

## Duplication of the inferior vena cava: Two case reports

著者	Nakatani Toshio, Tanaka Shigenori, Mizukami Shigeki
著者別表示	中谷 壽男
journal or publication title	解剖學雜誌
volume	73
number	2
page range	171-174
year	1998
URL	<a href="http://doi.org/10.24517/00063290">http://doi.org/10.24517/00063290</a>



*Short Report*

## Duplication of the Inferior Vena Cava: Two Case Reports

Toshio Nakatani, Shigenori Tanaka and Shigeki Mizukami\*

Department of Anatomy II, School of Medicine, Faculty of Medicine, Kanazawa University, 13-1 Takaramachi, Kanazawa 920-8640, Japan

\*Division of Anatomy, College of Nursing, Fukui Prefectural University, 4-1-1 Kenjojima, Matsuokacyo, Yoshida-gun 910-1145, Japan

(Received January 14, 1998; accepted February 24, 1998)

**Abstract:** We encountered two cases of duplication of the inferior vena cava (IVC) in the Japanese cadavers of a 91-year-old man and a 71-year-old woman. Both of the anomalies were classified as Type BC and as Type I according to the systems of Chuang et al. (1974) and of Sarma (1966), respectively. In one case the right IVC was twice the diameter of the left IVC, and in the other it was five times as large. We discuss the clinical importance and the development of duplication of the IVC.

