

## Multi-Detector CT Findings of Double Retroaortic Left Renal Veins 이중후대동맥좌신정맥의 다중검출기 전산화단층촬영 소견

Kyung Eun Park, MD, Young Mi Ku, MD, Su Lim Lee, MD

Department of Radiology, Uijeongbu St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Uijeongbu, Korea

The awareness of renal vascular anomalies is important in order to avoid diagnostic pitfalls and to plan for preoperative surgery and interventional radiology. Retroaortic left renal vein is an uncommon congenital venous variation that is classified type 1 and type 2. However, coexistence of type 1 and type 2, called double retroaortic left renal veins, is an extremely rare variation. Only a few cases of double retroaortic left renal veins have been reported. We present a case of a 51-year-old woman with double retroaortic left renal veins with multi-detector CT findings and review of embryological basis.

### Index terms

Multi-Detector CT  
Congenital Anomalies  
Renal Vein

## INTRODUCTION

Various anomalies of renal vein mainly result from errors of the embryological development, and are frequently seen on a cross-sectional imaging. Since the development of cross-sectional imaging, congenital anomalies of renal vein have become more frequently encountered in asymptomatic patients (1). Knowledge and detection of these venous anomalies are clinically important for retroperitoneal surgeons and interventional radiologists, as well as in staging of gynecological and urologic malignancy. Retroaortic left renal vein is an infrequently encountered congenital venous variation, but duplication of the retroaortic left renal vein is a rare congenital anomaly. We report an extremely rare multi-detector CT (MDCT) finding of double retroaortic left renal veins, combined with a review of the literature.

## CASE REPORT

A 51-year-old woman with periumbilical acute abdominal pain was brought to our emergency department. She under-

went a contrast-enhanced MDCT scan for the evaluation of abdominal pain and double retroaortic renal veins were revealed, incidentally. Superior retroaortic left renal vein was passing posterior to the abdominal aorta, which drained into the inferior vena cava (IVC) at the level of L1-2 vertebra (Fig. 1A, C-E). Inferior retroaortic left renal vein was also passing posterior to the abdominal aorta, separately draining into the IVC at the level of L3-4 vertebra (Fig. 1B-E). A thorough examination did not show preaortic renal vein. This patient also had advanced liver cirrhosis and esophageal varices. There was no other additional congenital anomaly.

