

Improving Neonatal Peripherally Inserted Central Catheter (PICC) Insertion: **The Use of Modified Seldinger Technique (MST)**

Holly A. Hess, RN, BSN, VA-BC, Pediatric/Neonatal Vascular Access Specialist

Introduction

PICC lines are used extensively in the neonatal population. In most facilities, the majority of infants weighing less than 1000 grams and at less than 28 weeks gestation will have at least one, and in some cases several, PICC lines throughout their hospital stay. The direct introducer method has been the standard method of insertion for neonatal PICC lines for over 20 years. While simple and straightforward, the direct introducer method is challenging when attempting to cannulate small veins, especially in active infants. Often multiple attempts are needed before access is successful. New advances in technology now make the MST method, which has become the standard of care for adult and pediatric PICC insertion, available for use in neonates (Petit, 2007). The 2Fr MicroSlide® by Galt used with the 0.008" wire and optional 24g needle are components of the system that have proven to be highly effective in improving PICC insertion success at the author's facility.

Modified Seldinger Technique

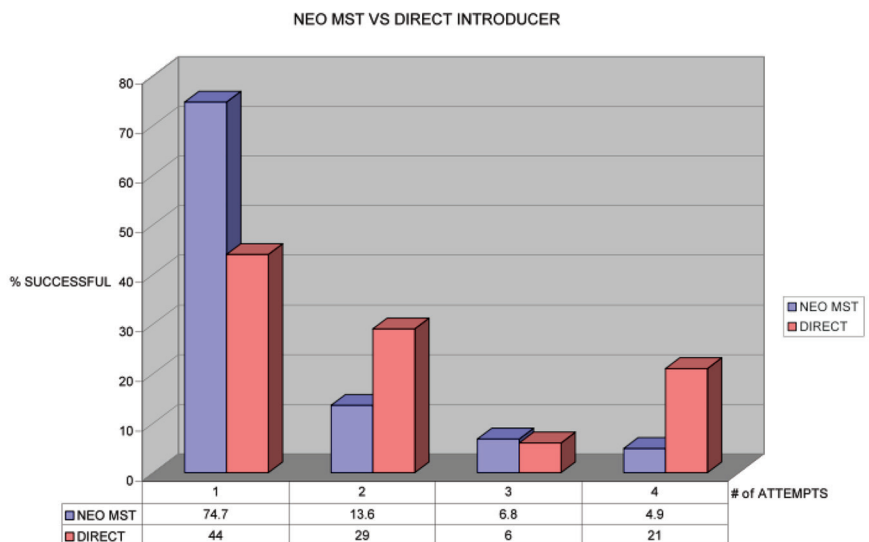
MST describes a method in which the clinician uses a small needle or angiocath to access the vein, followed by insertion of a small caliber, short, flexible wire through the access device as a placeholder in the vein. The angiocath or needle is removed over the wire, and then a dilator/introducer combination is advanced over the wire, following the wire into the vein. Next, the wire and dilator are removed, and the PICC is inserted through the introducer until fully threaded. In the final step, the introducer is removed and peeled away in a manner similar to the direct introducer method (Doellman & Nichols, 2009; Petit, 2007). See figures 1-7. The wire is not intended to extend into the central circulation, and the catheter is not threaded over the wire, which are the main differences from central line insertions done by physicians or advanced practice clinicians using the similar, but different, Seldinger method.

The advantages of the MST method in placing adult and pediatric PICC lines have been well documented (Burns, 2005). First-attempt success rates have been significantly increased (Mickler, 2008). Petit (2007) reports two small studies on infants from 580 to 3600 grams. Success rates were between 83% and 100% with no complications reported. In neonates, virtually any PICC-suitable vein that can be accessed by an IV catheter can be the entry point for a successful PICC insertion. Upper extremity, lower extremity, and scalp veins can be utilized when using the MicroSlide®. While the MST method has more steps, the initial step of starting in a manner identical to an IV insertion is a great benefit to nurse-inserters. The MST technique in neonates and infants has been reported in the literature for a number of years (Frey, 2002; Bayley, 2003; Stephenson & Khan, 1993), but has not been widely adopted, partially because of the lack of appropriately sized components (Sharpe & Petit, 2013). Clinicians who are experienced in placing pediatric PICCs using MST, and who are aware of the significant advantages, have been known to attempt to assemble MST components small enough to work in neonates (Wald, et al, 2008). While this is creative, it is not ideal. Recent advances in the manufacturing of smaller MST devices such as the MicroSlide® by Galt have made neonatal components readily available.

There are other advantages to neonatal MST PICC insertion related to improved first-attempt success. Multiple attempts are stressful to neonates and prolong the procedure, posing the risk of cold-stress, glucose abnormalities, and acid-base disturbances as well. Multiple attempts also often result in increased blood loss, which can become problematic in preterm infants. Repeated attempts are also costly if using a new direct introducer for each attempt (\$35-40 each). With MST, if more than one attempt is needed, the cost is just that of additional angiocaths (\$1-2 each).