**Key words:** duplication, inferior vena cava, anomaly, Japanese

### INTRODUCTION

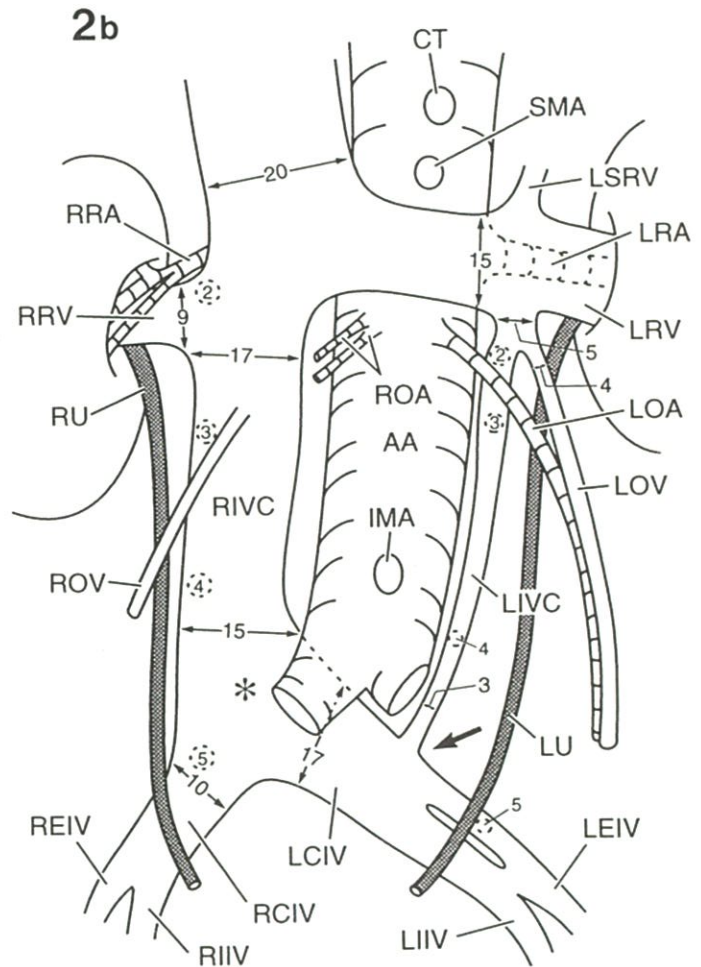
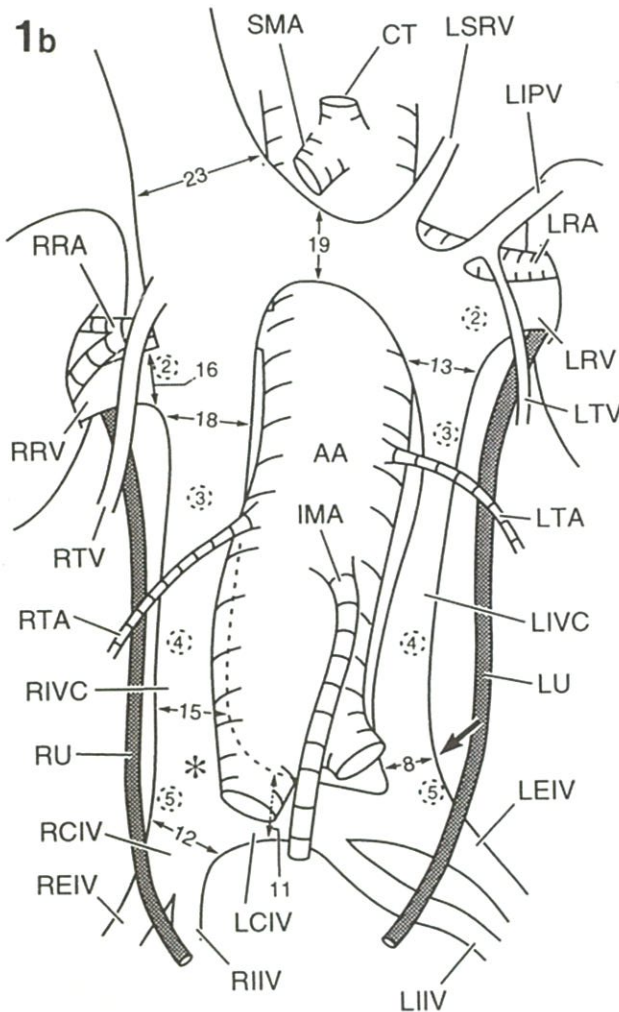
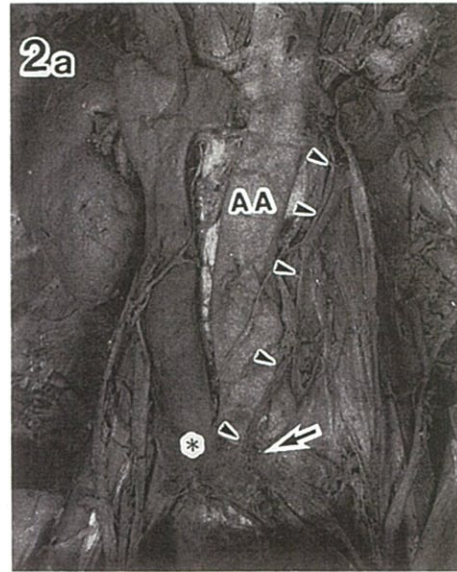
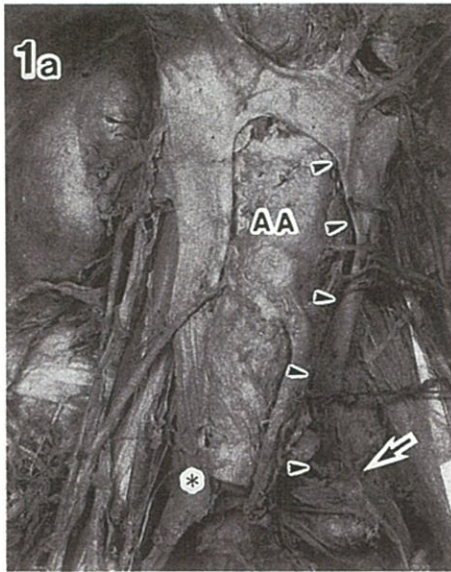
The development of the inferior vena cava (IVC) is complex (McClure and Butler, 1925). Based on its embryogenesis, the IVC is divided into four segments: the postrenal, renal, prerenal, and hepatic segment. According to the classification by Chuang et al. (1974), the anomalies of the postrenal segment are that with retrocaval ureter (Type A), otherwise normal IVC (Type B), left IVC (Type C), and double IVC (Type BC). The anomaly of the renal segment is a circumaortic venous ring, and that of the prerenal segment is azygous vein continuation. Sarma (1966) classified anomalous IVC into two types from the clinical and surgical point of view: Type I anomaly is duplication of the IVC, accessory IVC, and left-sided IVC with a right caval vein, and Type II anomaly as transposition of the IVC. Although these anomalies are detectable with computerized tomography and ultrasound examination (Mayo et al., 1983; Sener, 1993), they pose problems for surgeons if they are not recognized (Brener et al., 1974), for which reason it is important clinically to keep these anomalies in mind. We observed duplication of the IVC (Type BC as classified by Chuang et al., 1974; Type I as classified by Sarma, 1966) in two Japanese cadavers during a gross anatomical course for medical students conducted in 1997. We report the anomaly and discuss its clinical significance and embryogenesis.

