Interventional management of central vein occlusion in patients with peripherally inserted central catheter placement

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ABSTRACT

Objective: This study evaluated the incidence of central vein occlusion (CVO) and analyzed the interventional management for CVO during peripherally inserted central catheter (PICC) placement to suggest an adequate management protocol to ensure the success and patency of PICCs.

Methods: We retrospectively reviewed the records of 2568 PICCs to identify CVO in two medical centers between January 2016 and June 2017. Procedural images were reviewed for the following items: date and indication for the PICC; type of catheter; accessed vein and arm; characteristics of CVO on ascending arm venography; PICC placement technique; indwelling period of the PICC; and follow-up records. A guidewire passage trial was performed to the CVO, as follows: a trial with a 0.018-inch single or double guidewire through the pretrimmed PICC lumen; and a trial with a combination of a 0.035-inch guidewire and a curved 5F diagnostic catheter through the PICC introducer sheath.

Results: The incidence of CVO was 3.2% (71/2232), and 59 patients were analyzed (23 men; mean age, 69 ± 11 years; median age, 80 years; age range, 31-92 years). Forty-four patients had thrombotic CVO, and 12 patients had acute thrombotic CVO. Thirty-six patients had occlusion of the left innominate vein, and six patients had contiguous involvement of the adjacent central vein. Forty-two patients had obtuse stump morphology of CVO, and 28 patients had grade >III collateral development. The PICC indwelling time was statistically different between the group with successful catheter advancement (n = 36, success group) and the group with failed catheter advancement (n = 18, failure group; $P = .007$) with ipsilateral trimmed PICCs. Eight patients had a symptomatic catheter associated with upper extremity deep venous thrombosis (UEDVT; <30 days), one in the success group and seven in the failure group. The incidence of catheter-associated UEDVT after primary PICC placement on each arm was statistically different between the success and failure groups ($P = .004$).

Conclusions: A PICC passage trial for ipsilateral CVO is challenging but frequently successful with a simple guidewire technique, which can preserve catheter patency, decrease contralateral arm access, and prevent the development of new catheter-associated UEDVT. (J Vasc Surg: Venous and Lym Dis 2018;■:1-9.)

Keywords: Central vein occlusion; Peripherally inserted central catheter; Deep venous thrombosis

The upper extremity peripherally inserted central catheter (PICC) has replaced the central venous catheter (CVC) as the primary access point for a short to intermediate duration of intravenous therapy. The number of PICCs placed by interventional radiologists has been rapidly growing during the past decade. As the clinical use of PICCs rapidly increases, upper extremity deep venous thrombosis (UEDVT; thrombosis of the brachial, axillary, or subclavian vein that may extend proximally into the brachiocephalic, superior vena cava, or internal jugular veins) is also increasing, subsequently causing serious problems, such as chronic thrombosis and occlusion of the ipsilateral central vein or compromised future hemodialysis access.[1,2] Despite several reports documenting the various management techniques for catheter-associated UEDVT (CA-UEDVT), including systemic anticoagulation and catheter thrombolysis, the proper interventional management of central vein occlusion (CVO) during PICC placement has not been standardized and is not yet well understood in terms of technical feasibility, cost-effectiveness, and maintenance of long-term PICC patency.[3,4]

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This research was supported by the Central Medical Service Research Fund (Central Medical Service Inc, Seoul, Korea).

Author conflict of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2213-333X

https://doi.org/10.1016/j.jvsv.2018.01.006

The purpose of this study was to determine the incidence of CVO, which was identified during PICC placement in two institutional populations, and to suggest an adequate management protocol to preserve and to ensure the patency of PICC from the perspective of procedural efficacy and economy after analyzing the interventional management for CVO during PICC placement.

METHODS

Our Institutional Review Board approved this study's design (IRB No. 2017-09-002-001), and the Institutional Review Board of Bundang Jesaeng General Hospital, Daejin Medical Center, also approved the study and waived the requirement for informed consent because of the retrospective study design.

