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## Interchangeability Between the ClearSight System and Bolus Thermodilution



To the Editor:

WE READ with great interest the article entitled “Accuracy and Trending Ability of Blood Pressure and Cardiac Index Measured by ClearSight™ System in Patients With Reduced Ejection Fraction.”<sup>1</sup> This topic is of clinical interest for anesthesiologists because hemodynamic monitoring is of major importance to decrease morbidity in the perioperative setting, using both blood pressure and cardiac index monitoring.<sup>2</sup> Patients with low ejection fraction are commonly excluded from clinical research, emphasizing the importance of this study. However, we have some comments about this study.

A low sample size of patients is frequently observed in validation studies, typically ranging from 20 to 51, as reported in a recent meta-analysis comparing photoplethysmography with thermodilution.<sup>3</sup> Furthermore, the results could vary from center- to- center and from one study population to another, showing the importance of data sharing to perform large meta-analyses using individual patient data, as was recently published on this topic.<sup>3</sup> Pooled data could improve the analysis of some variables, such as norepinephrine infusion, mean arterial pressure value, or the type of manufacturer, which otherwise could decrease the performance of the study.<sup>3</sup>

The method of the study by Kanazawa et al. might have been strengthened by using new statistical tools that are especially designed to objectively assess the interchangeability between 2 methods of measurements for both absolute values<sup>4</sup> and changes<sup>5</sup> in measurements. For the interpretation of absolute values, the bias, precision, and limits of agreements used subjective interpretation, and the percentage of error approach did not take into account the distribution of values over a range. The interchangeability method has been suggested to objectively interpret each pair of measurements.<sup>4</sup> Using the ability to repeat the reference method, each pair of measurements (reference method and tested method) could be analyzed and classified as being or not being interchangeable, leading to an “interchangeability rate” as a percentage for all measurement and a possible range of interchangeability in a range of values.<sup>4</sup> For the interpretation of changes in hemodynamic variables (eg, blood pressure or cardiac index), the 4-quadrant plot method and polar plot methods have major limitations.<sup>6</sup> Recently, the trend interchangeability method, a novel method for comparing the changes of measurements recorded with 2 techniques, was proposed.<sup>5</sup> By analyzing the ability to repeat the reference method, each change was classified as uninterpretable or interpretable and then as either non-interchangeable, in the gray zone, or interchangeable. Again, a “trend interchangeability rate” can be calculated easily (number of interchangeable changes divided by the total number of interpretable changes).<sup>5</sup>

After adapted validation studies in design and method are conducted, the next step before using a device at the bedside would be performing randomized studies using photoplethysmography to assess the clinical utility (outcome) for the perioperative patient. Again, a recent meta-analysis conducted by our group showed no clinical benefit for using noninvasive photoplethysmography for hemodynamic monitoring in the perioperative setting.<sup>7</sup>

In conclusion, the study by Kanazawa et al., and all recent publications on this topic, have emphasized that photoplethysmography should not be used routinely in clinical practice, and additional studies are mandatory before recommending its use.

## Conflict of Interest

None.

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## A Rare and Unique Central Line Complication

To the Editor:



THE following describes a rare complication that can occur when placing multiple central venous catheters into a single vessel. In this patient, upon insertion of a second central line into the internal jugular vein, an existing catheter was pierced with the new catheter going through the existing line. The complication was not fully recognized until removal of the central access was attempted in the intensive care unit (ICU) days later.

The patient was a 59-year-old woman with a history of severe mitral stenosis, moderate mitral regurgitation, severe right ventricular dysfunction, and chronic obstructive pulmonary disease. The patient was admitted to an outside hospital (OSH) for acute hypoxemic respiratory failure secondary to pneumonia, with respiratory symptoms that were exacerbated in the setting of her severe mitral valve disease. The patient required mechanical ventilation while the pneumonia was treated and eventually required a tracheostomy for ventilatory-dependent respiratory failure before being transferred to our institution for mitral valve surgery. The patient underwent a successful mechanical mitral valve replacement and patent foramen ovale closure at our institution. The patient had a right internal jugular 9-Fr cordis introducer catheter present on arrival from the OSH. In the operating room, an Arrow 9-Fr multilumen access catheter (MAC) also was placed in the right internal jugular vein; this introducer catheter was placed proximal to the heart in relation to the existing 9-Fr cordis introducer catheter (ie, closer to the clavicle). A pulmonary artery catheter was floated successfully through the newly placed MAC line for intraoperative and postoperative hemodynamic monitoring. The intention was to remove the line

placed from the OSH and only use the catheter placed at our institution; however, resistance was noted when attempting to remove the cordis. Thus, the cordis was left in place but not used during the surgery. After the surgery, the patient was admitted to the cardiac surgery ICU; it was signed out that the 2 internal jugular vein central lines would need to be removed together and that only the MAC line placed at our institution should be used.

The patient progressed in her recovery in the ICU; she was weaned off her vasoactive medications, and her pulmonary artery catheter was removed. On postoperative day 5, it was determined that the patient no longer required central venous access, and the plan was to remove her right internal jugular catheters. Because of how the lines were inserted, the infusion ports of the MAC line were overlying the insertion site of the cordis; thus, removal of the MAC line was attempted first. Upon retraction of the MAC line, the cordis began to move in tandem, retracting as well. Resistance was felt when the MAC line was retracted about 2 inches. The assumption was that the lines were entangled because the lines could be identified as crossing over each other on chest x-ray (Figs 1 and 2).

When attempting to retract just the cordis, significant resistance was met immediately. At this point, members of the cardiac surgery and vascular surgery teams were called to be present at the bedside to examine the catheters and discuss the safest way to proceed without causing a vascular injury. The catheters and vessel were examined with ultrasound at the bedside, but the catheters could not be differentiated from each other because they appeared stuck together. The decision was made to place a guidewire through the MAC line while examining the vessel using ultrasound to ensure the wire stayed intravascular and moved freely. After this was accomplished, a dilator from a cordis kit was placed over the guidewire through the MAC line introducer port, with the thought being that if the lines were twisted around each other, the stiffer dilator may help them untwist and facilitate removal of the line. The plan worked because after dilator insertion, the MAC line was able to be removed with slow, steady retraction. Once the MAC line was removed, the cordis was removed without any difficulty or resistance. However, upon inspection of the removed lines, we were surprised with what we found (Figs 3 and 4; Video 1).

Central line entanglement and even knotting have been described in multiple case reports, most often when a pulmonary artery catheter is involved.<sup>1-5</sup> However, upon a PubMed literature search, no case reports describing a central line piercing/puncturing and transecting another catheter, as what happened in our case, were found. When reviewing 2 recent reviews on central line complications, neither review listed or discussed one catheter going through another catheter as being a complication described in the literature or in case reports.<sup>6,7</sup>

This is a rare complication of placing 2 central line catheters into a single vessel. We are lucky that upon placement, and then again upon attempting to remove the lines, that the distal end of the cordis did not break off and embolize to the patient's heart or lungs. This case highlights the importance of developing tactile sensation in addition to having visualization when obtaining venous access. Ideally, one can feel the needle go through different layers of tissue when going from skin to