

Failure to place a tunneled hemodialysis catheter due to malformation of right internal jugular vein draining to subclavian vein

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Abstract

The right internal jugular vein (IJV) is an important access site for hemodialysis catheterization. Venous cannulation failure is usually caused by central venous stenosis and is rarely related to vessel malformation. We herein present a case of failure to place a tunneled hemodialysis catheter into the right IJV. The patient had an arteriovenous fistula in the right arm with inadequate flow and a history of multiple central venous catheterizations. The guidewire was repeatedly misplaced into the right subclavian vein (SV) regardless of the technique used. Computed tomography venography revealed that the inferior segment of the right IJV drained into the ipsilateral SV. To the best of our knowledge, this is the first report of catheterization failure due to abnormal drainage of the right IJV into the ipsilateral SV.

Keywords

Renal dialysis, catheterization, central vein, right internal jugular vein, malformation, subclavian vein

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Introduction

The preferred site of central venous insertion for non-tunneled and tunneled hemodialysis catheterization is the right internal jugular vein (IJV) because it provides the shortest and most direct route to the right atrium.¹

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Although the use of a tunneled hemodialysis catheter is not encouraged because of its higher rate of complications, including infection and thrombosis, than an arteriovenous fistula, it plays an important role before fistula maturation and in patients with vessel exhaustion in the upper limbs.^{2,3} Catheter misplacement leads to inadequate blood flow and poor dialysis efficiency.⁴ Difficulty in placing catheters is rarely encountered, but in the rarest cases in which misplacement does occur, the misplacement is difficult to promptly identify and the cause is usually unknown.^{5,6} Misplacement of a right IJV catheter into the ipsilateral subclavian vein (SV) or axillary vein is rare.⁶⁻⁸ We herein present a case of unsuccessful right IJV catheterization due to malformation of the right IJV draining to the ipsilateral SV. The importance of reporting this case is that to the best of our knowledge, this malformation has not been previously described.

Case report

A 63-year-old man with diabetic nephropathy and end-stage renal disease undergoing hemodialysis was transferred from a local hospital to our hospital in November 2016 because of arteriovenous fistula dysfunction. Four months previously, at the local hospital, non-tunneled right IJV hemodialysis tube catheterization failed for an unknown reason, and the patient underwent non-tunneled femoral vein hemodialysis catheterization and right arm arteriovenous fistula surgery. After only four dialysis sessions, the femoral vein hemodialysis tube developed poor flow and was drawn away. He received a non-tunneled right IJV dialysis tube, and the catheterization was successful. However, the blood flow was poor, and the patient began using the arteriovenous fistula 3 months prior to presentation at our hospital. One month before presentation, the blood flow became inadequate

and decreased to 130 to 150 ml/min, and cephalic vein stenosis was detected by color Doppler ultrasound.

The cephalic vein stenosis was severe, and the length of the lesion was long. Percutaneous transluminal angioplasty would have been difficult. Considering the patient's severe cardiac insufficiency (ejection fraction of 36.2% by Simpson's rule), placement of a tunnel hemodialysis catheter was planned. After exclusion of stenosis and clots in the right IJV, the vein was successfully punctured and venous blood aspirated under ultrasound guidance. However, a J-shaped guidewire could not be introduced via the guiding needle because something seemed to be blocking it until the performer changed the direction of the puncture needle to the lateral cervix. Bedside consultation by an anesthesia specialist was required. Regardless of what the anesthesia specialist did, the guidewire always entered the SV. The patient refused to undergo placement of a femoral vein hemodialysis tube. Non-tunneled IJV cannulation was performed via the left side. We ordered right arm computed tomography (CT) venography to determine the reason for the unsuccessful catheterization.

CT venography showed that the inferior segment of the right IJV was draining into the ipsilateral SV behind the cranial part of the first rib and SV junction (Figure 1). The angle of the right IJV and the right SV was 35 degrees. The right brachiocephalic vein drained the right SV only.

This case report was approved by the ethics committee of the Second Affiliated Hospital, School of Medicine, Zhejiang University. The patient provided written informed consent to report his medical history and medical images, and the consent form has been archived by the authors.

