



## Left-Sided Inferior Vena Cava and Aortoiliac Surgery

Ghanem Ali Ahmad and Kheyrbek Mazhed\*

Department of Surgery, Tishreen University, Latakia, Syria

### Abstract

The Inferior Vena Cava (IVC) is formed by a complex process of embryogenesis during the sixth to tenth week of gestation.

Improper completion of the process may result in four anatomic anomalies:

- Duplication of the IVC.
- Transposition or left-sided IVC.
- Retroaortic left renal vein.
- Circumaortic left renal vein.

**Keywords:** Inferior vena cava; Venous congenital anomalies; Aortoiliac surgery

### Introduction

The first two anomalies can be diagnosed by Ultrasonography (USG) and all four anomalies can be seen on Computed Tomography (CT) scan of the abdomen. Preoperative diagnosis of the anomalies should reduce the complication rate of abdominal aortic operations. Anomalies of the IVC are uncommon but important entities to the radiologist and the vascular surgeon [1-5]. The radiologist must distinguish between an anomalous IVC and a pathologic process such as lymphadenopathy. They must also be aware of the anatomic variability of the renal veins [6-9]. The vascular surgeon needs to recognize anomalies of the IVC to perform safe dissections in patients undergoing aortic reconstruction (transperitoneal or retroperitoneal approach) or sympathectomy as well as to accurately insert a filter in the IVC in patients with pulmonary embolism or deep venous thrombosis.

### Case Presentation

A 65-year-old male complaining of intermittent claudicating visited the vascular surgery clinic. The pain is induced by walking for 100 meters and is relieved by rest. It spans the area of the gluteal and femoral muscles bilaterally, accompanied by numbness and paresthesia. There is no pain on rest. Past medical history is notable for essential hypertension, uncontrolled diabetes mellitus type 1, and hyperlipidemia. However, He is taking medications for hypertension and diabetes. Also, he is a heavy smoker with 30 pack-years.

Clinical examination shows bilateral pulselessness in the femoral and popliteal arteries, as well as the arteries around the ankle. His feet are slightly cold but the sense, movement, and color are normal and there are no ulcers. The Ankle-Brachial Index (ABI) is 0.6 on the left and 0.5 on the right. Duplex Ultrasonography (USG) reveals atherosclerosis in the arterial tree with multiple constrictions, low-velocity monophasic Doppler in the femoral (Figure 1), popliteal, and the arteries around the ankle bilaterally. Contrast arteriography shows atherosclerosis in the abdominal aorta pre-bifurcation, multiple constrictions in the common and external right iliac arteries (95% at peak), as well as 80% and 90% constrictions in the common and external left iliac arteries respectively (Figure 2). Collateral circulation was noted in the pelvic and femoral regions. However, no prominent constrictions were noted in the femoral, popliteal, and leg arteries.

The patient was diagnosed with bilateral aortoiliac atherosclerotic disease (TASC Class D, Fontaine Stage 2b, and Rutherford Stage 3). Reconstruction was planned for a bilateral aortofemoral bypass using a synthetic graft (Bentall procedure). The patient was prepped for surgery. Under general anesthesia, a longitudinal incision was made in the inguinal fold. The common femoral artery along with its deep and superficial branches was dissected with proximal and distal control. After that, a median longitudinal incision of the abdomen was done above and below the umbilicus to reach the aorta through the peritoneum. During this process, we noticed that the IVC was

### OPEN ACCESS

#### \*Correspondence:

Kheyrbek Mazhed, Department of Surgery, Tishreen University, Latakia, Syria, Tel: 963932029886; E-mail: majedkherbek@gmail.com

