ISSN: 2577 - 8005

Case Report

Medical & Clinical Research

Hemodialysis through persistent left superior vena cava. Should it be used?

Zvi Peled*, Olga Rutsky

Department of Critical Care Unit, Bnei-Zion Hospital, Haifa, Israel

*Corresponding Author
Zvi Peled, Department of Critical Care Unit, Bnei-Zion Hospital, Haifa, Israel.

Submitted: 10 April 2023; **Accepted**: 08 May 2023; **Published**: 15 May 2023

Citation: *Peled, Z., Rutsky, O. (2023). Hemodialysis through persistent left superior vena cava. Should it be used? Medical & Clinical Research, 8(5), 11-14.*

Abstract

Background

To describe a case of hemodialysis done through persistent left superior vena cava, identified incidentally after a left jugular central venous dialysis catheter insertion, and to discuss its feasibility.

Case Summary

Single case: A 66-year-old woman was admitted to the ICU with a diagnosis of septic shock, severe pneumonia, and acute renal failure. Hemodialysis was required for acute renal insufficiency. Persistent left superior vena cava (PLSVC) was detected on Chest x-ray after a left jugular central venous dialysis catheter placement. Hemodialysis was uneventful. Using a permanent dialysis catheter placed later through the PLSVC was less efficient. Although no complications were seen during hemodialysis, it was technically difficult (with high pressure in access and low blood flow rate).

Conclusion

Hemodialysis through PLSVC should remain an exceptional and short-term therapeutic alternative in dialysis patients.

Keywords: Persistent; Left; Vena Cava; Complication; Hemodialysis

Introduction

Hemodialysis is a common intensive care unit (ICU) procedure. For its implementation, it is necessary to place a temporary or permanent dialysis central venous catheter. A reliable and operational vascular access which can provide adequate extracorporeal blood flow is a prerequisite for effective hemodialysis. As with any central venous catheter, hemodialysis catheters can be inserted into any central vein. Choosing the vascular access site and catheter type, should be directed by the urgency of dialysis, expected length of dialysis, history of prior access, and the overall medical condition of the patient. The right internal jugular vein is one of the favorite initial access sites for catheter insertion because of the relative direct path to the superior vena cava (SVC), the right atrium, and the relative low frequency of central vein stenosis [1,13]. The subclavian site allows excellent function but has a high rate of central vein stenosis and should preferably be avoided [1].

Malposition of the tip of the central venous catheter (CVC) in a vessel other than SVC can occur with an incidence of up to 7%. Persistent left superior vena cava (PLSVC), a venous anatomy variation is one of the several factors that could contribute to misguidance and a malfunctioning CVC [2]. Placement and location of the dialysis catheter in the PLSVC may cause severe complications such as vascular perforation, catheter wedging, local venous thrombosis, catheter dysfunction, systematic embolization, coronary sinus thrombosis, cardiac arrhythmias, shock, angina pectoris and cardiac arrest due to irritation of the conduction system [2-7]. All these complications can be very substantial during hemodialysis and impact its efficacy and the patient's prognosis. PLSVC is generally asymptomatic and diagnosed incidentally during imaging or invasive procedures. We report a case of an ICU patient having a PLSVC, which was incidentally diagnosed after a jugular catheterization for hemodialysis.

Case Report

A 66-year-old woman was admitted to the ICU with a diagnosis of septic shock, severe pneumonia and acute renal failure. On her admission, a right internal Jugular central venous catheter was placed and she was started on standard treatment including antibiotics, fluids, and vasopressors. Despite adequate treatment, the patient's condition worsened. After starting enteral nutrition through a nasogastric tube, repeated aspirations were noted in

the endotracheal tube, followed by recurrent septic shock and additional deterioration of her respiratory and renal functions. Chest tomography showed bilateral consolidations at the lung bases, consistent with inflammatory processes, probably from the aspirations and accompanied by atelectasis in both lower lobes. Imaging also showed an enlarged and airy esophagus. This recent tomography was compared to a CT chest which was done 4 years earlier which revealed that the significant esophageal dilatation and interstitial lung disease were already apparent earlier, thus chronic.

After additional workup, a diagnosis of scleroderma was established. Hemodialysis was required for acute renal insufficiency. Left jugular central venous dialysis catheter was placed. On the Chest x-ray taken after the introduction of a new dialysis line, the central venous catheter appeared to be at the left mediastinum, raising the suspicion of a PLSVC anatomy.

