Radial Artery Cannulation in Young Children: Comment

To the Editor:

We read with interest the report by Quan *et al.* of a novel acoustic shadowing technique for pediatric arterial cannulation—a technically difficult procedure even for experts.[1] The first-pass success rate of 60% by experienced providers (with more than 50 ultrasound-guided cannulations) in their report in 9 ± 3-month-old children for the traditional ultrasound group seems low, but is consistent with previously published data.[2,3]

The authors choose to use procedural times as a secondary outcome, which we believe is a misleading metric in this context. The authors state that the decreased time to ultrasound localization of the artery (18 s *vs.* 4 s) and decreased time to arterial puncture (40 s *vs.* 24 s) demonstrate an efficiency advantage and time savings compared to traditional ultrasound utilization. A more accurate representation of the true impact on efficiency and timeliness would incorporate setup time for the novel technique, which we strongly suspect would outweigh the clinically insignificant (30 s total) time savings the authors report. In the pediatric critical care setting, trainee first-pass success utilizing ultrasound guidance has been reported at 28%, with an average total procedure time of 8.1 min.[4] Reduction in procedural time may be a more valid outcome measure among less experienced practitioners than in the context in which the authors found such minimal change. As educators, we would be interested in seeing the impact of this novel intervention on trainee performance and cumulative sum learning curves, and we encourage the authors to continue to investigate this issue.

Competing Interests

The authors declare no competing interests.

Samuel A. Hunter, M.D., Anushree Doshi, M.D., Alan Jay Schwartz, M.D., M.S.Ed., Justin L. Lockman, M.D., M.S.Ed. The Children's Hospital of Philadelphia, Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania (S.A.H.). hunters2@email.chop.edu

DOI: 10.1097/ALN.0000000000003273

References

1. Quan Z, Zhang L, Zhou C, Chi P, He H, Li Y: Acoustic shadowing facilitates ultrasound-guided radial artery cannulation in young children. Anesthesiology 2019; 131:1018–24
2. Schwemmer U, Arzet HA, Trautner H, Rauch S, Roewer N, Greim CA: Ultrasound-guided arterial cannulation in infants improves success rate. Eur J Anaesthesiol 2006; 23:476–80
3. Nakayama Y, Nakajima Y, Sessler DI, Ishii S, Shibasaki M, Ogawa S, Takeshita J, Shime N, Mizobe T: A novel method for ultrasound-guided radial arterial catheterization in pediatric patients. Anesth Analg 2014; 118:1019–26
4. Kantor DB, Su E, Milliren CE, Conlon TW: Ultrasound guidance and other determinants of successful peripheral artery catheterization in critically ill children. Pediatr Crit Care Med 2016; 17:1124–30

(Accepted for publication February 25, 2020. Published online first on March 31, 2020.)

Radial Artery Cannulation in Young Children: Comment

To the Editor:

I read with interest the publication by Quan *et al.* on a simple and effective method for lining up an ultrasound probe to the radial artery for its cannulation in pediatric patients in the November issue of Anesthesiology.[1] Their cannulation method using acoustic shadowing proved to be highly effective for first pass success.[1]

Two things need clarification for correct interpretation of their described technique. First, air is a poor conductor of ultrasound waves. The authors state, "The developing lines are made of metal-containing strands taken from x-ray–detectable surgical gauze." Lines from highly reflective metal are not immediately apparent in figure 3. Perhaps the metal strands are very small, and they are essentially artificial air pockets, which cause the shadowing. Second, preparing and setting up this method must take time. The difference of the median time to locate the artery between the traditional and the novel technique was 12 s. Getting the gauze wires lined up nicely in a parallel fashion on the probe while maintaining sterility seems challenging and would probably lose the seconds gained. Besides, we do not want an air bubble to get trapped between the two gauze wires because of poor application of the sterile probe cover, as it will obscure the underlying tissue in shadows.

There are also other approaches. On some ultrasound machines, M-mode draws a line in the center of the

ultrasound image, before displaying the M-mode trace of the tissue on that line (fig. 1). Once this M-line goes through the middle of the artery, one aligns the catheter with the center marker on the probe and attempts to cannulate the artery. The instruction manual of the ultrasound machine used by Quan *et al.* has a similar feature.

In the end, Quan *et al.* have shown us that a proper ultrasound alignment and artery cannulation technique diminishes the complication rate.[1] This is a result that counts.

Competing Interests

Dr. Kuiper received payment for lectures from Danube University Krems, Krems an der Donau, Austria, outside the submitted work.