**Received Date:** 01 Mar 2020

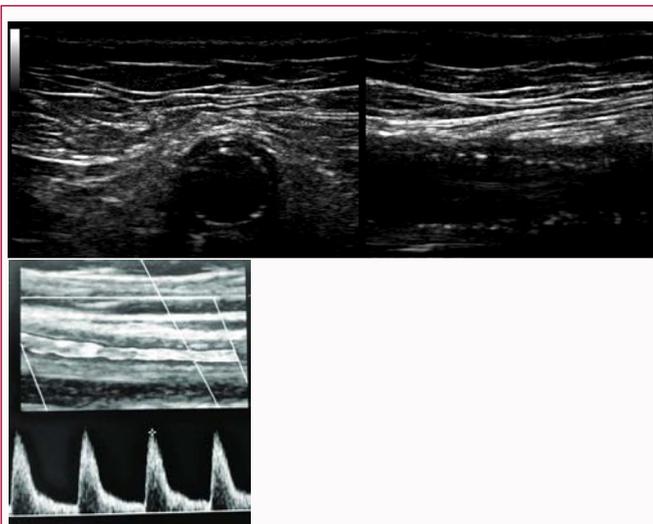
**Accepted Date:** 06 Apr 2021

**Published Date:** 09 Apr 2021

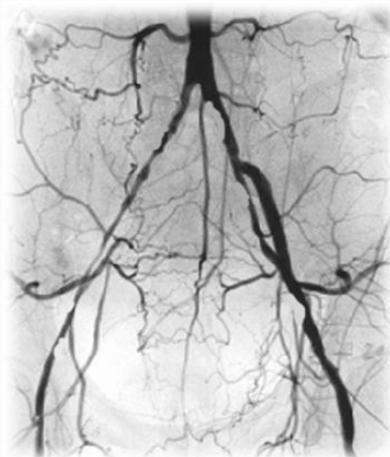
#### Citation:

Ahmad GA, Mazhed K. Left-Sided Inferior Vena Cava and Aortoiliac Surgery. *Ann Surg Case Rep.* 2021; 4(1): 1043.

**Copyright** © 2021 Kheyrbek Mazhed. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.



**Figure 1:** Doppler ultrasound shows severe atherosclerosis in the common femoral artery and monophasic graph in the superficial femoral artery.



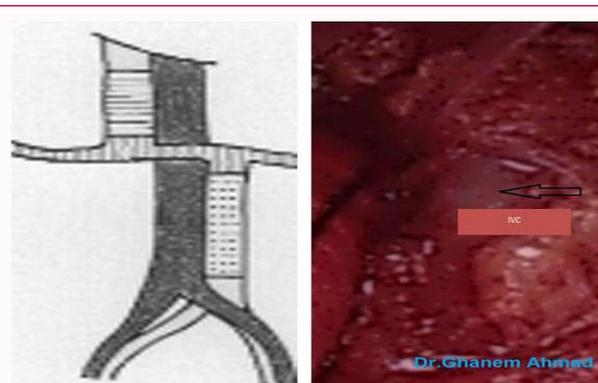
**Figure 2:** Contrast arteriography shows multiple constrictions in the infrarenal abdominal aorta as well as severe constrictions in the common and external iliac arteries bilaterally.

located to the left of the aorta (infrarenal left-sided IVC, Figure 3). A duplication of the IVC was excluded and then a careful dissection of the abdominal aorta was performed. A synthetic graft (Dacron 16x8) was inserted with lateral anastomoses using the appropriate threads (Figure 4). Finally, the incisions were closed after checking that the bypass was clear and checking the pulse around the ankle in both legs. The patient was monitored for a week and was discharged in a good condition. He was followed up in 3, 6, and 12 months with satisfactory outcomes.

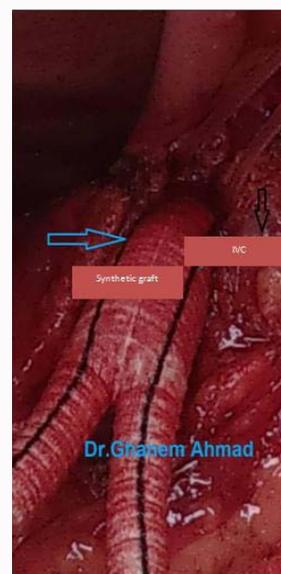
**Embryology overview**

The formation of the IVC is a complicated process that occurs between weeks 6 and 10 of gestation [6]. The common cardinal veins are the main vessels for embryonic venous circulation. Multiple vessel groups arise in different stages and places [8]. In each group, some segments may regress and some may develop as distinct vessels or share components with other segments in the same group.

In the first stage, pair of anterior and posterior cardinal veins is formed. They collect blood from the head and the body into a pair of common cardinal veins which in turn empty into the venous sinus of



**Figure 3:** Infrarenal left transposition of the inferior vena cave.



**Figure 4:** Bilateral aortofemoral bypass using a synthetic graft (Dacron 16x8).

the primitive heart. In the cranial region, the anterior cardinal veins form the internal jugular veins. Simultaneously, the anastomoses play a role in forming the left brachiocephalic vein which connects the left and right internal jugular veins. Through these anastomoses, blood circulates from the head to the anterior common cardinal vein which will form the superior vena cava. The proximal left cardinal vein forms the coronary sinus which is the endpoint for the coronary veins of the right atrium. In the trunk, a pair of inferior cardinal veins is formed and connects with the renal circulation. These veins form anastomoses with the posterior cardinal veins. Posterior and inferior cardinal veins collect blood from the renal circulation to multiple small lateral branches and when the intermediate kidney regresses, the inferior veins regress as well. All groups of cardinal veins begin to regress as the remaining veins connect to form the IVC along the right side of the inferior aorta.