### OBSERVATIONS

Case 1 (Fig. 1a, b): In the cadaver of a 91-year-old man, the right and left common iliac veins joined to form the right IVC anterior to and slightly to the right of the 5th lumbar vertebra. The right IVC ascended along its normal course to enter the right atrium. The right 3rd and 4th lumbar veins opened into the right IVC, while the 2nd and 5th lumbar veins opened into the junction of the right IVC and the right renal vein and into the right common iliac vein, respectively. The left IVC originated from the superior site of the left external iliac vein anterior to and slightly to the left of the 5th lumbar vertebra, 33 mm removed from the origin of the right IVC. The left vena cava ascended along the paravertebral column on the left side of the abdominal aorta for about 82 mm to join the left renal vein and received the 3rd and 4th lumbar veins. The 2nd and 5th lumbar veins opened into the junction of the left IVC and the left renal vein and into the confluence between the left IVC and the left external iliac vein, respectively. The left renal vein passed over the abdominal aorta below the superior mesenteric artery and extended to the right IVC. The right testicular vein drained into the anterior aspect of the right IVC superior to the right renal vein, while the left testicular vein drained into the left inferior phrenic vein, which together drained into the superior margin of the left renal vein. The right and left ureters descended deeply to the right and left testicular arteries and veins and superficially to the right and left inferior vena cava. The diameter of the right IVC was about twice that of the left IVC.

Case 2 (Fig. 2a, b): In the cadaver of a 71-year-old

Correspondence to: Toshio Nakatani, M.D., Department of Anatomy II, School of Medicine, Faculty of Medicine, Kanazawa University, 13-1 Takaramachi, Kanazawa 920-8640, Japan.



Figs. 1, 2

woman, the right and left common iliac veins joined to form the right IVC. The right IVC ascended along its normal course to empty into the right atrium. The right ovarian vein opened into the right IVC. The right 2nd and 5th lumbar veins emptied into the junction of the right IVC and the right renal vein and into the right common iliac vein, respectively. The right 3rd and 4th lumbar veins emptied into the right IVC. The left IVC occurred at the superior site of the left common iliac vein and united with the left ovarian vein 1 mm inferior to the left renal vein to drain into the left renal vein. Three left lumbar veins emptied into the left IVC. The 5th lumbar vein emptied into the left common iliac vein. The diameter of the right IVC was about five times that of the left IVC.

## DISCUSSION

Although the frequency of the left-sided IVC (Type C as classified by Chuang et al., 1974; Type II as classified by Sarma, 1966) is 0.11–0.57% on dissection, the frequency of duplication of the IVC (Type BC and Type I, respectively) is 0.2–2.8% on dissection (Gladstone, 1929; Seib, 1934; Adachi, 1940; Reis and Esenther, 1959). We encountered duplication of the IVC in 2 out of 101 cadavers (2.0% frequency) examined between 1995 and 1997. Since the anomaly in question is not extremely rare, it is important for surgeons who operate on the abdominal aorta to keep it in mind. When an abdominal aortic aneurysm is associated with a left-sided IVC, which is infrequent, the IVC passes upward from left to right across the aneurysm or the neck of the aneurysm. Thus, careful treatment of the IVC and the aneurysm is necessary (Gargiulo et al., 1994). According to Bartle et al. (1987), since the left renal vein is divided medially in duplication of the IVC, there ordinarily is no problem with exposure of the neck of the abdominal aortic aneurysm. When the left renal vein is large and crosses well above the neck, however, careful