## DISCUSSION

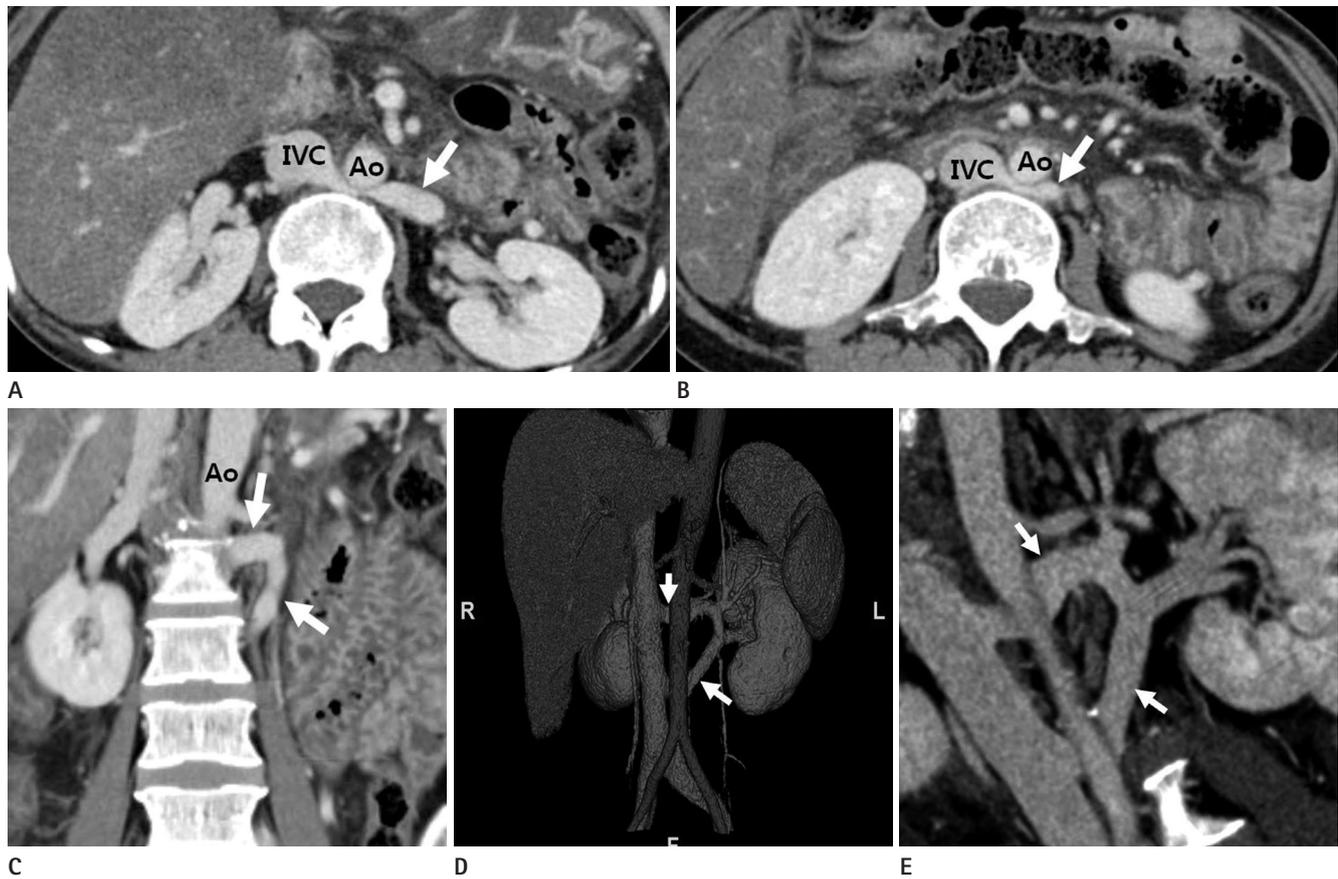
The development of the renal vein is closely related to the embryogenesis of the IVC (1-4). The IVC is formed from the three parallel veins, which subsequently appeared and regressed between the 4th and 8th weeks of fetal life (Fig. 2A).

The subcardinal veins lie in a plane ventral to the aorta and medial to the postcardinal veins, and communicate with each other through multiple anastomoses. These veins form the

Received May 17, 2012; Accepted July 26, 2012

Corresponding author: Young Mi Ku, MD  
Department of Radiology, Uijeongbu St. Mary's Hospital,  
College of Medicine, The Catholic University of Korea,  
271 Cheonbo-ro, Uijeongbu 480-717, Korea.  
Tel. 82-31-820-3148 Fax. 82-31-846-3080  
E-mail: ymiku@catholic.ac.kr

Copyrights © 2012 The Korean Society of Radiology



**Fig. 1.** Contrast-enhanced MDCT images of a 51-year-old woman with double retroaortic left renal veins. Axial CT image at level of L1-2 vertebra (**A**) shows the left retroaortic renal vein coursing behind the abdominal aorta and draining into the IVC (white arrow). Axial CT image at level of L3-4 vertebra (**B**) reveals another left retroaortic renal vein that runs dorsally to the abdominal aorta and draining into the IVC (white arrow). Coronal reformatted CT image (**C**) demonstrates two left retroaortic renal veins. Volume Rendering 3D reconstruction image (**D**) and Curved multiplanar reformation image (**E**) show two left retroaortic renal veins coursing behind the abdominal aorta and separately draining into the IVC behind the abdominal aorta.