**Discussion**

The 3 pairs of cardinal veins form the 4 components of the IVC in adults: Hepatic, suprarenal, renal, and infrarenal. Anatomic anomalies arise due to agenesis in the embryonic period [7]. The infrarenal segment of the IVC is formed by the right superior cardinal vein. In our case, it is formed by the left superior cardinal vein.

Transposition of the IVC is mostly asymptomatic. However, some cases were associated with deep vein thrombosis or Ivemark syndrome (asplenia with cardiac anomalies) [8,10,11]. CT is considered the best tool to diagnose IVC anomalies; it outperforms USG and contrast arteriography. Moreover, MRI can be as sensitive as CT while having a protective effect against contrast nephropathy.

In the infrarenal transposition of the IVC, the left renal vein usually empties into the IVC before crossing anterior to the aorta forming the suprarenal IVC which is located to the right of the aorta just as in a normal condition. Usually, the left-sided IVC crosses anterior to the aorta to its normal position on the right, it may also cross posteriorly. However, complete transposition of the IVC with hemiazygos vein continuation is considered very rare.

CT is not considered a routine preoperative diagnostic tool to discover aortoiliac atherosclerotic disease so this anomaly should be taken into consideration during surgery to prevent damage to the vein. It has also been suggested that the use of a lateral retroperitoneal approach would be a safer option. Finally, these anomalies may impose difficulties on aortic open surgery, as well as some other procedures such as placing an IVC filter, pace-maker insertion, and coronary artery catheterization [11].

## Conclusion

Transposition of the IVC is rarely seen in patients undergoing aortic and iliac surgeries. It should be taken into consideration in the preoperative evaluation. Should such anomaly be discovered, a cautious dissection of arteries should be done in order to prevent any vascular damage. This would prevent the risk of major bleeding without affecting the outcome of surgery.

## References

1. Babian RJ, Johnson DE. Major venous anomalies complicating retroperitoneal surgery south. *South Med J*. 1979;72(10):1254-8.
2. Chaung VP, Mena CE, Hoskins PA. Congenital anomalies of the left renal vein: Angiographic consideration. *Br J Radiol*. 1974;47(556):214-8.
3. Dardik H, Loop FD, Cox PA, Keshishian JM. C-pattern inferior vena cava. *JAMA*. 1967;200(3):248-9.
4. Kolbenstvedt A, Kolmannskog F, Lien HH. The anomalous inferior vena cava--another structure between the aorta and the superior mesenteric artery. *Br J Radiol*. 1981;54(641):423-5.
5. Brener BJ, Darling RC, Frederick PL, Linton RR. Major venous anomalies complicating abdominal aortic surgery. *Arch Surg*. 1974;108(2):159-65.
6. Carlson BM. *Human embryology and developmental biology*. 5<sup>th</sup> Ed. Netherlands: Elsevier; 2014.
7. Aljabri B, McDonald 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(6):615-8.
8. Minniti S, Visentini S, Procacci C. Congenital anomalies of the vena cavae: Embryological origin, imaging features and report of three new variants. *Eur Radiol*. 2002;12(8):2040-55.
9. Giglia JS, Thompson JK. Repair of a thoracoabdominal aortic aneurysm in the presence of a left-sided inferior vena cava. *J Vasc Surg*. 2004;40(1):161-3.
10. Nishibe T, Sato M, Kondo Y, Kaneko K, Muto A, Hoshino R, et al. Abdominal aortic aneurysm with left-sided inferior vena cava. Report of a case. *J Vasc Surg*. 2004;23(4):400-2.
11. Guray Y, Yelgec NS, Guray U, Yylmaz MB, Boyaci A, Korkmaz S. Left-sided or transposed inferior vena cava ascending as hemiazygos vein and draining into the coronary sinus *via* persistent left superior vena cava: Case report. *Int J Cardiol*. 2004;93(2-3):293-5.