Techniques to Minimize Posterior Wall Puncture during Internal Jugular Vein Cannulation

To the Editor:

We read the article by Auyong *et al.*[1] and have a few questions/comments about the study.

It is interesting to note that the authors did not observe any significant difference in the incidence of posterior wall (PW) puncture with respect to the years of experience of the provider. There also appears to be no association between the frequency of ultrasound procedures performed or supervised and the incidence of PW puncture. We noted that the academic practice was found to be somewhat protective toward the PW puncture.

We wondered why the authors counted a pass as any needle withdrawal of greater than 0.5 cm and how this was monitored, especially in the group with the navigation off. We would suggest that this distance be approximately 1 cm, as the internal jugular vein (IJV) was 1.1 cm below the skin. Vogel *et al.*[2] defined redirections as changes in the direction of the needle after insertion without removing it from the skin. In addition, to reconsider the distance of needle withdrawal to closely and accurately monitor the number of passes, we would suggest marking the introducer needle to measure the distance of the needle as it is introduced. Reconsidering the distance required to qualify as a pass and marking the introducer needle could have influenced the observed number of passes and may have affected the results of the study.

There are a few techniques we practice at our institution for ultrasound-guided central venous catheterization. An ultrasound examination is performed before prepping and draping the site of venous cannulation, and the depth of the vein from the skin is noted. Marking the introducer needle based on the depth of IJV as observed on the preprocedural ultrasound may prevent inadvertent insertion of the needle beyond the lumen of the vein and could possibly decrease the incidence of PW puncture.[3] After successful cannulation of the IJV with the introducer needle and subsequent insertion of the guidewire *via* the introducer needle, inadvertent penetration of the PW of IJV or carotid artery may occur during the process. It may be prudent to confirm the location of the guidewire within the vein to avoid complications.[4,5]

The authors used the out-of-plane technique to compare the incidence of PW and carotid artery puncture. We would suggest using the in-plane technique because the needle can be seen along the entire length as it is introduced into the vein.[3,6] Vogel *et al.*[2] observed that the long-axis view for IJV cannulation was more efficient than the short-axis view and was associated with a significantly decreased number of redirections during IJV cannulation. The in-plane use of the ultrasound probe could possibly have decreased the number of passes, the incidence of PW, and subsequent carotid artery puncture, especially in the group with navigation off, and may have altered the results of the study. Alternatively, a medial-oblique approach of the ultrasound probe may be used to possibly decrease the risk of PW penetration.

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Competing Interests

The authors declare no competing interests.

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References

1. Auyong DB, Yuan SC, Rymer AN, Green CL, Hanson NA: A randomized crossover study comparing a novel needle guidance technology for simulated internal jugular vein cannulation. Anesthesiology 2015; 123:535–41
2. Vogel JA, Haukoos JS, Erickson CL, Liao MM, Theoret J, Sanz GE, Kendall J: Is long-axis view superior to short-axis view in ultrasound-guided central venous catheterization? Crit Care Med 2015; 43:832–9
3. Maheshwari P, Maheshwari P: Long-axis *versus* short-axis view of ultrasound-guided central venous cannulation. Crit Care Med 2015; 43:e597
4. Maheshwari P, Maheshwari P: Ultrasound-guided internal jugular vein cannulation: Techniques to confirm guidewire location. Can J Anaesth 2015; 62:1344
5. Maheshwari P, Maheshwari P: Ultrasound-guided internal jugular vein cannulation: A novel technique for confirming that the guidewire is directed towards the right atrium. Can J Anaesth 2015; 62: (in press)
6. Blaivas M, Adhikari S: An unseen danger: Frequency of posterior vessel wall penetration by needles during attempts to place internal jugular vein central catheters using ultrasound guidance. Crit Care Med 2009; 37:2345–9; quiz 2359

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In Reply:

We appreciate the insightful comments from Drs. Maheshwari and Maheshwari on our article.[1] First, we agree that marking the introducer needle might have improved the accuracy of tracking needle withdrawals in our study. However, such placement of markers on the needles is not part of most standard clinical practices and might have potentially influenced our primary outcome data by affecting subject behaviors. This study was designed to closely replicate the environment of an actual clinical procedure, using a custom-designed gel phantom model that closely simulated *in vivo*

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vessel pressures and vessel depth. Correspondingly, we used an introducer needle and a syringe procured from a standard central line placement kit. As any definition of a needle pass can be arbitrary, we chose 0.5 cm to improve objectivity. Because we defined a "pass" in this manner, our blinded assessor viewing the recorded videos counted almost every needle withdrawal as a pass. Although we did track needle passes in this manner as a secondary outcome, we emphasize the significant differences found in our primary outcome of posterior vessel wall puncture. This outcome is a surrogate of "lost" needles under ultrasound and has been used in several previous studies.[2,3] In addition, the high number of carotid punctures (21% without guidance) should be highlighted as an outcome that could cause significant morbidity in an actual patient.

