Peripherally Inserted Central Catheter Thrombosis—Reverse Tapered versus Nontapered Catheters: A Randomized Controlled Study

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ABSTRACT

Purpose: To compare the thrombosis rate, ease of insertion, bleeding rate, and complications of a nontapered peripherally inserted central catheter (PICC) versus a reverse tapered PICC.

Methods: This was a prospective randomized, controlled trial conducted in single center. All patients 18–90 years old requiring PICC insertion were considered for the study. All patients were followed until PICC removal. Ultrasound examination of the arm was performed at PICC removal or at 28 days. There were 332 patients randomly assigned—164 to the nontapered PICC group and 168 to the reverse tapered PICC group.

Results: The overall thrombosis rate was 71.9%. The thrombosis rate was 70.4% in the nontapered PICC group and 73.4% in the reverse tapered PICC group ($P = .58$). The symptomatic thrombosis rate was 4.3% in the nontapered PICC group and 3.6% in the reverse tapered PICC group ($P = .75$). The complete thrombosis rate was 15.6% in the nontapered PICC group compared with 20.8% in the reverse tapered PICC group ($P = .44$). There was a statistically significantly higher thrombosis rate in patients with cancer (71.9% vs 66.7%, $P = .002$).

Conclusions: This study showed a high incidence of thrombosis of peripheral veins used for PICC insertion. The implication of this thrombosis is significant in light of the morbidity and potential mortality associated with this condition. A difference in thrombosis rate between devices could not be detected in this study.

ABBREVIATIONS

IFU = instructions for use, PICC = peripherally inserted central catheter

Peripherally inserted central catheters (PICCs) have become an essential part of the care of patients in need of prolonged intravenous therapy. Insertion of a PICC is safer than insertion of a central venous catheter because the risk of pneumothorax and injury to the great vessels is eliminated (1). One recognized complication of PICCs is venous thrombosis (2). The rate of symptomatic thrombosis has been reported to be 3%–20% (2–6), and the rate of asymptomatic thrombosis has been reported to be 61.9% (7). The consequences of upper extremity venous thrombosis can be significant and include pulmonary embolism (8) and postthrombotic syndrome (9,10). Additionally, the association between venous thrombosis and infection is well recognized (11,12).

PICC diameter has been found to be a predictive factor for thrombosis in several studies (2). Some authors have recommended use of the smallest diameter PICC possible to reduce the rate of thrombosis (13). "Reverse tapered " is a PICC design in which the catheter diameter increases toward the hub. The main purpose of this design is strain relief (prevention of kinking) at the insertion site. In addition, the thicker portion of the PICC could

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potentially reduce bleeding after catheter placement (14). However, because larger diameter PICCs are associated with higher thrombosis rates (13), the taper near the hub also potentially could result in an increased thrombosis rate, especially at the insertion site. Alternative PICC designs have a uniform diameter from the tip toward the hub (ie, "non-tapered"). This prospective, randomized controlled study was designed to compare the thrombosis rate, ease of insertion, bleeding rate, and complications of a reverse tapered PICC and a nontapered PICC.

MATERIALS AND METHODS

This study was approved by the institutional review board and was conducted in compliance with the Health Insurance Portability and Accountability Act. From August 2008 to December 2010, 339 patients were enrolled in a single institution and randomly assigned to receive either a reverse tapered PICC or a nontapered PICC. The CONSORT flow diagram (**Fig**) shows the randomization and flow of patients throughout the trial. Seven patients did not receive a PICC after enrollment because of randomization errors and other reasons. There were 164 patients who received a nontapered PICC and 168 patients who received a reverse tapered PICC. In 58 patients, the primary endpoint (ultrasound [US] examination) could not be reached. There was no significant difference between the groups in terms of demographics, clinical characteristics, or indications (**Tables 1, 2**).

