



## Incidentally Found Absence of the Left Brachiocephalic Vein with Venous Return Through the Left Superior Intercostal Vein in an Adult Patient: Venography and CT Findings

정맥조영술과 다중검출 컴퓨터단층촬영으로 성인 환자에서 우연히 발견된 증상 없는 왼팔머리정맥의 부재

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A 63-year-old male patient was referred for venography of the thoracic venous system and multidetector computed tomography (CT) due to the unusual location of the left subclavian catheter tip. His venogram and CT images showed an absence of the left brachiocephalic vein (LBCV). Instead of through the LBCV, the usual venous circulation of neck and left upper limb was carried out by the engorged left superior intercostal vein (LSIV); this subsequently drained into the accessory hemiazygos vein and then the azygos vein that drains into the superior vena cava. Here, we report a rare case of an incidentally found absence of the LBCV with venous return through the LSIV in an adult patient, and we present a brief review of the relevant literature.

### Index terms

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## INTRODUCTION

The congenital anomalous condition of the left brachiocephalic vein (LBCV) is considered to be a rare anomaly in the thoracic venous system (1). In recent years, wide application of various imaging modalities has improved the detection of these conditions. The prevalence of an anomalous brachiocephalic vein in patients with congenital heart disease is about 0.2–1.7% (1, 2). The exact cause of anomalous brachiocephalic vein remains unknown; currently, three major theories have been proposed to explain this condition (1, 2). Here, we present a case of an incidentally found absence of the LBCV with venous return through the left superior intercostal vein (LSIV) in an adult pa-

tient who was studied with thoracic venography and multidetector computed tomography (MDCT).