Gerhardus J. A. J. M. Kuiper, M.D., Ph.D., Peter Munk Cardiac Centre, Toronto General Hospital, University Health Network, University of Toronto, Toronto, Canada. Gerhardus.kuiper@one-mail.on.ca

DOI: 10.1097/ALN.0000000000003272

Reference

1. Quan Z, Zhang L, Zhou C, Chi P, He H, Li Y: Acoustic shadowing facilitates ultrasound-guided radial artery cannulation in young children. Anesthesiology 2019; 131:1018–24

(Accepted for publication February 25, 2020. Published online first on March 31, 2020.)

Radial Artery Cannulation in Young Children: Comment

To the Editor:

With great interest we have read the article written by Quan *et al.*[1] recently published in Anesthesiology. In their article, they describe a method to improve the success rate of correct placement of radial artery cannulation in young children. They use acoustic shadowing ultrasound to guide cannulation versus conventional ultrasound use. They found a significantly improved success rate of radial artery puncture using acoustic shadowing ultrasound.

Arterial cannulation in young children can be challenging, and its success is influenced by patient characteristics and operator experience. We explored its use in our own practice. Doing so, we came across the following issues. First, we experienced that the described gain in puncture time was outweighed by the extra preparation time.

To extract the metal-containing strand out of a surgical gauze and fixate it on the ultrasound probe exceeds the 16 s of time won during correct placement. Second, extracting the metal-containing strand from a surgical gauze in the operation theatre could lead to confusion during surgical gauze counting, compromising patient safety.

Third, with use of the acoustic shadowing, the first attempt success rate was 90%. The control group, however,

Fig. 1. In the *left* panel, the M-line is activated and centered through the radial artery. In the *right* panel, an HFL38x/13-6 MHz probe (FUJIFILM SonoSite, Inc., USA) is shown with its center marker, which can be used for final alignment.

had a first pass success of only 60%, which is low compared with recent published literature, 68 to 83%.[2–4]

Fourth, the authors used a short-axis, out-of-plane approach, while recent literature suggests that an in-plane approach has additional benefits with a lower incidence of posterior wall puncture.[5] In our opinion, a combined short- and long-axis approach should be used for optimal success.

Finally, we have concerns about figure 3, which demonstrates the process of radial artery puncture in humans. However, we noticed discrepancies in distances between the figure and the reported patient data. The average depth of the radial artery in the article was 2 mm. This leads to a distance between the acoustic shadowing to be around 0.6 mm. This equals the diameter of the suggested radial artery in figure 3. In the final frame, the arterial canula is correctly positioned in the artery. However, the diameter of a 24-gauge catheter is also 0.6 mm. The general appearance suggests a tissue phantom, not representing reality.

In conclusion, we suggest using a long-axis approach when possible. If extra guidance is needed and a short-axis approach is used, existing and commercially available ultrasound with centerline functionality could be easier and more reliable to use in daily practice.

Competing Interests

The authors declare no competing interests.

Karen M. A. Slikboer, M.D., Manon P. A. J. Vugts, M.D., Cornelis Slagt, M.D., Ph.D. Radboud University Medical Center, Nijmegen, The Netherlands (C.S.). cor.slagt@radboudumc.nl

DOI: 10.1097/ALN.0000000000003271

References

1. Quan Z, Zhang L, Zhou C, Chi P, He H, Li Y: Acoustic shadowing facilitates ultrasound-guided radial artery cannulation in young children. Anesthesiology 2019; 131:1018–24
2. Kim EH, Lee JH, Song IK, Kim JT, Lee WJ, Kim HS: Posterior tibial artery as an alternative to the radial artery for arterial cannulation site in small children: A randomized controlled study. Anesthesiology 2017; 127:423–31
3. Min JJ, Tay CK, Gil NS, Lee JH, Kim S, Kim CS, Yang JH, Jun TG: Ultrasound-guided *vs.* palpation-guided techniques for radial arterial catheterisation in infants: A randomised controlled trial. Eur J Anaesthesiol 2019; 36:200–5
4. Ishii S, Shime N, Shibasaki M, Sawa T: Ultrasound-guided radial artery catheterization in infants and small children. Pediatr Crit Care Med 2013; 14:471–3
5. Song IK, Choi JY, Lee JH, Kim EH, Kim HJ, Kim HS, Kim JT: Short-axis/out-of-plane or long-axis/in-plane ultrasound-guided arterial cannulation in children: A randomised controlled trial. Eur J Anaesthesiol 2016; 33:522–7

(Accepted for publication February 25, 2020. Published online first on March 31, 2020.)