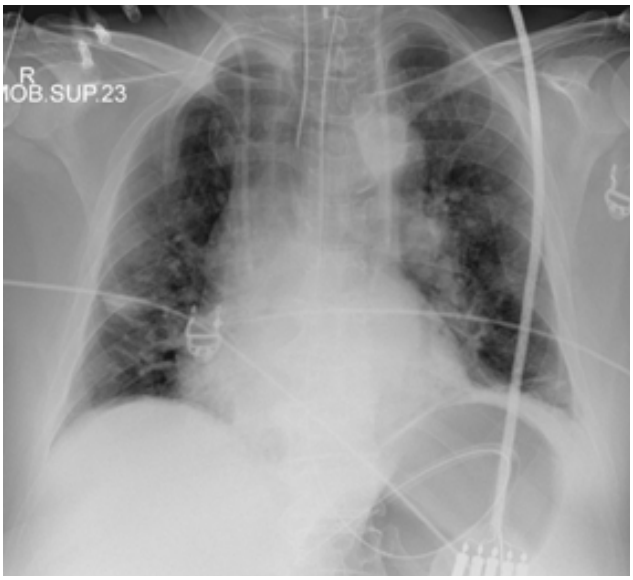

Figure 1: CVC catheter tip at the left mediastinal border. The diagnosis was confirmed by reviewing the chest CT

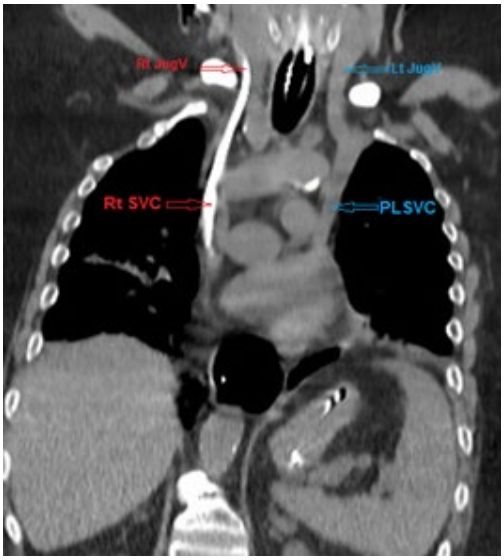

Figure 2: This hemodialysis catheter, although sitting in the coronary sinus worked well with good flow.

Unfortunately, the patient kept worsening, renal function did not improve and she became anuric. In patients who need chronic dialysis a tunneled permanent hemodialysis catheter is placed (Perm-a-cath) this procedure is done in the angiography suite by the interventional radiography specialists.

Figure 3: Due to fact that other insertion sites were already in use, although the patient was known to have a PLSVC the perm-a-cath catheter was inserted to the left jugular vein.

Figure 4: There were no signs of hypotension, cyanosis or bleeding during and after the insertion procedure.

Catheter had good flow and was used for hemodialysis. There was no hypotension, cardiac arrhythmias, or cardiac-respiratory arrest during hemodialysis but it was technically difficult (with high pressure and low blood flow rate), therefore not so effective. This catheter was removed and a new permanent catheter was inserted into the right jugular vein.

Discussion

Persistent left superior vena cava (PLSVC) is the most common type of vena cava malformations despite its low incidence: of 0.3%-0.5% in the common population [5, 8]. In patients with congenital heart disease, the incidence is higher (percentages vary in different studies). [5, 9, 10]. Cardiac anomalies accompanying PLSVC associated with shunt lesions (atrial and ventricular septal defects, patent ductus arteriosus, anomalous pulmonary venous drainage), left-sided obstructive lesions (aortic coarctation, mitral stenosis, bicuspid aortic valve), right-sided lesions (pulmonary stenosis and atresia, tricuspid atresia, bicuspid pulmonary valve, Ebstein anomaly) ,tetralogy of Fallot, absent right superior vena cava [3,5,9-11].

The left superior vena cava is formed during the third week of gestation. Between the fourth and the eighth week, it is obliterated by the compression of the left atrium and the hilum of the left lung, forming the ligament of Marshall. If this compressive force does not occur, the vein stays open (persistent) PLSVC begins at the junction of the left subclavian and internal jugular veins, passes through the left side of the mediastinum adjacent to the arcus of the aorta [3,12]. It typically drains into the right atrium via the coronary sinus, often causing it to widen, without significant hemodynamic changes or clinical consequences, thus being usually asymptomatic. Therefore, it is commonly identified incidentally during a diagnostic or therapeutic procedure on chest x-ray, angiography, CT or echocardiography [3, 6,7,13].