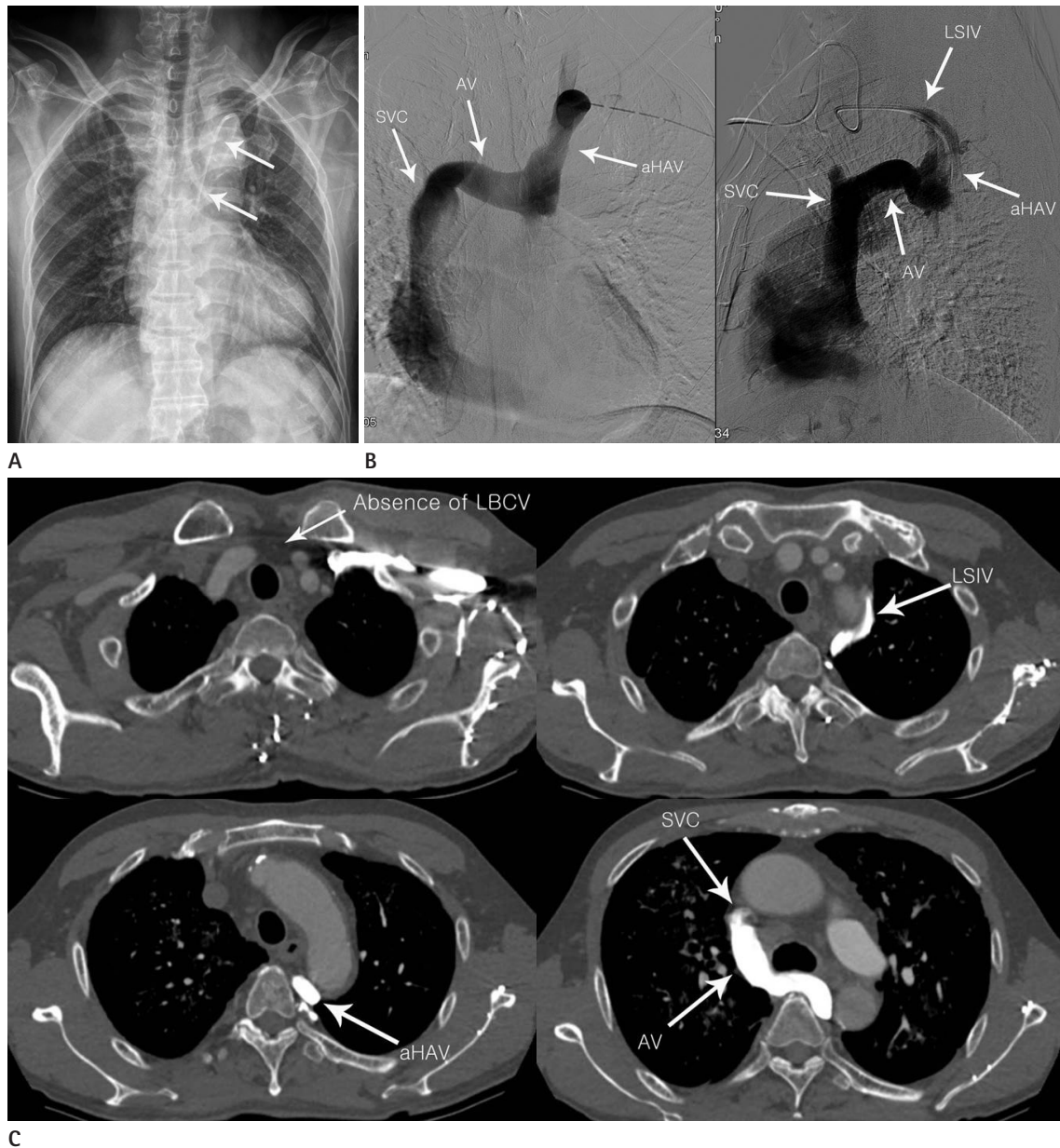
## CASE REPORT

A 63-year-old man was admitted for evaluation of severe lumbar pain and claudication of both legs. He had undergone laminectomy of the L2–3 vertebral body with posterior lumbar interbody fusion of the L1–4 body at an outside hospital due to burst fracture of the L2 vertebral body. In our hospital, revision surgery was scheduled due to severe spinal stenosis and severe pain. The patient's history included hypertension that had been diagnosed 10 years earlier, for which he had been taking anti-

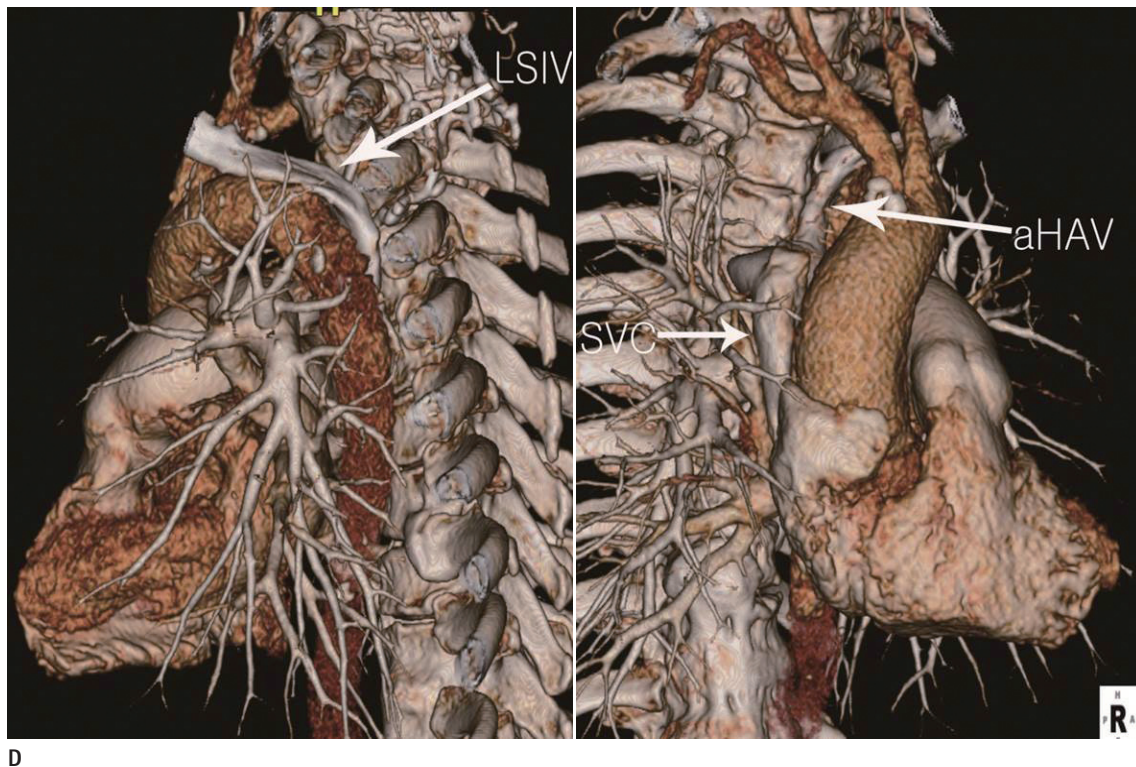
hypertensive drugs for the past 8 years; there was no other history of trauma, diabetes, or surgery. The patient had no connective tissue disorders or other systemic anomalies, and there was no significant family history of disease.

