Peer Review File

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Review Comments A:

Major comments:

The result of the paper is that ultrasound is useful in reducing malposition of PICC catheters, and abduction of the ipsilateral arm is also useful. However, these are well known. I'm bewildered that the authors did not know them.

The research method is ambiguous.

The authors are required to explain a relation of catheter tip position and effect of ultrasound guidance.

Answer> Thank you very much for your raising these points. I am sorry for the insufficient information on the background of the study. However, not only did we get better results than the papers presented, but we also got results similar to other methods. Compared with other methods, it can be implemented more easily with less effort, and there was no need for additional equipment. Although it is impossible to achieve 100% accuracy, I think it could be an easy way to solve the problem.

The section of the "Title page"

"Title: Novel ultrasound-assisted technique for reducing malpositions of peripherally inserted central catheters in the intensive care unit"

A technique of detecting migration into the internal jugular vein using ultrasound was reported in the journal of "Critical Care Medicine" in 2009. Today, the technique has been become in popular.

Schweickert WD, Herlitz J, Pohlman AS, Gehlbach BK, Hall JB, Kress JP. A randomized, controlled trial evaluating postinsertion neck ultrasound in peripherally inserted central catheter procedures. Crit Care Med. 2009 Apr;37(4):1217-21. doi: 10.1097/CCM.0b013e31819cee7f. PMID: 19242336

Answer>Thank you for helpful comment. We have changed the title accordingly:

~~**Novel ultrasound-assisted technique for reducing malpositions of peripherally inserted central catheters in the intensive care unit**~~

>> Ipsilateral ultrasound-monitoring technique for reducing malpositions of peripherally inserted central catheters in the intensive care unit

The section of the “Methods”

L83-86: The authors are required to describe the research method clearly. It looks a prospective study. If it is a prospective study, a clinical study registration is required.

Answer> Thank you for raising this point. I fully agree with your opinion and added the study design in the methods section. This is a retrospective, case-control single-center study.

We conducted a case-control study of patients aged 18 to 95 years who required a PICC in the ICU of a single institution from January 1, 2018 to December 31, 2018.

>> We conducted a retrospective, case-control, single-center study of patients aged 18–95 years who required a PICC in the ICU of a single institution from January 1, 2018, to December 31, 2018.

Table 2: From July to December 2018, PICCs were inserted with the arm abducted 90°

The authors are required to move the sentence to the “Methods” section.

Answer> In the table, procedures A and B are described them, and the same sentence is also described in methods.

From January to June 2018, PICCs were inserted with the arm abducted at 90° from the patient’s body and the head turned toward the ipsilateral side (if possible) under ultrasonic guidance. The presence of the PICC in the ipsilateral IJV was not confirmed using ultrasonography during this timeframe (procedure A). From July to December 2018, PICCs were inserted with the same posture as in procedure A. This time, however, the presence of the PICC in the ipsilateral IJV was confirmed using ultrasonography (procedure B) to compare the accuracy of the PICC tip positioning using the two methods.

There is no information about the operator who inserted the PICC. Information of the surgeon is required, especially considering mechanical complications related to procedures. There is no information of the ultrasound machine used.

Answer> We added related content as you pointed out. As regards surgeon information, I am curious about what specific information is needed. Please let me know; I'll describe it in more detail.

All PICC procedures in the ICU took place at the bedside and were performed in the upper arm by a single vascular surgeon.

The same LOGIQ e ultrasound (GE Healthcare, Chicago, IL, USA) was used for both PICC procedure and ipsilateral IJV monitoring.

The section of the "Results" and "Discussion"

Migration of catheter into the internal jugular vein is easily recognized using ultrasound view. The authors are required to explain why the malposition was still high at 2.4%, even though using ultrasound examination.

Answer> Thank you for this valuable point. Accordingly, the following content was added in the discussion:

As shown in Table 2, 14 cases of malposition B occurred in procedure A and two cases in procedure B. Even though we observed the IJV using ultrasonography, we missed two cases. It is presumed that despite the monitoring of the IJV using ultrasonography, these cases were missed because of the insufficient monitoring to the proximal portion of the IJV. Malpositions A and C could not be resolved by ultrasound observation of the IJV because the catheter tip was located in the right subclavian vein and left innominate vein. Although the number of malposition B cases decreased significantly, malposition of 2.4% occurred.

According to Schweickert et al., when monitoring the ipsilateral IJV while placing PICCs at the bedside, the malposition of the ipsilateral IJV was significantly lower than that of the unmonitored ipsilateral IJV (0.7% vs 7.4%, $p = 0.003$). The number of cases where the PICC was accurately located in the SVC was statistically significantly higher in the ipsilateral IJV-monitored group (68.9% vs 58.4%, $p = 0.06$). In addition, malposition to other proximal vein (subclavian vein, brachiocephalic vein, and axillary vein) occurred in this study, and no statistically significant difference was found between ipsilateral IJV monitoring and non-monitoring (17).

In this study, the accuracy of the catheter tip location was similar to that of the bedside ultrasonography and saline flush technique and an ECG-guided PICC tip location technique and was more accurate than other studies that monitored the ipsilateral IJV using ultrasonography; however, the technique for ultrasound monitoring of the ipsilateral IJV did not require a professional assistant nor an echocardiography probe, and patients with arrhythmias or heart disease could safely go through this procedure.

Review Comments B:

A good effort. What was the explanation for the reported rate still of 2.4% of PICC malposition despite the introduction of the post-placement ultrasound examination? Could a very high-resolution ultrasound system made the difference to get this rate down to zero?

Answer> Thank for raising this valuable point. In line with your comment, the following content has been added in the discussion:

As shown in Table 2, 14 cases of malposition B occurred in procedure A and two cases in procedure B. Even though we observed the IJV using ultrasonography, we missed two cases. It is presumed that despite the monitoring of the IJV using ultrasonography, these cases were missed because of the insufficient monitoring to the proximal portion of the IJV. Malpositions A and C could not be resolved by ultrasound observation of the IJV because the catheter tip was located in the right subclavian vein and left innominate vein. Although the number of malposition B cases decreased significantly, malposition of 2.4% occurred.

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I would recommend a change of the title from "Novel ultrasound-assisted technique for reducing malpositions of peripherally inserted central catheters in the intensive care unit" to "Novel post-placement ultrasound-assisted technique for reducing malpositions of peripherally inserted central catheters in the intensive care unit".

Answer> We fully agree with your opinion; however, we have revised the title considering as well the opinions of other reviewers:

~~**Novel ultrasound-assisted technique for reducing malpositions of peripherally inserted central catheters in the intensive care unit**~~

Ipsilateral ultrasound-monitoring technique for reducing malpositions of peripherally inserted central catheters in the intensive care unit