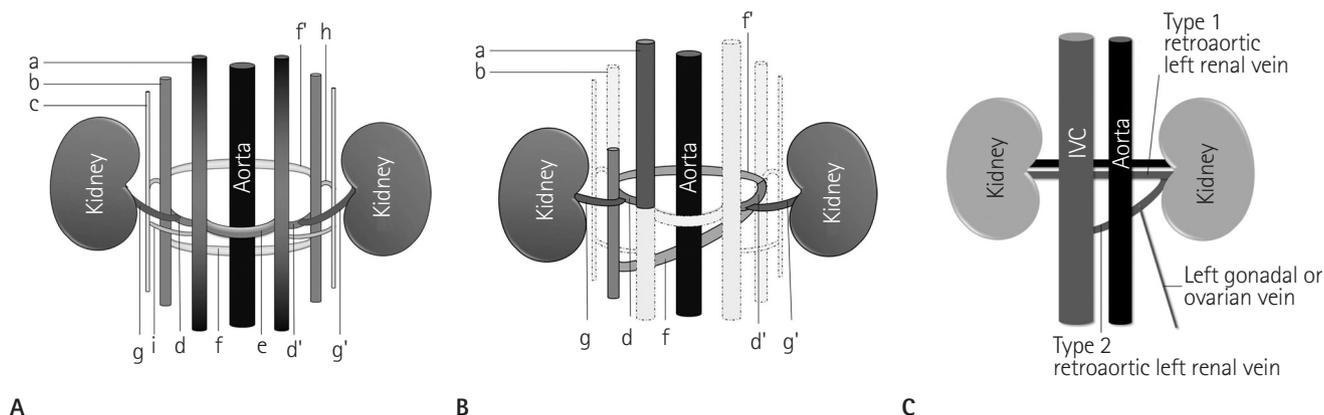
Note.—Ao = aorta, IVC = inferior vena cava, MDCT = multi-detector CT, 3D = three-dimensional

stem of the left renal vein, the suprarenal veins, the gonadal veins and the prerenal segment of the IVC. The supracardinal veins lie in a plane that is dorsal to the aorta. The caudal part of the right supracardinal vein enlarges and forms the infrarenal segment of the IVC, and the cranial end forms the azygos and hemiazygos veins.

The renal veins are formed by the anastomoses of the supracardinal and subcardinal veins (Fig. 2B). The two renal veins form as the ventral and dorsal vein; the dorsal vein usually regresses, and the ventral vein forms the renal vein. Various anomalies of the renal vein can develop during the developmental process. The major anomalies of the renal vein are circumaortic left renal vein and retroaortic left renal vein. The prevalence of circumaortic left renal vein and retroaortic left renal vein are 8.7% and 3.2%, respectively (5). Both circumaortic and ret-

roaortic of the left renal veins are the result of persistence of the dorsal limb of the embryonic left renal vein and of the dorsal arch of the renal collar, which is the intersupracardinal anastomosis. However, in retroaortic left renal vein, ventral vein regresses so that a single renal vein passes posterior to the aorta.

Two types of retroaortic renal vein have been reported, and all of them were present on the left (Fig. 2C). In type I, the ventral preaortic limb of the left renal vein is obliterated, but the dorsal retroaortic limb, along with the normally placed left renal vein, persists and joins the IVC in the orthotropic position. However, the dorsal midline anastomosis can occur at variable distances inferiorly, leading to the retention of a longer segment of the left supracardinal vessel. As a result, the left supracardinal vein descends two lumbar segments before anastomosis occurs, the left renal vein lies at the level of L4 to L5 and joins the



**Fig. 2.** Conceptual framework for the development of double retroaortic renal veins.

**A.** Coronal diagram shows embryological development of the renal veins and inferior vena cava. Three paired embryonic vessels and their anastomoses contribute the inferior vena cava and renal veins. The subcardinal and the supracardinal veins are interconnected by a network of veins, forming a venous collar around the aorta.

**B.** Coronal diagram shows developmental process of retroaortic left renal vein. Ventral intersubcardinal veins are regressed and remained dorsal intersupracardinal anastomosis and left renal collar veins are formed left renal vein. Regressed embryonic veins are illustrated by dash-line.

**C.** Coronal diagram shows coexistent two types of retroaortic left renal veins in case of our patient.

Note. — a = subcardinal vein, b = supracardinal vein, c = postcardinal vein, d, d' = supra-subcardinal anastomosis, renal collar, e = intersubcardinal anastomosis ventral to the aorta, f, f' = intersupracardinal anastomosis dorsal to the aorta, g, g' = renal vein from renal collar, h = post-supracardinal anastomosis, i = post-subcardinal anastomosis, IVC = inferior vena cava

gonadal and ascending lumbar veins before joining the IVC (Type 2).