The day before surgery, a central venous cannulation was performed via the left subclavian vein without any problems by blinded manner in the admission ward. However, chest X-ray

after the procedure showed an unusual location of the left subclavian catheter tip (Fig. 1A): The central venous catheter tip is usually located at the junction of the superior vena cava (SVC) and the right atrium and thus should be seen at the right side of the thoracic vertebra bodies at the carina level. However, in this patient, the catheter tip was located at the left side of the thoracic vertebra. The patient was referred to the Department of



**Fig. 1.** A 63-year-old man presenting incidentally found absence of the LBCV with venous return through the LSIV. Chest X-ray (A) showed the unusual location of the left central venous catheter tip at the left side of the thoracic vertebral bodies (arrows). Anteroposterior and lateral venographic images (B) and axial (C) three dimensional reconstruction computed tomography images (D) showing an absence of the LBCV with venous drainage into the LSIV, which subsequently drained into the accessory hemiazygos vein and the azygos vein, and finally into the SVC. aHAV = accessory hemiazygos vein, AV = azygos vein, LBCV = left brachiocephalic vein, LSIV = left superior intercostal vein, SVC = superior vena cava



**Fig. 1.** A 63-year-old man presenting incidentally found absence of the LBCV with venous return through the LSIV. Chest X-ray (A) showed the unusual location of the left central venous catheter tip at the left side of the thoracic vertebral bodies (arrows). Anteroposterior and lateral venographic images (B) and axial (C) three dimensional reconstruction computed tomography images (D) showing an absence of the LBCV with venous drainage into the LSIV, which subsequently drained into the accessory hemiazygos vein and the azygos vein, and finally into the SVC.  
aHAV = accessory hemiazygos vein, LBCV = left brachiocephalic vein, LSIV = left superior intercostal vein, SVC = superior vena cava

Radiology for assessment of a catheter tip abnormality. First, venography was performed via a previously inserted catheter, but we concluded that a more detailed investigation of the thoracic vascular system was needed from a wider perspective. Then, MDCT for the thoracic venous system was performed with the administration of contrast media via a previously inserted catheter in the left arm. The chest MDCT was performed on an Aquilion ONE 320 CT scanner (Toshiba Medical Systems corp., Tokyo, Japan) through the chest to the adrenal glands after the junction of 100 cc of intravenous contrast at flow rate of 3 cc/s, using bolus tracking to trigger the scan at 120 HU over the aortic arch. The kVP was 120, the effective mAs was 180, and the pitch was 1.1. One-millimeter axial images with a 3 mm overlap using a very sharp kernel were obtained of the lung window; additional 3 mm axial, coronal, and sagittal reconstructions with a 3 mm overlap were obtained for the mediastinum. Volumetric 3 dimensional reconstruction was performed, and the results revealed absence of the LBCV; the left subclavi-

an vein was connected via a LSIV, which subsequently drained into the dilated accessory hemiazygos vein. At the carina level, the accessory hemiazygos vein crossed the midline to drain into the dilated azygos arch, which then drained into the SVC (Fig. 1B-D). There were no other congenital heart or vascular anomalies or other systemic disorders.

