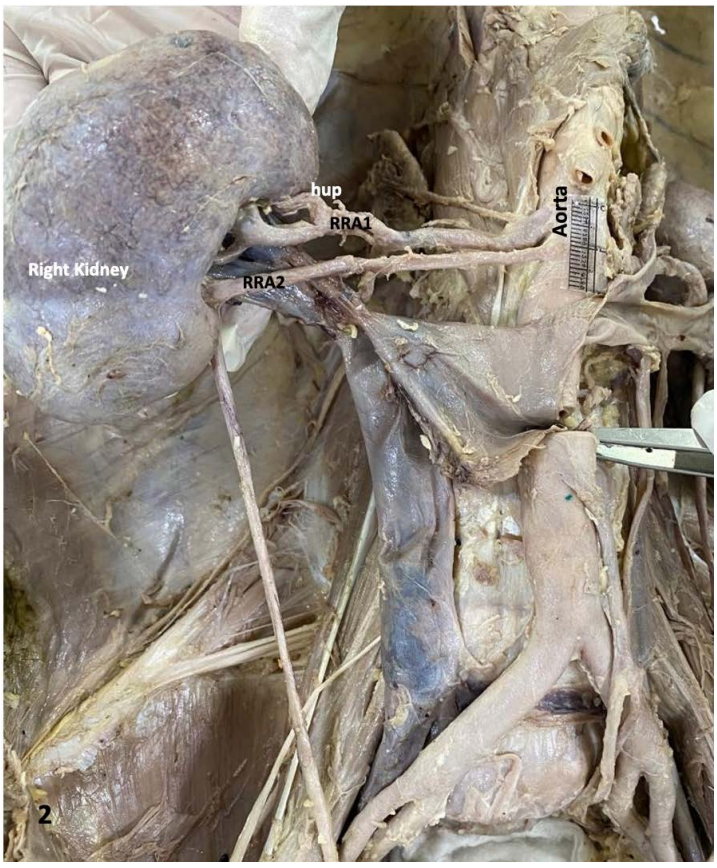

Fig. 2.- Double renal artery on the right side (RRA1, RRA2- hilar arteries) originating from aorta, hup- hilar upper polar artery from RRA1; RRA, right renal artery.

a preaortic trunk and drains into the right IVC) and incomplete (left common iliac vein ascends as DIVC, drains in the left renal vein, which later joins the right IVC), as in the current case. Spratt (2016), described that the communication between the right and left IVC is typically situated in the position normally occupied by the left common iliac vein.

Absence of right common iliac vein

The recent rise in kidney transplantation requests has led to increased research into the vascular anatomy of patients with various kidney anomalies. Notably, the right common iliac vein is a crucial vessel for angiostomy (Iwanaga et al., 2016). Thus, its absence in rare cases should be considered for successful surgery.

Chen et al. (2012) analyzed 109 DIVC reported cases in literature and confirmed the existence of interiliac vein (transverse intercaval channel) connecting DIVC in 74 cases (67.9%). It was placed obliquely and horizontally in 55.9% and 11.9% cases respectively. This channel was described as the left common iliac vein in normal development, but the exact embryogenesis is not clarified yet (Oertel, 1928). It is important to know the presence of intercaval channel, as otherwise unexpected hemorrhage during retroperitoneal procedures, e.g., in anterior lumbar interbody fusion may occur, because of its presence in front of the anterior lumbar or sacral region (Inamasu and Guiot, 2005). In the current case too, the channel was located anterior to lower lumbar vertebrae and the presence of osteophytes may further impact the channel (Fig. 1b). This venous channel is also considered to be critical factor in deciding the strategy for venous interventional radiology, like in IVC filter placement, as otherwise such IVC anomalies may be a possible source for deep venous thrombosis especially in adults (Anne et al., 2005).