management is necessary as in the left-sided IVC. Morishita et al. (1993) reported that when a left nephrectomy is performed in a patient with the duplication of the IVC, it is advisable to cut the left renal vein peripheral to the confluence of the left renal vein and the left IVC, because cutting the left renal vein central to the confluence can result in occlusive thrombus in the left IVC. Although the left IVC is usually smaller than the right IVC in duplication of the IVC (Takemoto et al., 1978), venous hemorrhage from the thin left IVC during left lumbar sympathectomy could have very grave consequences (Sarma, 1966). This is yet another reason that clinicians should keep in mind the possibility of anomalies of the IVC in patients undergoing abdominal surgery.

During the embryogenesis of the IVC a pair of postcardinal veins, of subcardinal veins and of supra-cardinal veins develop, regress, anastomose, and are replaced. The right subcardinal vein is the precursor of the prerenal segment of the IVC, the subcardinal anastomosis between the right and left subcardinal veins and the sub-supracardinal anastomosis between the right subcardinal and the right supracardinal veins become the renal segment of the IVC, and the right supracardinal vein becomes the postrenal segment of the IVC in the normal development of the IVC. Since the ureter extends posterior to the postcardinal vein, anterior to the supracardinal vein, and posterior to the subcardinal vein, it finally extends downward anterior to the supracardinal vein as the postrenal segment of the IVC after the disappearance of the postcardinal and subcardinal veins. Therefore, since in the present case the hepatic, prerenal and renal segments of the IVC are normal and the ureter is located ventral to the postrenal segment of the IVC, both the right and left supracardinal veins, as the postrenal segment of IVC, persist resulting in the duplication of the IVC (McClure and Butler, 1925; Chuang et al., 1974; Bannister et al., 1995). Moreover, the right and left intersegmental veins

**Fig. 1.** Case 1. Photograph (a) and drawing (b) of the duplication of the IVC in the cadaver of a 91-year-old man.

**Fig. 2.** Case 2. Photograph (a) and drawing (b) of the duplication of the IVC in the cadaver of a 71-year-old woman.

In figures 1a and 2a, the left IVC is indicated by arrow heads. In both cases, the right and left common iliac arteries have been cut to demonstrate the courses of the iliac veins. Asterisks indicate the confluence of the right and left common iliac veins. The left renal arteries and veins have been cut, and the left kidney removed. Arrows indicate the origin of the left IVC from the left external iliac vein (case 1) and from the left common iliac vein (case 2). Dotted circles indicate sites where lumbar veins join the posterior side of the veins, and numbers of the circles correspond to the 2nd, 3rd, 4th and 5th lumbar veins. Numbers indicate the diameters (denoted by small arrows) of veins.

**Abbreviations:** AA, abdominal aorta; CT, celiac trunk; IMA and SMA, inferior and superior mesenteric artery; LCIV and RCIV, left and right common iliac vein; LEIV and REIV, left and right external iliac vein; LIIV and RIIV, left and right internal iliac vein; LIPV, left inferior phrenic vein; LIVC and RIVC, left and right inferior vena cava; LOA and LOV, left ovarian artery and vein; LRA and LRV, left renal artery and vein; LSRV, left suprarenal vein; LTA and LTV, left testicular artery and vein; LU and RU, left and right ureter; ROA and ROV, right ovarian artery and vein; RRA and RRV, right renal artery and vein; RTA and RTV, right testicular artery and vein.

