Challenges of Post-Venipuncture Jugular Venous Thrombosis in Patients with Secondary Hyperparathyroidism: A Case Report

Jian Zeng, Li Zhao, Hui Jiang, Xiongtiao Yang, Lin Liao, Yanli Zhang, Hongyi Lei

Corresponding Author: Hongyi Lei, e-mail: leihongyi2012@163.com

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Patient: Female, 66-year-old

Final Diagnosis: Chronic renal insufficiency stage 5 (uremia stage) • subsequent development of secondary hyperparathyroidism (SHPT)

Symptoms: Vascular calcification

Clinical Procedure: —

Specialty: Anesthesiology

Objective: Unusual clinical course

Background: Hyperparathyroidism is a common issue in patients on long-term hemodialysis, necessitating parathyroidectomy with deep venipuncture. These patients frequently exhibit a heightened incidence of vascular calcification, complicating deep venipuncture and increasing the risk of associated complications. Therefore, a crucial aspect of preoperative assessment in this population involves identifying vascular calcification, with a preference for ultrasound-guided in-plane puncture. Special care is required to prevent blood vessel injuries and postoperative complications such as deep vein thrombosis.

Case Report: We present the case of a 66-year-old woman with secondary hyperparathyroidism who encountered challenges during an internal jugular vein puncture, leading to subsequent thrombosis. Initial attempts were hindered by calcification of the internal jugular vein's vascular wall, resulting in stratified damage to the vessel's wall. However, the ultrasound-guided in-plane puncture technique successfully allowed the insertion of a central venous catheter without further damage to the vascular wall. On the postoperative fourth day, thrombus formation was observed in the damaged vascular wall from the initial puncture.

Conclusions: The ultrasound-guided in-plane puncture technique is advantageous in overcoming the difficulties associated with puncturing through deep vein calcification in patients with secondary hyperparathyroidism. This technique also diminishes the likelihood of complications such as venous thrombosis.

Keywords: Vascular Calcification • Venous Thrombosis • Hyperparathyroidism, Secondary

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Background

Patients in the advanced stages of chronic renal failure, particularly those in the uremia stage, commonly experience disturbances in calcium and phosphorus metabolism. This imbalance frequently results in hyperphosphatemia and subsequent development of secondary hyperparathyroidism (SHPT). Prolonged elevation of parathyroid hormone (PTH) levels can stimulate osteoclast activity, releasing bone calcium into the bloodstream and subsequently increasing blood calcium levels. These individuals are prone to vascular endometrial calcification [1,2], complicating deep vein punctures and increasing the risk of associated complications. Therefore, during procedures such as internal jugular vein punctures in patients with SHPT, meticulous attention is essential to the potential presence of calcified vascular intima.

Case Report

A 66-year-old woman was admitted to the hospital due to persistently elevated PTH levels observed over a period exceeding 3 years. The patient had undergone maintenance hemodialysis for >5 years, initiated due to “renal insufficiency.” Five years prior, she discontinued the oral administration of cinacalcet, calcitriol, and lanthanum carbonate. The initial diagnosis included SHPT, chronic renal insufficiency stage 5 (uremia stage), and Grade I hypertension with high risk. The patient’s preoperative vital signs were as follows: blood pressure of 155/80 mmHg, heart rate of 84 beats per minute, and body temperature of 36.7°C.

Laboratory examination revealed N-terminal pro-brain natriuretic peptide (NT-proBNP) levels of 5240 pg/mL, while whole parathyroid hormone (iPTH) levels fluctuated between 1000 and 1500 pg/mL. Cervical color ultrasound demonstrated multiple hypoechoic foci within the parathyroid area behind the bilateral thyroid lobes, indicating the presence of parathyroid lesions. A chest computed tomographic (CT) scan revealed calcification in the aorta and trachea. Notably, there was a consistent elevation of iPTH levels, and a neck color ultrasound confirmed the presence of parathyroid lesions. Consequently, a proposal was made for bilateral parathyroidectomy with autologous transplantation.