Patients. We retrospectively reviewed the procedural images and electronic medical records of a total of 2568 PICCs between January 2016 and June 2017 to identify ipsilateral CVO during PICC placement in two medical centers (Kangdong Seong-Sim Hospital, Hallym University College of Medicine; and Bundang Jesaeng General Hospital, Daejin Medical Center).

Study design. The electronic medical records were reviewed to extract the following data:

- Patients' demographics: name, admission number, age, and sex;
- Clinical data: clinical diagnosis, comorbidities, and history of UEDVT or CVO;
- History of PICC, CVC, or chemotherapy port and the related procedure records: date, indication for the procedure, accessed vein and arm, type of catheter (lumens, gauge, brand), catheter tip location, and catheter indwelling period;
- History of combined lower extremity DVT or pulmonary thromboembolism;
- Length of admission and follow-up;
- History of anticoagulation treatment;
- Thrombosis risk factors, including inherited and acquired hypercoagulable states, recent surgery, trauma, immobilization (≤30 days), and cancer;
- Postprocedural complications, including the presence or aggravation of UEDVT after the current PICC; and
- Presence of secondary PICC and the interval from primary PICC.

The images and records of the current PICC procedure were reviewed for the following items:

- Date and indication for the procedure;
- Type (lumens, gauge, brand) of PICC;
- Accessed vein and arm;
- Characteristics of CVO on ascending arm venography: thrombotic occlusion vs nonthrombotic occlusion, acute occlusion vs chronic occlusion, lesion location, collaterals and their developmental degree, proximal morphology of CVO (bird beak vs obtuse);
- Technique for guidewire passage: 0.018-inch guidewire vs 0.035-inch guidewire; single 0.018-inch guidewire vs double 0.018-inch guidewire; success rate of guidewire passage; causes of failed guidewire passage;
- Presence of combined angioplasty;
- Length of pretrimmed PICC;
- PICC tip location;
- Indwelling period of present PICC; and
- Records of follow-up ascending arm venography or Doppler ultrasound (DUS).

ARTICLE HIGHLIGHTS

- **Type of Research:** Two-center, retrospective analysis of the incidence of central vein occlusion (CVO) and attempted crossing of CVOs in 2232 patients undergoing placement of a peripherally inserted central catheter (PICC)
- **Take Home Message:** In 2232 patients undergoing placement of a PICC, CVO was found in 3.2%. A PICC passage trial through the CVO with simple guidewire techniques was successful in 61% and induced less PICC-associated upper extremity deep venous thrombosis than trimmed PICC placement in the axillary or subclavian vein proximal to the CVO.
- **Recommendation:** The authors recommend attempts to cross CVOs and placement of the PICC across them, rather than placement of a trimmed PICC proximal to the CVO, to prevent new upper extremity deep venous thrombosis and to preserve contralateral venous access.

Inclusion and exclusion criteria. The inclusion criteria were as follows: the presence of ipsilateral CVO, which was identified by complete ascending arm venography during the primary PICC procedure; the presence of complete medical records about the history of PICC, CVC, chemotherapy port, and CA-UEDVT; and at least 30 days of follow-up after the PICC procedure.

The exclusion criteria were as follows: incomplete venography of the CVO for analysis; incomplete medical records regarding the history of PICC, CVC, chemotherapy port, or CA-UEDVT; and <30 days of follow-up after the PICC procedure.

Procedure. After puncture of the access vein, an introducer sheath with a stylet was inserted through a 0.018-inch guidewire, which was originally included in the PICC set (5F dual lumen PowerPICC [Bard Access Systems, Salt Lake City, Utah]; 5F dual lumen Pro-PICC [Medcomp, Harleysville, Pa]). Routinely, we tried to pass to the ipsilateral central vein to identify the presence of CVO with a 0.018-inch guidewire through the introducer sheath (guidewire traversal test). Any resistance met during the guidewire passage trial at any level from the access vein to the ipsilateral central vein was an