respectively drain into the right and left supracardinal veins. Intersupracardinal anastomoses between the right and left supracardinal veins are present. The normal right lumbar veins consist of the right intersegmental veins and drain into the IVC. The normal left lumbar veins consist of the junction of the left intersegmental veins and the intersupracardinal anastomoses due to the disappearance of the left supracardinal vein, and drain into the IVC. Thus, if the intersupracardinal anastomoses are underdeveloped or disappear early due to unknown events, the left IVC continues to drain blood from the left side through the left intersegmental

veins which remain as the left lumbar veins. Although this is merely hypothetical, the right and left lumbar veins do usually empty into the right and left IVC, respectively, in duplication of the IVC, and there are reports of rare cases in which both the right and left lumbar veins join only the right or the left IVC in this anomaly (Maxwell and Erwin, 1928).

*Acknowledgments.* We thank Mr. Y. Shiraishi for drawing the illustrations, Mr. T. Nakamura for technical assistance, and Ms. I. Koizumi for secretarial assistance.

## REFERENCES

- 1) Adachi B (1940) *Das Venensystem der Japaner*, Bd 2, Kenkyusha, Tokyo, pp 199–266
- 2) Bannister LH, Berry MM, Collins P, Dyson M, Dussek JE, Ferguson MWJ (1995) *Gray's Anatomy*, 38th ed, Churchill Livingstone, New York, pp 320–327
- 3) Bartle EJ, Pearce WH, Sun JH, Rutherford RB (1987) Infrarenal venous anomalies and aortic surgery: Avoiding vascular injury. *J Vasc Surg* 6: 590–593
- 4) Brener BJ, Darling RC, Frederick PL, Linton RR (1974) Major venous anomalies complicating abdominal aortic surgery. *Arch Surg* 108: 159–165
- 5) Chuang VP, Mena CE, Hoskins PA (1974) Congenital anomalies of the inferior vena cava. Review of embryogenesis and presentation of a simplified classification. *Br J Radiol* 47: 206–213
- 6) Gargiulo M, Stella A, Pedrini L, Faggioli GL, Mirelli M, Caputo M (1994) Left-side inferior vena cava and inflammatory abdominal aortic aneurysms: A case report. *Cardiovasc Surg* 2: 619–622
- 7) Gladstone RJ (1929) Development of the inferior vena cava in the light of recent research, with especial reference to certain abnormalities, and current descriptions of the ascending lumbar and azygos veins. *J Anat* 64: 70–93
- 8) Maxwell EV, Erwin GS (1928) Four cases of anomalous inferior vena cava with an explanation of their developmental origin. *J Anat* 62: 184–197
- 9) Mayo J, Gray R, Louis ES, Grosman H, McLoughlin M, Wise D (1983) Anomalies of the inferior vena cava. *AJR* 140: 339–345
- 10) McClure CFW, Butler EG (1925) The development of the vena cava inferior in man. *Am J Anat* 35: 331–383
- 11) Morishita H, Tsukahara K, Nango C (1993) Double inferior vena cava discovered by examination of traumatic rupture of congenital hydronephrotic renal pelvis: A case report. *Acta Urol Jpn* 39: 141–143 (in Japanese with English abstract)
- 12) Reis RH, Esenther G (1959) Variations in the pattern of renal vessels and their relation to the type of posterior vena cava in man. *Am J Anat* 104: 295–318
- 13) Sarma KP (1966) Anomalous inferior vena cava—Anatomical and clinical. *Br J Surg* 53: 600–602
- 14) Seib G (1934) The azygos system of veins in American whites and American negroes, including observations on the inferior caval venous system. *Am J Phys Anthropol* 19: 39–163
- 15) Sener RN (1993) Nonobstructive right circumcaval ureter associated with double inferior vena cava. *Urol* 41: 356–360
- 16) Takemoto R, Tezuka M, Yada D (1978) Four cases of anomalous postrenal vena cava with special regard to the classification of this kind of anomaly. *Acta Anat Nippon* 53: 423–434 (in Japanese with English abstract)