Following intubation and administration of general anesthesia, a right subclavian vein puncture and catheterization were initially attempted. However, the guide wire encountered resistance during insertion into the vascular cavity. After consulting with the senior physician, a right internal jugular vein puncture was performed. The patient was positioned supine with the head tilted downward and to the left at a 30-45° angle. Ultrasound was employed to locate the right internal jugular vein at the clavicle level, and the puncture point was marked. The puncture needle was inserted along the marked point, and at a depth of approximately 3.5 cm, significant resistance was encountered, although blood retrieval remained normal. Effective resistance reoccurred when the guide wire reached a depth of 10 cm, leading to the withdrawal of the guide wire and a repetition of the procedure. However, the same situation persisted. Subsequently, an ultrasound examination revealed that part of the guide wire had looped between the outer and middle membranes of the internal jugular vein (Figure 1A). The guide wire was withdrawn, and the ultrasound image displayed a “pseudolumen” within the vessel wall (Figure 1B). A transverse intraplane puncture technique was employed under ultrasound guidance. At a depth of 3.5 cm, the puncture needle encountered significant resistance. Ultrasound examination confirmed that the puncture needle had not wholly entered the internal jugular vein (Figure 1C). Upon further insertion, a distinct “lost sensation” was perceived, and the needle tip was observed to have entirely entered the internal jugular vein lumen. Blood retrieval proceeded smoothly, and a 7F double-lumen deep vein catheter was successfully inserted with the guide wire.

The operation, lasting approximately 2 hours, proceeded smoothly, and the patient was safely returned to the ward postoperatively. The patient exhibited neck swelling and pain on the fourth day following the procedure. A color Doppler ultrasound examination of the neck revealed the formation of a thrombus in the right internal jugular vein. The patient was advised to keep the neck relatively immobilized and received anticoagulation and thrombolysis treatment. After 4 days, symptoms improved. Post-discharge, the patient was prescribed oral rivaroxaban for 3 months. A follow-up color Doppler neck ultrasound was performed 14 days after discharge to assess thrombus elimination and postoperative recovery. Telephone follow-ups were conducted on the 30th and 60th days. The follow-up results indicated successful central venous catheter removal on the 14th day at a local hospital. A color Doppler ultrasound examination on the 55th day revealed varying degrees of calcification in the internal jugular vein wall, with no other significant abnormalities.

Discussion

Significance of Target Vessel Evaluation Before Puncture

In our patient, bilateral parathyroidectomy was deemed necessary, and the placement of a central venous catheter proved effective in overcoming preoperative challenges. These challenges included difficulties establishing peripheral venous channels, monitoring intraoperative central venous pressure, and postoperative pain from excessive calcium supplementation. Given the patient’s history of long-term hemodialysis and compromised peripheral vascular conditions, establishing peripheral
venous channels was particularly challenging. Furthermore, the requirement for bilateral parathyroidectomy added complexity to the procedure. Postoperatively, substantial calcium supplementation was required, posing a potential risk of pain due to hematoma formation or blood extravasation during the vascular passage of drug solutions [3,4]. In this patient, prolonged elevation of PTH levels stimulated osteoclast activity, releasing bone calcium into the bloodstream. Continuous oral administration of calcium-containing drugs such as cinacalcet and calcitriol, and long-term hemodialysis with high-calcium dialysate resulted in prolonged elevated blood calcium levels, causing tissue calcification in the vascular endothelium and trachea [5,6]. Evaluating vascular calcification before undertaking a deep vein puncture procedure is important. Despite employing ultrasound positioning techniques beforehand, the procedure faced challenges, leading to stratification of the vascular intima and forming a “false cavity.” Subsequently, the patient underwent a successful ultrasound-guided intraplane puncture. While central venous access typically poses a low risk of vascular intima injury in regular patients, cases involving calcification of the internal jugular vein wall can result in increased puncture resistance, complicating the procedure. A calcified vascular wall is the primary contributor to increased puncture resistance and stratification of the vascular intima. Therefore, meticulous attention should be given to assessing the presence of calcification in target blood vessels. Preoperative ultrasound or CT examinations of target blood vessels are recommended to detect calcification. If calcification is identified preoperatively, it is recommended to utilize ultrasound-guided intraplane puncture techniques for dynamic monitoring of the puncture process, enhancing the success rate and reducing the likelihood of complications.