Radial Artery Cannulation in Young Children: Reply

In Reply:

We thank Hunter *et al.*,[1] Kuiper,[2] and Slikboer *et al.*[3] for their interest in our new approach for radial artery cannulation in pediatric patients,[4] and it is our great honor to respond the questions and comments raised by them.

In response to the comment by Hunter *et al.*,[1] our new approach is featured by adding two more isolation lines to the ultrasonic probe. These two developing lines were placed on the ultrasonic probe before applying the coupling agent (fig. 1). In addition, placing these two developing lines takes less than 5 s. For less experienced practitioners, this method may shorten the time taken for both locating the targeted artery and puncturing it.

In response to Kuiper,[2] we admit that air may be trapped in the space between the two gauze wires and sterile probe cover. However, this situation can be overcome by filling the space with the coupling agent. In fact, in the current study, we first placed the two developing lines and then applied the coupling agent (fig. 1). Thereafter, we wrapped the probe with a 3M Tegaderm (3M Company, 3M Health Care, USA) transparent film to maintain aseptic conditions. We found that the developing effect was not related to the type of wire used; rather, it is associated with its diameter. Use of extremely fine wire (*e.g.*, surgical suture) might result in poor developing effect. Thus, we utilized the wire from the surgical gauze because of its superior developing effects, rather than its metallic nature.

Based on our experience, preparations for this method should not take longer than 5 s because the developing lines do not have to be placed under sterile conditions. After placing the two developing lines and applying the coupling agent, we wrapped the ultrasound probe with a 3M Tegaderm transparent film to maintain aseptic conditions. Moreover, the M-mode draws a line in the center of the ultrasound image, but the needle often overlaps with the M-line during the procedure. Our method is better than those using M-mode because the targeted vessels are

Fig. 1. Effect of drawing double lines on an ultrasonic probe using a milky white coupling agent (no air bubble in the ultrasonic probe).

located by the two developing lines, and the shade of the needle can be visualized between these two lines.

In response to the comment and concern by Slikboer *et al.*,[3] as we have mentioned above, our settings take no longer than 5 s to prepare. The wires from the surgical gauze need not be aseptic and can be reused multiple times. After placing the two developing lines and applying the coupling agent, the ultrasonic probe is wrapped in a 3M Tegaderm transparent film to maintain aseptic conditions.

The surgical gauze that contains the metal-containing wire (developing line) can be taken from the anesthesia toolbox rather than from the operating theatre. In addition, the wires do not require sterilization.

Since 2013, the research team has mainly used a modified out-of-plane approach (with a developing line tied to the midpoint of the ultrasound probe) for artery puncture,[5] rather than the traditional out-of-plane approach. Therefore, the slightly lower accuracy of the first attempt may be related to the practitioners' familiarity with one approach over the other.

Previous studies have shown that for ultrasound-guided vascular puncture, the first attempt success rate of the conventional out-of-plane approach does not differ significantly from that of the conventional in-plane approach.[6–8] However, compared to the conventional out-of-plane method, our newly developed out-of-plane method significantly improves the first attempt success rate. We also appreciate the suggestion of a combined short- and long-axis approach for radial artery puncture. It will help to reduce the incidence of unwanted posterior wall puncture. In addition, based on our experience, the short-axis, out-of-plane approach is more applicable for puncturing shallow vessels with small diameters, whereas the long-axis in-plane approach is more applicable for puncturing deep vessels with a large diameters. Nevertheless, if the targeted vessel is fine and deep, a combined short- and long-axis approach should be used.

Figure 3 in our original article[4] was generated using a vascular puncture model rather than a radial artery model. Therefore, the display scale does not accurately match the actual image. We used the vascular model for better illustration of the display of our method. The actual image is shown in figure 2B in the article.[4]

Competing Interests

Dr. Zhang reports financial support from Beijing Municipal Science and Technology Commission (No. Z171100001017036). The other authors declare no competing interests.