The embryogenesis of IVC is a complex process as it involves development, regression, anastomosis and replacement of three embryonic veins i.e., posterior cardinal, subcarinal and supracardinal (McClure and Butler, 1925; Chen et al., 2012). During the fourth week of embryonic development, the right and left horns of the sinus venosus receive three pairs of veins—common cardinal, umbilical, and vitelline—which drain blood from the general body tissues, placenta, and yolk sac, respectively (McClure and Butler, 1925). IVC typically is a right sided vein which develops as: a) Infrarenal segment from right supracardinal vein, b) Renal segment from right supracardinal anastomosis, c) suprarenal segment from right subcardinal vein, d) hepatic segment from right hepatocardiac channel vein. The infrarenal DIVC as in the current case, is due to the persistence of both supracardinal veins (McClure and Butler, 1925; Chen et al., 2012). The absence of right common iliac vein may be related to non-development of part of right posterior cardinal vein just before the iliac venous anastomosis of posterior cardinal veins. The persistence of long iliac venous anastomosis of posterior cardinal veins may be considered as intercaval channel in the current case.

Duplicated right renal artery

The variations in renal artery number are well reported (20-23% cases) in literature (Satyapal et al., 2001; Bordei et al., 2004). However, bilateral duplication of renal arteries along with DIVC has rarely been reported previously (Xue et al., 2006). The previous authors reported DIVC with bilateral double renal arteries, in contrast with unilateral presence in this case.

In the current case, the renal arterial variation corresponds to Pattern II, comprising two-type, “a” hilar artery and one-type, “b” superior polar (hilar) renal artery, as per the classification by Cases et al. (2017). The information regarding variations in renal arteries is important while planning surgical or radiological procedures, as otherwise it may lead to complications (Cases et al., 2017).

Nine lateral mesonephric arteries of the developing embryo are divided into cranial, middle and caudal groups; the renal artery usually originates from the middle group, and the existence of an extra branch from lateral mesonephric arteries leads to the formation of accessory renal artery (Xue et al., 2006). Although, from an embryological perspective, the developments of IVC and the renal arterial system are distinct and unrelated

processes, however, their occurrence in a single case should still be taken into consideration.

Osteophytes/bony spurs represent a frequent joint pathology, and their risk of development increases with age. The presence of such bony growths can impact the adjacent structures, e.g. in the current case, the bilateral osteophytes presence on anterolateral aspect of L1 and L3 may affect the wall of IVC or aorta and may lead to perforation or ischemia (Padur et al., 2017). Their occurrence should be kept in mind, especially in cases with DIVC, where both the veins may be at risk, because of bilateral osteophyte presence, as in the current case.

CONCLUSION

To conclude, the co-existence of infrarenal DIVC, anteriorly coursing intercaval venous channel, right common iliac vein absence, duplicated right renal artery, all in one case, conveys important surgical and interventional implications, as it may predispose to unexpected hemorrhage during retroperitoneal procedures such as anterior lumbar interbody fusion, influence decision-making in procedures like IVC filter placement, and increase the risk of thrombotic events. Thus, the prior knowledge of such complex variations is vital for surgeons, radiologists and interventional specialists.

AUTHOR CONTRIBUTION

A. Singal: Dissection, analysis, or interpretation of report, manuscript writing. A. Choudhary: Acquisition of information, manuscript drafting. P. Chaudhary: Illustration, Manuscript editing; All the authors approved the final draft of the paper.

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REFERENCES

ADACHI B (1940) Das Venensystem der Japaner. *Die Kaiserlich-Japanischen Universtät zu Kyoto*, pp 216-266.

ANNE N, PALLAPOTHU R, HOLMES R, JOHNSON MD (2005) Inferior vena cava duplication and deep venous thrombosis: case report and review of literature. *Ann Vasc Surg*, 19(5): 740-743.

BORDEI P, SAPTE E, ILIESCU D (2004) Double renal arteries originating from the aorta. *Surg Radiol Anat*, 26(6): 474-479.

CASES C, GARCÍA-ZOGHBY L, MANZORRO P, VALDERRAMA-CANALES FJ, MUÑOZ M, VIDAL M, SIMÓN C, SANUDO JR, MCHANWELL S, ARRAZOLA J (2017) Anatomical variations of the renal arteries: cadaveric and radiologic study, review of the literature, and proposal of a new classification of clinical interest. *Ann Anat*, 211: 61-68.