Figure 1. (A) Ultrasound depiction during internal jugular vein puncture, illustrating the observation encountered during guide wire insertion. The longitudinal ultrasound image reveals that after the guide wire penetrated the outer membrane of the internal jugular vein, a section of the wire wrapped around the blood vessel wall. The long white arrow denotes the central venous puncture guide wire. S – superior; I – inferior. (B) Representation of ultrasound conducted when insertion after guide wire removal proved challenging. The image displays a “pseudolumen” (indicated by the white dashed line) situated between the outer and inner-middle membrane of the internal jugular vein, with discernible fluid-filled dark areas within. IJV – internal jugular vein; SCM – sternocleidomastoid muscle. White dashed line represents the “pseudolumen” formed in the blood vessel wall after removing the guide wire. S – superior; I – inferior. (C) Ultrasound-guided intraplane jugular venocentesis catheter placement. IJV – internal jugular vein; SCM – sternocleidomastoid muscle. White arrowheads indicate vascular intimal calcification; the long white arrow represents the central vein puncture needle.
Causes and Consequences of Thrombosis

A postoperative ultrasound examination of the patient revealed the formation of a thrombus in the right internal jugular vein. Possible causes of thrombosis include: (1) toxins in the body of a uremic patient can damage the endothelial cells of blood vessels, leading to abnormalities in the coagulation and fibrinolysis systems, thereby promoting thrombosis [7,8]; (2) during the puncture process, ultrasound scanning did not initially reveal thrombus formation in the right internal jugular vein. However, after the guide wire damaged the outer and middle membranes of the internal jugular vein, a “pseudolumen” was formed, subsequently causing thrombosis. No evidence of thrombosis in the internal jugular vein was observed preoperatively. However, on the fourth postoperative day, a color Doppler ultrasound examination revealed a low-echo image resembling a crescent moon wrapped around the lumen of the right internal jugular vein adjacent to its wall (Figure 2). Although the thrombus formation, in this case, did not cause severe harm, detachment of an internal jugular vein thrombus can lead to serious complications such as pulmonary embolism, posing a direct threat to the patient’s life safety. Therefore, vigilance is crucial [9].

Importance of Thrombosis Prevention

With the advancement of science and technology, ultrasound-guided deep venipuncture has emerged as a preferred method due to its high safety, precision, and simplicity [10]. In performing deep venipuncture on patients with SHPT, the emphasis on applying ultrasound-guided in-plane puncture technology is crucial. Calcified vascular walls can pose challenges during puncture, increasing the risk of endothelial injury. Utilizing ultrasound-guided in-plane puncture catheters enables real-time monitoring of the puncture process, minimizing the need for repeated attempts and reducing damage to the blood vessel wall. Subsequently, this approach lowers the likelihood of postoperative thrombosis. However, limitations in applying ultrasound-guided intraplane subclavian vein puncture technology should be acknowledged due to the unique anatomical structure of the subclavian vein. In such cases, alternative sites for vascular access should be prioritized. Studies indicate that a negative plasma D-dimer test excludes the diagnosis of venous thrombosis [11]. Prompt plasma D-dimer testing is recommended when the blood vessels of patients with SHPT are inadvertently damaged during deep vein procedures. Depending on the circumstances, considering low-dose or fixed-dose anticoagulant therapy can prevent deep vein thrombosis, ensuring both efficacy and safety.

Conclusions

In conclusion, patients with SHPT face an increased risk of vascular calcification, complicating deep vein puncture. Anesthesiologists frequently overlook the evaluation of vascular calcification before puncture, opting for target vessels with less calcification. The recommended approach involves...
employing the ultrasound-guided transversal intraluminal technique for puncture. Prompt postoperative D-dimer testing is essential if there is accidental vascular wall damage during the procedure. Appropriate measures should be swiftly implemented to prevent deep vein thrombosis, minimizing severe complications.

**References:**


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