In most cases, only one retroaortic left renal vein, either type 1 or 2, is presented. Simultaneous existence of the two types, as in our case, is extremely rare and has been reported only once, to the best of our knowledge (6). This is the first report of incidentally found double retroaortic left renal vein on MDCT of an asymptomatic patient.

Renal venous anomalies have several important clinical implications in retroperitoneal surgeons and interventional radiologists (1, 7, 8). Anomalous venous structures tend to be dilated and tortuous, making them more prone to injury. For this reason, the lack of preoperative recognition of renal vein anomalies can lead to dangerous complication during and after the procedure. Intraoperative trauma of an anomalous vein may cause life-threatening hemorrhage. The relationship of the ureters to the vessels in the retroperitoneum may also be confusing. During the removal of donor kidneys or urological procedures, veins need close attention because venous variations may lead to severe vascular complications. It is also important for radiologists who interpret angiograms or evaluate lymph node for staging of urological or testicular cancer (9).

In conclusion, precise awareness of rare renal venous variations, such as double retroaortic renal veins, is important to

prevent unforeseen complications during the operations or interventional procedures, and make accurate diagnosis in staging of gynecological and urologic malignancy.

## REFERENCES

1. Bass JE, Redwine MD, Kramer LA, Huynh PT, Harris JH Jr. Spectrum of congenital anomalies of the inferior vena cava: cross-sectional imaging findings. *Radiographics* 2000;20:639-652
2. Moore KL, Persaud TVN. *The cardiovascular system. The developing human: clinically oriented embryology*, 8th ed. London: Saunders, 2008:285-336
3. Mathews R, Smith PA, Fishman EK, Marshall FF. Anomalies of the inferior vena cava and renal veins: embryologic and surgical considerations. *Urology* 1999;53:873-880
4. Mayo J, Gray R, St Louis E, Grosman H, McLoughlin M, Wise D. Anomalies of the inferior vena cava. *AJR Am J Roentgenol* 1983;140:339-345
5. Aljabri B, MacDonald PS, Satin R, Stein LS, Obrand DI, Steinmetz OK. Incidence of major venous and renal anomalies relevant to aortoiliac surgery as demonstrated by computed tomography. *Ann Vasc Surg* 2001;15:615-618
6. Koc Z, Ulusan S, Tokmak N, Oguzkurt L, Yildirim T. Double

- retroaortic left renal veins as a possible cause of pelvic congestion syndrome: imaging findings in two patients. *Br J Radiol* 2006;79:e152-e155
7. Hoeltl W, Hruby W, Aharinejad S. Renal vein anatomy and its implications for retroperitoneal surgery. *J Urol* 1990; 143:1108-1114
8. Satyapal KS, Kalideen JM, Haffejee AA, Singh B, Robbs JV. Left renal vein variations. *Surg Radiol Anat* 1999;21:77-81
9. Kara E, Oztürk NC, Oztürk A, Yıldız A, Oztürk H. Ectopic kidney with varied vasculature: demonstrated by CT angiography. *Surg Radiol Anat* 2011;33:81-84

## 이중후대동맥좌신정맥의 다중검출기 전산화단층촬영 소견

박경은 · 구영미 · 이수림

신정맥의 다양한 선천성 기형들은 발생학적인 오류에서부터 발생한다. 최근 들어 전산화단층촬영과 같은 영상촬영기술이 발달하고 널리 사용됨에 따라 무증상의 환자에게서 신정맥의 선천성 기형의 발견 빈도가 높아지고 있다. 영상의학과 의사로서 선천성 기형에 관해 충분히 이해하고, 영상검사에서 발견해 내는 것은 비노생식기계 종양의 병기 결정뿐 아니라 후복막강을 수술하거나 중재시술을 시행하는 경우에 상당히 중요한 임상적 의미를 갖는다. 후대동맥좌신정맥은 드물지 않은 선천성 기형이나 동시에 두 개의 후대동맥좌신정맥이 존재하는 것은 굉장히 드문 경우로, 두 예 정도의 문헌 보고만 되었다. 저자들은 드문 선천성 기형인 이중후대동맥좌신정맥의 다중검출기 전산화단층촬영의 영상소견과 함께 발생원인 및 임상적인 의의에 대해 보고하고자 한다.

가톨릭대학교 의과대학 의정부성모병원 영상의학과