Discussion

The standard procedure of right IJV cannulation involves the patient lying in bed with

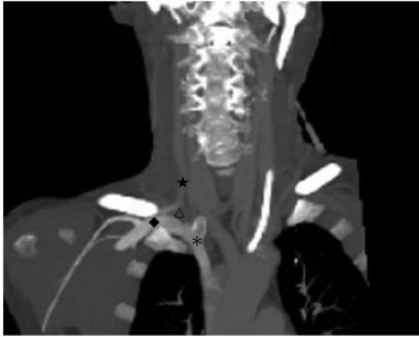


Figure 1. Right internal jugular vein draining to ipsilateral subclavian vein with an angle of about 35 degrees. ◆ Right subclavian vein, * right brachiocephalic vein, ★ right internal jugular vein, △ angle of right internal jugular vein and right subclavian vein.

his or her head turned to the left side with mild neck extension. The access needle is advanced through the skin at an approximately 60-degree angle along the direction of the right nipple. The IJV joins the SV behind the sternoclavicular joint to form the brachiocephalic vein, and the angle formed by the IJV and SV is about 130 to 160 degrees. The easiest and safest route for central venous cannulation is through the right jugular vein because the right jugular vein, brachiocephalic vein, and superior vena cava go almost straight to the right atrium. Right IJV catheterization has the lowest risk of malpositioning during central venous catheter insertion. The frequency of malpositioning into the SV is low. Yilmazlar et al.⁵ reported that among 770 cases of right IJV catheterization, no malpositioning into the right SV occurred. Pikwer et al.⁶ investigated 1023 right IJV catheterizations and checked the tip positions by chest X-ray soon after cannulation. They found that 10 catheters were misplaced in the right SV. Almost all misplaced catheters that had been inserted into the SV had advanced smoothly and were subsequently found on routine radiographs.⁶⁻⁹ Some authors suspected that this

phenomenon was related to the fact that the patients were lying in bed with the head too far rotated to the left side, inducing a small angle between the IJV and SV that made misplacement of the guidewire into the SV possible.⁸ Resistance during catheterization was felt in our patient; after adjusting the patient's position, repuncturing at another puncture point, and reinserting a J-shaped guidewire, the guidewire tip was still in the right SV although we called an anesthesia specialist for help. Therefore, the above-mentioned postulation does not apply to our case.

None of the patients in previously reported cases were checked by CT venography to determine whether any anatomic malformation was present. Anatomically, IJV malformations involve carotid-jugular fistulas, aneurysms, and duplication or absence of the IJV. One case of formation of the right brachiocephalic vein at the level of the superior border of thyroid cartilage by union of the right IJV and SV was reported in a cadaveric study.¹⁰ In the cadaveric case, the angle of the right IJV and ipsilateral SV was much smaller than normal. Our patient is the first case of the IJV directly draining into the SV. Why the guidewire always entered the SV was unclear until CT venography revealed the malformation. Although the patient had undergone right IJV catheterization at a local hospital, the blood flow was so poor that the catheter was soon removed. No radiograph was obtained to check the position before the catheter was removed. We consider that the catheter tip was probably within the SV at that time.

The ideal position of a tunneled cuffed catheter tip is within the conjunction of the superior vena cava and right atrium, nearly in line with the superficial landmark of the third intercostal space on the body surface.¹ Blood flow of 250 to 300 ml/min is required for adequate hemodialysis. Incorrect or inappropriate catheter placement restricts

blood flow and increases the incidence of early thrombosis. Use of ultrasound-guided catheterization is recommended because under direct ultrasound guidance, the rates of clinical mechanical complications (e.g., arterial puncture, hematoma, and pneumothorax) are reduced and the success rate at the first attempt is increased.¹¹

Ultrasonography reveals stenosis or thrombosis in the IJV lumen, but it is difficult to detect malformation or abnormalities in the lower part of the IJV, brachiocephalic vein, and superior vena cava. The UK Renal Association recommends imaging to exclude central vein stenosis in all patients with previous central venous cannulations.² Contrast venography is preferred over magnetic resonance angiography, which is associated with the risk of nephrogenic systemic fibrosis after gadolinium use in patients with advanced kidney disease.¹² Imaging including contrast venography to evaluate the central veins before tunneled catheter cannulation in patients with a high risk of central venous stenosis is not a routine test in our center. Imaging assessment should be routinely employed to avoid catheterization failure and vessel injury. If venography reveals an abnormality, alternative insertion sites such as the femoral veins are chosen.

