CORRESPONDENCE

A modified Tuohy needle tip design for catheter over needle catheterization: *in vitro* testing

Jonathan Jenkin Tsui, BSc (Hons), MBChB

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To the Editor,

Continuous catheter regional anesthesia has commonly utilized a catheter-through-the-needle technique using a Tuohy-tipped needle. Recently, a catheter-over-the-needle (CON) technique with a facet needle tip has been introduced for peripheral nerve placement.^{1,2} Nevertheless, the CON technique with a Tuohy needle tip has not been described. Since the CON technique requires the needle to be loaded on and pulled out from its outer sheath catheter, the existing Tuohy needle design may not be ideal for a CON technique. This is because the tip of the Tuohy needle has a curved angle, which results in the sharpest point of needle tip contacting the catheter's inner lumen during its insertion and extraction. This poses a risk of cutting or shearing the catheter during use. A new CON design (E-Cath Tuohy, Pajunk, Geisingen, Germany) with a reduced Tuohy tip angle (with the sharpest point at the centre of the needle) was recently developed (Figure) with the aim of minimizing the risk of catheter damage. This *in vitro* study aimed to evaluate whether a less-angulated CON Tuohy needle design could reduce the shearing force on the catheter (as measured by the sliding frictional force exerted between the needle and catheter) when the needle is pulled out from and inserted into the lumen.

The 20-G CON design with a needle bevel angle of 9° and a rounded heel that points and positions the needle's sharp tip at the centre was compared with a standard 20-G Tuohy needle (Braun, Bethlehem, PA, USA) with an approximate 12–15° bevel and a bent curve³ that places the

needle's sharp tip facing horizontally outwards and located at the edge (Figure). For uniform needle trajectory while loading onto and withdrawing from the catheter, the needles were tested by mounting them on a digital frictional force measuring device (Digital Force Gauge H-5, M&A Instruments Inc, Arcadia, CA, USA). The needle was extracted (unloaded) from and then re-inserted (loaded) onto the over-the-needle 18-G catheter at 1 mm·sec⁻¹ using a computer-controlled motor (NE-4000 Programmable Syringe pump, New Era Pump Systems Inc, Farmingdale, NY, USA). All measurements were repeated four times at room temperature. The peak frictional forces of unloading (maximum point) and loading (minimum point) were then recorded from each tracing. The mean (standard deviation [SD]) of the measured peak forces (unloading and loading) were then calculated, and values were compared using the paired *t* test (Statistica-12, StatSoft, Tulsa, OK, USA).

As shown in the Figure, a series of the tracings represented the sliding frictional force generated during the needle unloading and loading onto an 18-G catheter. The peak force of each tracing was recorded. The mean (SD) peak force was significantly lower with the CON needle [unloading, 0.124 (0.002) N; loading, 0.131 (0.002) N] than with the Tuohy needle [unloading, 0.540 (0.058) N; loading, 0.592 (0.095) N] when the needle was loaded and unloaded onto the 18-G outer catheter. These results show that the new CON design generated significantly less frictional force when loading and unloading into the outer catheter. This finding suggests that the modified CON may lessen potential shearing force during needle unloading and loading onto and over a catheter, respectively. Nevertheless, it is important to note that reinsertion of any of the needles back into the catheter should be avoided given the potential risk for shearing the catheter.⁴ Further study in a clinical setting will

J. J. Tsui, BSc (Hons), MBChB (✉)
Department of Medicine, University of Calgary, Calgary, AB,
Canada
e-mail: jonathanjenkintsu@gmail.com

Figure The sliding frictional force between the needles and outer sheath during unloading and loading of the catheter. Both needle's initial positioned at 20 mm from the tip of the catheter. At time zero seconds, the needle was extracted (unloading) from the tip of the 18-G catheter at the rate of $1 \text{ mm} \cdot \text{sec}^{-1}$. At time 25 sec, the needle was then reversed in its direction and started to insert back (loading) into the outer sheath. The sliding frictional force tracings were generated during unloading off and loading into the catheter with (blue) 20-G standard Tuohy needle (Braun, Bethlehem, PA, USA) and (red) 20-G modified needle catheter-over-the-needle (CON) design (E-Cath Tuohy, Pajunk, Geisingen, Germany). All measurements were repeated four times.

be required to determine whether the tactile sensation experienced by clinician would be similar with the new design.

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