Drs. Maheshwari and Maheshwari also point out that there are many variations in the method of ultrasound-guided central venous cannulation.[4] Even in their brief letter, they recognize that at least three techniques have been described: in-plane, out-of-plane, and medial-oblique approaches. The fact that there are so many different techniques to perform the task of vessel cannulation only reinforces that accurate needle placement using ultrasound is not always easy and no single technique is successful every time. Indeed, even ultrasound-guided in-plane approaches have been associated with a high level of procedural errors, primarily advancing without visualization.[5] As with any study, we wanted to replicate the conditions of actual clinical practice, and we found that the out-of-plane needle approach was very common among our peers and numerous studies. The authors of the aforementioned letter will be pleased to know that the ultrasound technology highlighted in our article is able to track needles with any needle/probe orientation, including in-plane. However, results of our study may not be directly transferrable to in-plane approaches and confirmation with further research would be required to make any definitive statements on the benefits of needle guidance with in-plane approaches.

Competing Interests

The authors declare no competing interests.

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References

1. Auyong DB, Yuan SC, Rymer AN, Green CL, Hanson NA: A randomized crossover study comparing a novel needle guidance technology for simulated internal jugular vein cannulation. Anesthesiology 2015; 123:535–41
2. Blaivas M, Adhikari S: An unseen danger: Frequency of posterior vessel wall penetration by needles during attempts to place internal jugular vein central catheters using ultrasound guidance. Crit Care Med 2009; 37:2345–9; quiz 2359
3. Moon CH, Blehar D, Shear MA, Uyehara P, Gaspari RJ, Arnold J, Cukor J: Incidence of posterior vessel wall puncture during ultrasound-guided vessel cannulation in a simulated model. Acad Emerg Med 2010; 17:1138–41
4. Auyong DB, Hsiung RL: Ultrasound in central venous cannulation. Adv Anesth 2010; 28:59–79
5. Sites BD, Spence BC, Gallagher JD, Wiley CW, Bertrand ML, Blike GT: Characterizing novice behavior associated with learning ultrasound-guided peripheral regional anesthesia. Reg Anesth Pain Med 2007; 32:107–15

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One Size Does Not Fit All

To the Editor:

I read with interest the detailed review on intraoperative protective mechanical ventilation.[1] On the basis of their analysis of existing scientific data, the authors recommend to ventilate healthy lungs with a combination of low tidal volume (V_T, 6 to 8 ml/predicted body weight [PBW], no or minimal positive end-expiratory pressure (PEEP more than or equal to 2 cm H_2O), and no recruitment maneuver (RM). In case of a peripheral oxygen saturation (Spo_2) less than 92%, they further recommend to increase the inspired oxygen fraction (Fio_2) up to 0.6 without a simultaneous increase in PEEP, to increase PEEP to maximally 6 cm H_2O should a Fio_2 of 0.8 be required, and to consider a single RM. They designate this ventilatory strategy as "protective." I am concerned with these recommendations because they are not necessarily supported by scientific data and may well result in "nonprotective" ventilation in individual patients.

My first concern relates to the undifferentiated use of the term "healthy" lungs. Baseline function and morphology and compensatory capacity differ substantially between the "healthy" lung of a young and that of an advanced-age individual. In addition to such intrinsic differences between "healthy" lungs, differences in patient physical fitness and body habitus, intraoperative positioning, and type of surgery (to name just a few factors) will be associated with entirely different intraoperative impacts on "healthy" lungs. It is unrealistic to assume that an identical ventilation strategy will be equally "protective" in the case of a 75-yr-old obese patient undergoing major abdominal surgery intermittently requiring Trendelenburg position and in that of a 20-yr-old normal weight patient undergoing peripheral surgery in the recumbent position. As the impact on the lungs differs considerably between conditions, even for "healthy" lungs, nonindividualized recommendations are unwarranted.

When excluding nonpulmonary causes, the most likely cause of intraoperative desaturation is progressive lung collapse related to the consistent 15 to 25% decrease in functional residual capacity (FRC) associated with any induction of general anesthesia and formation of atelectasis in the majority of patients.[2,3] It is accepted knowledge that increasing of the Fio_2 is associated with an increased risk

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