



## Conservative management of superior vena cava injury due to hemodialysis catheter placement: A case report and literature review

Mohammad Mozafar<sup>1</sup>, Masoud Hossein<sup>1</sup>, Fuad Majidi<sup>1</sup>, Sina Zarrintan<sup>1\*</sup>

<sup>1</sup>Division of Vascular & Endovascular Surgery, Department of General & Vascular Surgery, Shohada-Tajrish Medical Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

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### ABSTRACT

We reported the case of a 78-year old woman with the inadvertent superior vena cava injury resulting from hemodialysis catheter placement. The catheter was placed through the left internal jugular vein. Hemodynamics were stable. The initial chest film illustrated an extraluminal catheter and mediastinal widening. The patient did not have hemothorax. Computed tomography venography also confirmed the extraluminal position. The catheter was removed at the operating room, and the case was conservatively managed.

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### Introduction:

The internal jugular and subclavian veins are the most common sites for the placement of tunneled hemodialysis catheters (1). Frequent puncture of these veins leads to the superior vena cava (SVC) intimal damage, thrombosis, and narrowing (2). These changes may predispose SVC to rupture or tear during catheter placement. This condition could have significant morbidity and mortality due to hemothorax, hemorrhagic shock, and instability of vital signs (3).

Iatrogenic and inadvertent tearing of SVC during catheterization for hemodialysis could be managed conservatively or by surgical intervention. Rupture of SVC may be managed by covered stents or open repair through right thoracotomy (4, 5). Hemothorax is usually managed by tube thoracostomy (6). In the present study, we reported a case of inadvertent SVC injury due to tunneled hemodialysis catheter

placement through the left internal jugular vein.

### Case report:

A 78-year old woman was referred to our vascular surgery center due to access failure and requiring dialysis. The patient had an end-stage renal disease since a month ago. She had hypertension and type 2 diabetes mellitus. The case had a tunneled dialysis catheter from her right internal jugular vein since a month ago. The catheter was not functional, and the patient had a massive hematoma on the right side of her neck. The catheter was placed at the Department of Anesthesiology in Afshar Hospital, Yazd, Iran. The catheter was removed due to hematoma. Then, temporary dialysis catheter was placed through the right femoral vein.

The femoral catheter was used for hemodialysis; however, it also lost function after a week. The patient was referred to the Department of Surgery in Shahid-

\*Corresponding author: Sina Zarrintan Department of General & Vascular Surgery, Shohada-Tajrish Medical Center, Tehran, Iran 1989934148. Tel/Fax: +98-21-22721144; s.zarrintan@yahoo.com

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Rahnemoun Hospital in Yazd. The general surgery team used the left internal jugular vein to place a temporary dialysis catheter. This catheter was utilized for hemodialysis for two weeks. Then, the same team tried to change the left internal jugular temporary catheter to tunneled permanent catheter. The catheter was not functional. The surgeon reported that during the exchange of the catheter, the 0.035 guidewire was kinked in a pull-away catheter introducer. The patient was not dialyzed for a week because a secure and functioning access was not present. Then the patient was referred to our center to place a dialysis catheter and manage the present non-functioning access.

The case was admitted to our vascular surgery center. She was stable with a blood pressure of 150/90 mmHg and pulse rate of 98 per minute. Distal pulses were normal and symmetric in the upper and lower extremities. A contained hematoma was observed at the right side of her neck. Breath and heart sounds were normal. A chest X-ray film was also obtained. The mediastinal widening was present at the right side, and the catheter tip was outside the shadow of SVC lumen (Figure 1).

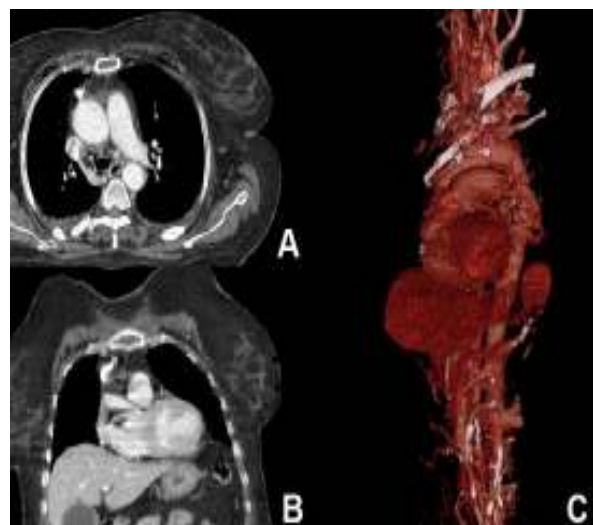
The patient did not have dialysis access. The case was transferred to hybrid operating room, and under fluoroscopic guidance, a permanent cuffed catheter was placed through the right femoral vein. The case was dialyzed by this access. Then, a computed tomography venography was performed on the neck and thorax. The left internal jugular vein catheter was noticed, and the tip of the catheter was extraluminal. The SVC injury adjacent to the catheter tip was observed, and a contained hematoma was present (Figure 2).

The patient was under close observation for 72 h. Then, the case was again transferred to the operating room, and the left internal jugular catheter was removed under close monitoring. The patient was under observation on the bed of the operating room for 2 h. Vital signs were stable, and breath sounds were normal. Then, the case was transferred to the intensive care unit, and a chest X-ray was performed. The mediastinal widening was shrunken, and hemothorax was not present (Figure 3). The patient was discharged after 48 h. After one-

month follow-up, a left brachiocephalic arteriovenous fistula was created for definitive hemodialysis access.