In some rare cases this enlargement of coronary sinus may cause compression of the atrioventricular node and His bundle, which can lead to cardiac arrhythmias, such as atrial/ventricular fibrillation, angina or even cardiac arrest. When PLSVC directly drains into the left atrium through an unroofed coronary sinus (in up to 8% of patients), it can create a right to left shunt which may suffer obvious clinical cyanosis, syncope, reduced exercise tolerance, and progressive fatigue. Thromboembolic events and even brain abscesses may develop in these patients [3,4,6,7,13,14]. Schummer et al. created the most recognized classification of the superior vena cava according to the position of a central venous catheter on the chest radiograph [14].

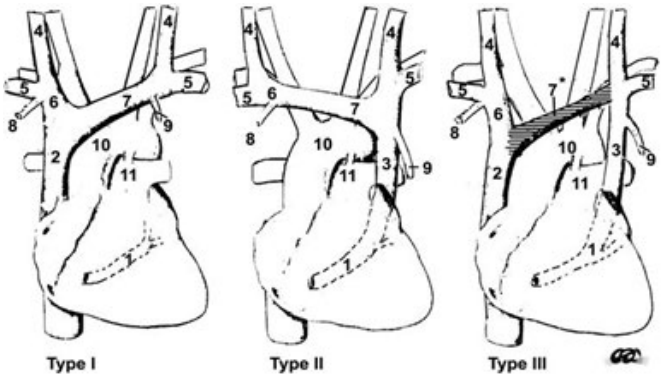

Figure 5: Permacath in PLSVC

Variations of the superior vena cava: type I–IIIa. 1, coronary sinus; 2, right superior vena cava (RSVC); 3, left superior vena cava (LSVC); 4, internal jugular vein (IJV); 5, subclavian vein (SV); 6, right and 7, left brachiocephalic vein (*type IIIb: left brachiocephalic vein is obliterated or missing); 8, right and 9, left internal thoracic vein; 10, aortic arch; 11, main pulmonary artery.

Our patient presented the most frequent variant that appears in up to 90% of the cases, the right superior vena cava accompanies a PLSVC, a variation that is known as double SVC (Shummer type III) The presence of PLSVC creates difficulties and risks for central venous catheterization and technical obstacles for hemodialysis [13]. Rare but devastating technical complication of central venous catheterization with such a venous variant is perforation or rupture of the coronary sinus or brachiocephalic vein which occur typically when an effort is made to introduce a catheter through the narrow opening of the coronary sinus to reach the right atrium and may result cardiogenic shock and tamponade [3,15].

The question whether to insert a hemodialysis through a persistent left superior vena cava for hemodialysis is still in debate. PLSVC is relatively narrow and the blood flow may not be sufficient to maintain long-term hemodialysis specially if the patient is hypovolemic, furthermore the locally created turbulence may increase the probability of thrombosis and arrhythmias. However, if the diameter of PLSVC and blood flow is sufficient, with steady blood flow through the coronary venous sinus into the right atrium, it is feasible to insert a hemodialysis catheter through the PLSVC for hemodialysis. A review of the literature that comprised a meta-analysis of dialysis catheterization through PLSVC for end stage renal disease case reports, showed that most catheters provided adequate blood flow and that the majority of the procedures were completed safely [5,13,15-19].

Conclusions

PLSVC is uncommon congenital anomaly of vena cava, mostly with no symptoms, and is generally found incidentally during invasive procedures such as hemodialysis catheter insertion. Our case supported by Literature reviews show the possibility of PLSVC being used as hemodialysis access in hemodialysis patients, certainly with tighter monitoring. But owing to the potential complications, we think that hemodialysis through PLSVC should remain an exceptional and short-term therapeutic alternative in dialysis patients. Physicians who place hemodialysis catheters in the left jugular vein should be aware of the existence, diagnosis and complications of PLSVC. The catheterization procedure in case PLSVC is diagnosed should be performed after investigation for cardiovascular abnormalities.

Conflicts of Interest

The authors have disclosed that they do not have any potential conflicts of interest.