Inclusion and Exclusion Criteria

All patients 18–90 years old with a request for a double-lumen PICC indicated for treatment $\geq$ 2 weeks (our institution's standard criteria for PICC placement) were considered for the study. Exclusion criteria included the following: (*a*) coagulopathy (international normalized ratio

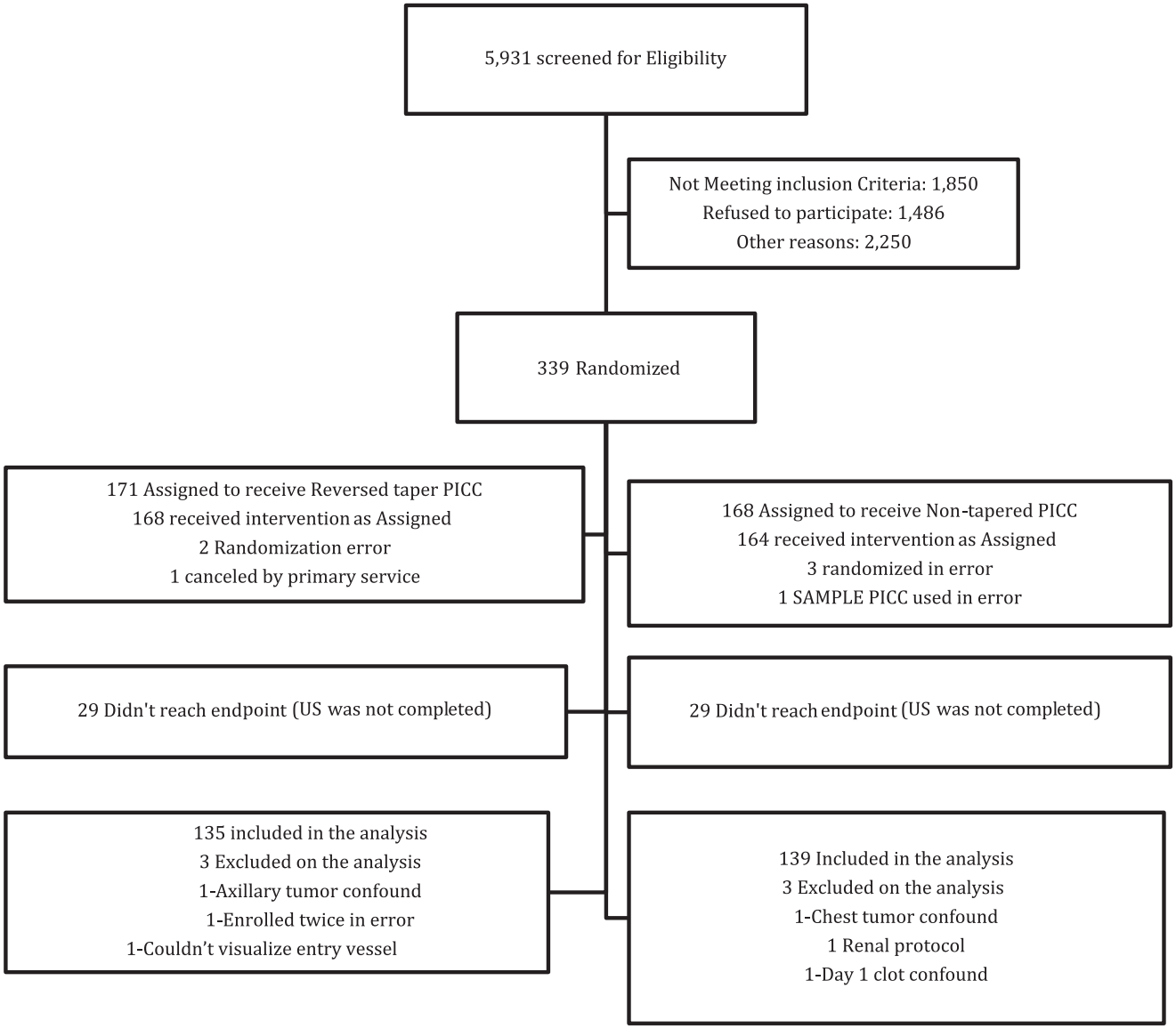

Figure. Consort diagram.