**Figure 1.** Chest X-ray of patient before removal of catheter; mediastinal widening being evident and tip of catheter being extraluminal



**Figure 2.** Computed tomography venography; axial plane showing tip of catheter outside the superior vena cava and surrounding hematoma being evident (A); coronal plane also illustrating the extraluminal position (B); reconstruction of contrast material also demonstrating catheter position (C)



**Figure 3.** Chest X-ray after removal of catheter; mediastinal widening being significantly disappeared

### Discussion

We reported a case of the inadvertent SVC trauma during hemodialysis access placement through the left internal jugular vein. The patient was managed neither with surgery nor with endovascular intervention. Successful conservative management was used for the patient. Kabutey et al. (6) reported a similar case of SVC perforation following dialysis catheter placement through the left subclavian vein. They used right thoracostomy tube to drain acute right hemothorax. Perforation of the SVC was sealed without intervention. Similar management was used for the present case.

However, the patient in the present case report did not have hemothorax, and the thoracostomy tube was not used for the case. The present case had a widened mediastinum disappeared after 72 h of observation and catheter removal. Table 1 tabulates the comprehensive literature review of previously reported cases with the inadvertent SVC injury due to hemodialysis catheter insertion.

The SVC rupture during hemodialysis catheter placement sometimes leads to hemodynamic instability and hemorrhagic shock. This will necessitate the emergent surgical control of bleeding. Turkyilmaz et al. (7) reported a case of the SVC perforation resulting from hemodialysis catheter

placement through the left subclavian vein. Following tube thoracostomy and massive hemothorax and hemodynamic compromise, a right posterolateral thoracotomy was conducted, and the rupture was observed on the anteromedial aspect of the SVC. The rupture was repaired by 3-0 polypropylene, and the patient was successfully recovered.

The literature review revealed that out of 15 cases with the inadvertent SVC rupture, 12 cases (80%) were cannulated through the subclavian vein. The most common cannulation site was the left subclavian vein (2-15).

It seems that the risk of rupture increases when the pill-away introducer passes the acute angle of left brachiocephalic vein. In addition, previous catheterization in hemodialysis patients causes intimal damage and thrombosis and contributes to the predisposition of SVC to rupture. It is likely that the introduction of the pill-away dilator under fluoroscopic guidance could potentially reduce the risk of inadvertent injuries.

Rupture of SVC during hemodialysis catheterization may cause hemothorax presenting with decreased breath sounds at right hemithorax that usually necessitates tube thoracostomy (5, 6, 15).

In addition, a massive hemothorax may cause the instability of hemodynamics (2, 3, 5-7, 10, 12, 15). Unstable vital signs in the presence of SVC rupture during catheterization are the indications for repairing SVC. This could be performed by the right posterolateral thoracotomy and venorrhaphy (4, 10, 12, 14) or endovascular stent-graft placement (5).

It seems that due to the higher morbidity and mortality of thoracotomy and open repair, endovascular intervention is a superior procedure. An endovascular repair can be carried out under local anesthesia in the supine position in a hybrid operating room. The access can be obtained through femoral vein, and stent deployment can be conducted through a long sheath crossing the inferior vena cava and reaching to the SVC.

**Table 1:** Reported cases of iatrogenic superior vena cava (SVC) injuries during catheterization for hemodialysis access

No	Author(s)	Year	Patient	Access site	Shock	Management
1	Barton et al. (2)	1983	No data	Subclavian	Yes	No data
2	Kappes et al. (8)	1983	71 yrs - M	Left Subclavian	Yes	No data
3	Carbone et al. (9)	1987	No data	Subclavian	No	No data
4	Salahudeen & Pingel (10)	1988	No data	Subclavian	No	No data
5	Rodríguez et al. (3)	2002	No data	Left Subclavian	Yes	No data
6	Florescu et al. (4)	2005	47 yrs - F	Left Subclavian	No	Right PL Thoracotomy
7	Azizzadeh et al. (5)	2007	54 yrs - F	Left Subclavian	Yes	CT - Stent Graft
8	Wang et al. (11)	2009	78 yrs - F	Right Subclavian	Yes	Right PL Thoracotomy
9	Kuzniec et al. (12)	2010	53 yrs - M	Right Internal Jugular	No	Thoracoscopic Management
10	Tawfic et al. (13)	2010	No data	Subclavian	Yes	Right PL Thoracotomy
11	Iwańczuk et al. (14)	2013	39 yrs - M	Right Subclavian	No data	Died
12	Kabutey et al. (6)	2013	68 yrs - M	Left Subclavian	Yes	CT + Conservative Management
13	Kurabe et al. (15)	2016	62 yrs - F	Left Internal Jugular	No	CT + Conservative Management
14	Turkyilmaz et al. (7)	2017	69 yrs - M	Left Subclavian	Yes	Right PL Thoracotomy
15	Mozafar et al.*	2019	78 yrs - F	Left Internal Jugular	No	Conservative Management

CT – Chest Tube, F – Female, M – Male, PL – Posterolateral, yrs – Years of Age \*the present case

In conclusion, the inadvertent SVC rupture is an uncommon but catastrophic event during the placement of hemodialysis catheters. The left subclavian vein is the most common puncture site that may lead to this condition. Precise attention and clinical suspicion are necessary for the prompt diagnosis and management of the SVC rupture because it could cause hemodynamic instability, hemorrhagic shock, and mortality. In the case of hemothorax, performing tube thoracostomy is mandatory. Stable patients are usually conservatively managed. In the case of hemodynamic compromise, the SVC repair is necessary either by thoracotomy or endovascular intervention. Selection of open or

endovascular repair depends on the availability of equipment and vascular surgeon's experience.

#### Conflicts of interest

The authors declare that there is no conflict of interest.

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