## DISCUSSION

The normal course of the LBCV passes across the middle mediastinum, toward the right side in front of the aortic arch and its major tributary (1). The LBCV receives venous return from the ipsilateral subclavian and jugular veins, and finally, it joins the right brachiocephalic vein to form the SVC. Congenital anomaly of the LBCV is rare and has been reported infrequently in the literature (1-5). To appreciate aberrations of the LBCV, it is important to first understand the normal development of the cardinal veins (4-6). Embryologically, at approximately 4



weeks, the primordia of the systemic veins first appear as paired anterior and posterior cardinal veins that unite on each side to form a common cardinal vein that opens into the primitive sinus venosus; during this subsequent development, most of the left anterior cardinal vein disappears. Venous drainage from the left side of the head and neck and the left arm is then directed into the right anterior cardinal vein by the development of new transverse anastomotic channels above and below the fourth aortic arch by week 8. A new transverse anastomotic channel becomes the LBCV, and the distal portion of the right precardinal vein becomes the right brachiocephalic vein. At term, the azygos vein represents the site of the right postcardinal vein, and its orifice marks the junction of the precardinal vein and common cardinal venous components of the SVC (3-5, 7).

Three major hypotheses have been proposed to account for the formation of an anomalous brachiocephalic vein (1, 2, 7, 8). The first theory supports double precardinal anastomoses, with regression of the upper anastomosis resulting in an anomalous brachiocephalic vein. The second theory posits that an anomalous brachiocephalic vein is formed secondarily as an alternative channel in patients when the normal course of the LBCV is obstructed. The third theory postulates that a precardinal anastomosis can be formed in any pathway where space is available after the development of the aortic arch. However, the exact cause of anomalous brachiocephalic veins remains unclear.

In our case, there was no evidence of closure or traces of the primitive LBCV, and the position and occupying volume of the aortic arch also fell within the normal category, suggesting that the first hypothesis was likely. During the early stages of development, interruption of the upper anastomosis between the right and left precardinal veins arising from any cause may induce anomalous development of the lower anastomosis (5, 9).

Confirming the congenital absence of the LBCV may be important if the affected individual needs to undergo catheterization, including an implantable cardioverter defibrillator, via a left-sided approach. An LBCV anomaly may occur as isolated, although its association with a number of other cardiac malformations such as tetralogy of Fallot, atrial and ventricular septal defects, and double-outlet right ventricle has been reported (1, 2). Fortunately, the present case had no other associated anomalies and there were no significant symptoms.

In summary, we report a rare case of an incidentally found

absence of the LBCV, with venous return through the LSIV, in an adult patient who was studied with thoracic venography and MDCT. The practitioner who makes many venous approaches in daily work will not be confused by knowing various types of congenital LBCV anomalies upon encountering a rare one. Also, this case may help the practitioner avoid misinterpreting venography findings and thereby prevent troublesome complications in left-sided venous approaches with congenital anomalies.

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## 정맥조영술과 다중검출 컴퓨터단층촬영으로 성인 환자에서 우연히 발견된 증상 없는 원팔머리정맥의 부재

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허리 통증을 주소로 내원한 63세 남자 환자에게 수술 전 준비로 좌측 쇄골 하 정맥을 통한 중심정맥관 삽입을 했다. 흉부 촬영에서 중심정맥관의 카테터 팁이 정상시와는 다른 곳에 위치하여 추후 정맥조영술 및 다중 검출기 컴퓨터단층촬영을 시행하였다. 영상 검사상 원팔머리정맥이 관찰되지 않았다. 원래의 좌측 경부 및 상지의 정맥 순환은 원팔머리정맥 대신 늘어난 원위갈비사이정맥과 부반기정맥을 통해 대정맥으로 이루어졌다. 저자들은 성인 환자에서 증상이 없는 원팔머리정맥의 부재와 관련한 드문 증례를 보고하고 관련 문헌에 대해 검토하고자 한다.

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