References

1. Schwab, S. J., & Beathard, G. (1999). The hemodialysis catheter conundrum: hate living with them, but can't live without them. Kidney International, 56(1), 1-17.
2. Roldan, C. J., & Paniagua, L. (2015). Central venous catheter intravascular malpositioning: causes, prevention,

diagnosis, and correction. Western Journal of Emergency Medicine, 16(5), 658–664.
3. Azizova, A., Onder, O., Arslan, S., Ardali, S., & Hazirolan, T. (2020). Persistent left superior vena cava: clinical importance and differential diagnoses. Insights into Imaging, 11(1), 1-19.
4. Granata, A., Andrulli, S., Fiorini, F., Logias, F., Figuera, M., Mignani, R., ... & Fiore, C. E. (2009). Persistent left superior vena cava: what the interventional nephrologist needs to know. The Journal of Vascular Access, 10(3), 207-211.
5. Stylianou, K., Korsavas, K., Voloudaki, A., Patrianakos, A., Vardaki, E., Tzenakis, N., & Daphnis, E. (2007). Can a left internal jugular catheter be used in the hemodialysis of a patient with persistent left superior vena cava?. Hemodialysis International, 11(1), 42-45.
6. Hołda, M. K., Tyrak, K. W., Klimek-Piotrowska, W., Hołda, J., Koziej, M., & Piątek, K. (2017). Persistent left superior vena cava. Cardiovascular Journal of Africa, 28(3), e1-e4.
7. Goyal, S. K., Punnam, S. R., Verma, G., & Ruberg, F. L. (2008). Persistent left superior vena cava: a case report and review of literature. Cardiovascular ultrasound, 6(1), 1-4.
8. Laurenzi, L., Natoli, S., Pelagalli, L., Marcelli, M. E., Abbattista, D., Carpanese, L., & Arcuri, E. (2003). Long-term central venous catheterization via persistent left superior vena cava: a case report. Supportive care in cancer, 11, 190-192.
9. Nagasawa, H., Kuwabara, N., Goto, H., Omoya, K., Yamamoto, T., Terazawa, A., ... & Kuwahara, T. (2018). Incidence of persistent left superior vena cava in the normal population and in patients with congenital heart diseases detected using echocardiography. Pediatric Cardiology, 39, 484-490.
10. Perles, Z., Nir, A., Gavri, S., Golender, J., TaShma, A., Ergaz, Z., & Rein, A. J. (2013). Prevalence of persistent superior vena cava and association with congenital heart anomalies. The American journal of cardiology, 112(8), 1214-1218.
11. Lendzian, T., Vogt, J., & Krasemann, T. (2007). Are anomalies of the caval veins more common in complex congenital heart disease. Herz, 8(32), 657-664.
12. Nsah, E. N., Moore, G. W., & Hutchins, G. M. (1991). Pathogenesis of persistent left superior vena cava with a coronary sinus connection. Pediatric Pathology, 11(2), 261-269.
13. Tuncay Sahutoglu, Tamer Sakaci, Ekrem Kara, et al. Persistent left superior vena cava: Two case reports and a review from nephrologists' perspective Hemodial Int.2016 Jul;20(3):369-77.
14. Schummer, W., Schummer, C., & Fröber, R. (2003). Persistent left superior vena cava and central venous catheter position: clinical impact illustrated by four cases. Surgical and Radiologic Anatomy, 25, 315-321.
15. He, H., Li, B., Ma, Y., Zhang, Y., Ye, C., Mei, C., ... & Liu, Y. (2019). Catheterization in a patient with end-stage renal disease through persistent left superior vena cava: a rare case report and literature review. BMC nephrology, 20, 1-10.
16. Sahutoglu, T., Sakaci, T., Kara, E., Ahbap, E., Basturk, T., Koc, Y., ... & Unsal, A. (2016). Persistent left superior vena cava: two case reports and a review from nephrologists' perspective. Hemodialysis International, 20(3), 369-377.
17. Kuppusamy, T. S., & Balogun, R. A. (2004). Unusual placement of a dialysis catheter: persistent left superior vena cava. American journal of kidney diseases, 43(2), 365-367.
18. Kute, V. B., Vanikar, A. V., Gumber, M. R., Shah, P. R., Goplani, K. R., & Trivedi, H. L. (2011). Hemodialysis through persistent left superior vena cava. Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine, 15(1), 40.
19. Meena, P., Bhargava, V., Gupta, A., Srivastava, A., Gaur, L., & Rana, D. S. (2018). Successful hemodialysis through persistent left superior vena cava: A case report. Journal of the Association for Vascular Access, 23(3), 177-180.