However, the presence of central vein stenosis cannot always be excluded before catheter insertion, especially in emergency situations. Operators can use the access needles and guidewires in single-lumen central venous catheter packages in patients with a high risk of central vein stenosis, such as those with previous central venous catheter placements, malignant tumors, and chemotherapy. If guidewire insertion into the right IJV fails, the tunneled dialysis catheter package is not to be opened, and other routes should be considered.¹ Furthermore, a tunneled dialysis catheter package costs about 3000 to 4000 RMB,

or nearly 1/15 of the annual average wages of employed persons in Hangzhou, China in 2016.¹³ One tunneled dialysis catheter package includes access needles, one guidewire, one tunneling tool, one cuffed catheter, two dilators without a sheath, and one 14- to 16-F dilator with a peel-away sheath. These items are packed together, and if access failure occurs, as in our patient, the other items are wasted and cannot be used in other patients despite the fact that the items are sterile and new. We suggest that medical material factories pack items into two packages: the puncture package, which contains access needles and a guidewire, and the catheter package, which contains all other items. This would allow operators to avoid opening the catheter package until the guidewire has been successfully inserted into the right IJV.

Conclusion

Right IJV misplacement into the ipsilateral SV is rare and a very infrequent cause of right IJV catheterization failure. In addition to stenosis, vessel malformation should be considered if the guidewire is not inserted smoothly. Under these circumstances, dilation of the vein is contraindicated. Imaging to exclude central venous abnormalities in high-risk patients is suggested.

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Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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References

1. Wu S and Kalva S. *Dialysis access management*. Basel: Springer International Publishing, 2015.
2. Kumwenda M, Mitra S and Reid C. Clinical practice guideline vascular access for haemodialysis: UK renal association 6th edition final version, 2015.
3. Watanabe Y, Yamagata K, Nishi S, et al. Japanese society for dialysis therapy clinical guideline for “hemodialysis initiation for maintenance hemodialysis”. *Ther Apher Dial* 2015; 19(Suppl 1): 93–107.
4. Calvino J, Bravo J, Martinez L, et al. Recognizing misplacement of a dialysis catheter in the azygos vein. *Hemodial Int* 2013; 17: 455–457.
5. Yilmazlar A, Bilgin H, Korfali G, et al. Complications of 1303 central venous cannulations. *J R Soc Med* 1997; 90: 319–321.
6. Pikwer A, Baath L, Davidson B, et al. The incidence and risk of central venous catheter malpositioning: a prospective cohort study in 1619 patients. *Anaesth Intensive Care* 2008; 36: 30–37.
7. Honarmand A and Safavi M. Unusual right internal jugular vein catheter malposition into the right axillary vein: A rare case report. *Adv Biomed Res* 2012; 1: 16.
8. Ryu J, Yoon JH, Lee EJ, et al. Correction of malposition of central venous catheter with 9-Fr introducer sheath assisted by mobile type diagnostic X-ray apparatus: a case report. *Korean J Anesthesiol* 2015; 68: 402–406.
9. Gladwin MT, Slonim A, Landucci DL, et al. Cannulation of the internal jugular vein: is postprocedural chest radiography always necessary? *Crit Care Med* 1999; 27: 1819–1823.
10. Jana R. Unusual site of formation of brachiocephalic vein along with multiple venous anomalies in neck and its clinical importance. *NJCA* 2014; 3: 93–95.
11. Troianos CA, Hartman GS, Glas KE, et al. Guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. *J Am Soc Echocardiogr* 2011; 24: 1291–1318.
12. Agarwal AK. Central vein stenosis. *Am J Kidney Dis* 2013; 61: 1001–1015.
13. Hangzhou Municipal Statistics Bureau. Statistical Bulletin on Average Annual Wages of Employed Persons in Hangzhou in 2016, www.hangzhou.gov.cn/art/2017/7/6/art_1256301_8248532.html.