CHEN H, EMURA S, NAGASAKI S, KUBO KY (2012) Double inferior vena cava with interiliac vein: a case report and literature review. *Okajimas Folia Anat Jpn*, 88: 147-151.

GUPTA P, KHULLAR M, SHARMA R, SINGH R (2013) A rare presentation of the double inferior vena cava with an anomalous retrocaval right ureter: embryogenesis and clinical implications. *J Clin Diagn Res*, 7: 518-521.

HOSTIUC S, MINOIU C, NEGOI I, RUSU MC, HOSTIUC M (2019) Duplication and transposition of inferior vena cava: A meta-analysis of prevalence. *J Vasc Surg Venous Lymphat Disord*, 7: 742-755.

HUNTINGTON GS, MCCLURE CFW (1920) The development of the veins in the domestic cat (Felis domestica) with especial reference, 1) to the share taken by the supracardinal veins in the development of the postcava and azygos veins and 2) to the interpretation of the variant conditions of the postcava and its tributaries, as found in the adult. *Anat Rec*, 20(1): 1-30.

INAMASU J, GUIOT BH (2005) Laparoscopic anterior lumbar interbody fusion: a review of outcome studies. *Minim Invasive Neurosurg*, 48: 340-347.

IWANAGA J, WATANABE K, SAGA T, YAMAKI K (2016) Bilateral malrotated kidney with major venous variant: a cadaver case report. *Int J Anat Var*, 9: 43-44.

KAWAMURA M, YAMASHITA S, IMAOKA H, SHIMURA T, KITAJIMA T, OKUGAWA Y, OKITA Y, OHI M, TOIYAMA Y (2023) Double inferior vena cava, an uncommon but relevant anatomical anomaly in surgery for lower rectal cancer: a report of two cases. *Surg Case Rep*, 9: 162.

LUCAS MF (1916) A case of double inferior vena cava. *J Anat*, 51: 69-70.

MCCLURE CFW, BUTLER EG (1925) The development of the vena cava inferior in man. *Am J Anat*, 35: 331-383.

OERTEL O (1928) Teilweser Fortbestand der unteren Cardinalvenen beieinem Erwachsenen. *Anat Anz*, 65: 312-314.

PADUR AA, KUMAR N, SHANTHAKUMAR SR, BISHNU A (2017) Morphometric and histological study of osteophytes in human cadaveric lumbar vertebrae. *J Clin Diagn Res*, 11(10): AC05-AC07.

PETIK B (2015) Inferior vena cava anomalies and variations: imaging and rare clinical findings. *Insights Imaging*, 6(06): 631-639.

SATYAPAL KS, HAFFEJEE AA, SINGH B, RAMSAROOP L, ROBBS JV, KALIDEEN JM (2001) Additional renal arteries: incidence and morphometry. *Surg Radiol Anat*, 23(1): 33-38.

SHAHEEN S, ALYAHYA KI, EL FOUHIL AF, SALAMA EEA, ATTEYA M, ELSHAER F, DARWISH H (2022) An extremely rare complete bilateral duplication of inferior vena cava in a male cadaver: anatomy, embryology and clinical relevance. *Folia Morphol (Warsz)*, 81: 247-253.

SHARMA A, BHATIA H, NAGANUR SH, SINGHAL M (2024) Complete duplication of inferior vena cava coexisting with double superior vena cava in situ solitus: hitherto unreported pattern. *Indian J Radiol Imaging*, 34: 177-180.

SPRATT JD (2016) Inferior vena cava, portal and hepatic venous systems. In: Tubbs RS, Shoja MM, Loukas M (eds.). *Bergman's Comprehensive Encyclopedia of Human Anatomic Variation*. John Wiley & Sons, Inc. pp 877-889.

XUE HG, YANG CY, ASAKAWA M, TANUMA K OZAWA H (2006) Duplication of the inferior vena cava with other variations. *Anat Sci Int*, 82: 121-125.

YANO R, HAYAKAWA D, EMURA S, CHEN H, OZAWA Y, TAGUCHI H, SHOUMURA S (2000) Two cases of the double inferior venae cavae. *Okajimas Folia Anat Jpn*, 77: 133-136.