ZheFeng Quan, M.D., Chen Zhou, M.D., Liang Zhang, M.D.
Beijing YouAn Hospital, Capital Medical University, Beijing, China (Z.Q.). 15811190059@126.com

DOI: 10.1097/ALN.0000000000003275

References

1. Hunter S, Doshi A, Schwartz AJ, Lockman JL: Radial artery cannulation in young children: Comment. Anesthesiology 2020; 132:1605
2. Kuiper GJAJM: Radial artery cannulation in young children: Comment. Anesthesiology 2020; 132:1605–6
3. Slikboer KMA, Vugts MPA, Slagt C: Radial artery cannulation in young children: Comment. Anesthesiology 2020; 132:1606–7
4. Quan Z, Zhang L, Zhou C, Chi P, He H, Li Y: Acoustic shadowing facilitates ultrasound-guided radial artery cannulation in young children. Anesthesiology 2019; 131:1018–24
5. Quan Z, Tian M, Chi P, Cao Y, Li X, Peng K: Modified short-axis out-of-plane ultrasound *versus* conventional long-axis in-plane ultrasound to guide radial artery cannulation: a randomized controlled trial. Anesth Analg 2014; 119:163–9
6. Song IK, Choi JY, Lee JH, Kim EH, Kim HJ, Kim HS, Kim JT: Short-axis/out-of-plane or long-axis/in-plane ultrasound-guided arterial cannulation in children: A randomised controlled trial. Eur J Anaesthesiol 2016; 33:522–7
7. Sethi S, Maitra S, Saini V, Samra T, Malhotra SK: Comparison of short-axis out-of-plane *versus* long-axis

in-plane ultrasound-guided radial arterial cannulation in adult patients: A randomized controlled trial. J Anesth 2017; 31:89–94
8. Maitra S, Bhattacharjee S, Baidya DK: Comparison of long-, short-, and oblique-axis approaches for ultrasound-guided internal jugular vein cannulation: A network meta-analysis. J Vasc Access 2019; 1129729819868927

(Accepted for publication February 25, 2020. Published online first on March 31, 2020.)

Dexmedetomidine Sedation and Airway Collapsibility: Comment

To the Editor:

We have just read the article "Upper Airway Collapsibility during Dexmedetomidine and Propofol Sedation in Healthy Volunteers: A Nonblinded Randomized Crossover Study,"[1] and we really appreciate this nice work demonstrating the equal possibility of dexmedetomidine and propofol leading to upper airway obstruction or ventilatory depression. However, we wonder whether the patients in either group were in similar stable condition by the end of first airway assessments, as a run-in period or washout period was not mentioned in this crossover study. Liu *et al.* found that terminal half-life of dexmedetomidine could be as long as 4.4 h,[2] so during the infusion of two sedatives by Lodenius *et al.*, is it possible that the residual sedative effect of dexmedetomidine overlaps with sedation of propofol after overcross, or *vice versa*? As the total time lasted only 101 min, it would be very useful if the authors could supplement details of crossover for this study.

Competing Interests

The authors declare no competing interests.

Binbin Zhu, M.D., Lina Zhang, M.D., Ningbo University School of Medicine, The Affiliated Hospital of Medical School of Ningbo University, Ningbo, China. (B.Z.) pingchi1983@126.com

DOI: 10.1097/ALN.0000000000003269

References

1. Lodenius Å, Maddison KJ, Lawther BK, Scheinin M, Eriksson LI, Eastwood PR, Hillman DR, Fagerlund MJ, Walsh JH: Upper airway collapsibility during dexmedetomidine and propofol sedation in healthy volunteers: A nonblinded randomized crossover study. Anesthesiology 2019; 131: 962–73
2. Liu HC, Lian QQ, Wu FF, Wang CY, Sun W, Zheng LD, Schüttler J, Ihmsen H: Population pharmacokinetics of dexmedetomidine after short intravenous infusion in Chinese children. Eur J Drug Metab Pharmacokinet 2017; 42:201–11

(Accepted for publication February 15, 2020. Published online first on March 27, 2020.)

Dexmedetomidine Sedation and Airway Collapsibility: Reply

In Reply:

We thank Drs. Zhu and Zhang[1] for their interest in our study comparing the effect of sedation with dexmedetomidine and propofol on upper airway collapsibility.[2] We are also thankful for the opportunity to clarify facts regarding washout time between airway assessments during sedation with the two drugs.

It is true that without an adequate washout period, a sedative effect of the first drug could affect the result when evaluating the second drug in a crossover study. However, in our study, the time between testing airway collapsibility with the two drugs was 7 days or more. A residual effect of the first drug at the second airway assessment therefore seems very unlikely.

Competing Interests

The authors declare no competing interests.

Åse Lodenius, MD., Ph.D., Malin Jonsson Fagerlund, M.D., Ph.D. Karolinska Institutet, Stockholm, Sweden. Ase.Lodenius@remeoclinic.se

DOI: 10.1097/ALN.0000000000003270