Comparison of Direct Introducer vs MST in NICU

When neonatal MST products, such as the MicroSlide® by Galt became available, the Pediatric Vascular Access Team (PVAT) at the author's facility began a trial comparing the traditional insertion method to the MST method. After 6 months using the Galt MicroSlide®, the results were retrospectively compared to the direct introducer method. One hundred and three insertions using MST were compared to 100 insertions using direct introducer, all done by the PVAT in the 48 bed Level III NICU. The babies ranged from 500 grams to over 4kg in both groups (see chart). One-attempt insertions increased from 44% using the direct introducer method to 74.7% using neonatal MST. In addition to increasing first-attempt success, multiple attempts, defined as 4 or more, were reduced from 21% to 4.9%. While this was not a randomized controlled trial, the group of inserters were the same and the patient populations were similar. Due to the improved success and the demonstrated advantages of MST, all PICC lines in the author's NICU (approximately 400/year) are now placed using the Galt MicroSlide® system, with an overall success rate of 97% in the NICU.



Case Study Example

One of the first few patients who received the Galt MicroSlide® as the method of PICC placement was a 600 gram baby born at 26 weeks gestation. The baby had already had an unsuccessful PICC attempt by an experienced practitioner using the direct introducer method. A suitable vein was identified in the right antecubital area, and was successfully cannulated with a 24 gauge angiocath in a manner identical to an IV start. At this point, the angiocath can be flushed to confirm appropriate placement into the vein and eliminate the possibility of inadvertent arterial cannulation, a step that is not possible with a direct introducer. The small wire passed easily with no resistance, and with gentle stretching of the skin at the entry point, the dilator/introducer was passed over the wire and into the vein. Because of the small size of the baby and the vein, the dilator/introducer was passed only about halfway into the vein before removal of the dilator and wire, and finally, successful threading of the PICC into position completed the insertion. Following threading, the peel-away introducer was removed, bleeding was controlled, and the PICC was secured.

MST is an insertion method that has significant advantages over the direct introducer method in adults, pediatrics, and now neonates, including extremely low birth weight infants. With the availability of neonatal MST components such as the MicroSlide®, practitioners who insert neonatal PICCs should consider this method for PICC placement to improve PICC insertion success in this population.



Figure 1: Access an appropriate vein with a 24g angiocath



Figure 2: After removing the needle, prepare to insert the 0.008" wire

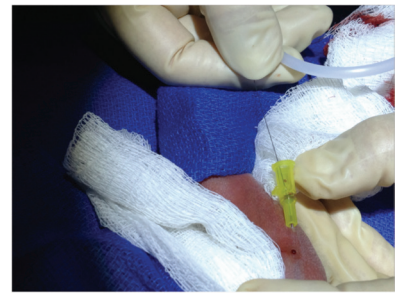


Figure 3: Insert the wire far enough in the angiocath to pass the end of the angiocath and lay in the vein, but not beyond the shoulder

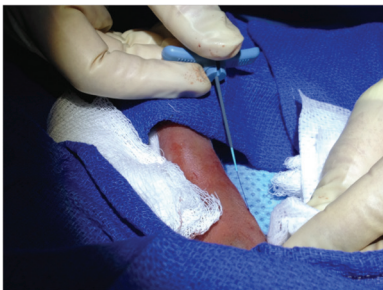


Figure 4: After removing the angiocath, thread the MicroSlide® dilator/introducer combination over the wire and into the vein

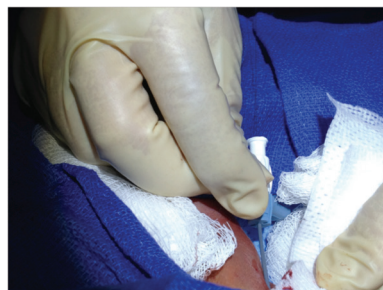


Figure 5: Continue gently threading the dilator/introducer as far into the vein as desired

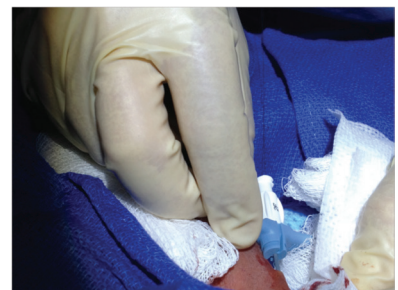


Figure 6: When the dilator/introducer is seated as desired, the white dilator and wire will be removed, leaving the introducer in the vein

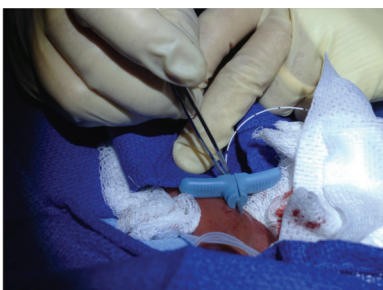


Figure 7: Once the dilator and wire have been removed, the PICC catheter is threaded into the vein through the introducer sheath. When threading is complete the sheath is peeled away

KEY POINTS:

- MST has been shown to improve PICC insertion success in adults, pediatrics, and now neonates.
- The Galt 2Fr MicroSlide® has been successfully used in neonates from 500gm to 4kg at the author's facility and has significantly increased first-attempt success rates from 44% to 74.7%.
- Using MST reduces procedure time, procedure-related stress, and cost.

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