Reviewer's report

Title: A novel approach to neuraxial anesthesia: application of an automated ultrasound spinal landmark identification

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Reviewer: Vincent Chan

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The authors have revised the manuscript. I have remaining questions and comments.

Again I respectfully disagree with your primary aim "to evaluate the first attempt success rate of spinal anesthesia using landmarks obtained from the automated spinal landmark identification technique." I strongly believe that your primary aim should be to evaluate the correlation between spinal landmark identification by the automated machine and identification by an expert anesthesiologist skilled in spine imaging." Your image processing system does not improve operator error in needle insertion technique. This should be clearly addressed in the Discussion section.

The text says, "The transverse scan consisted of horizontal movements of the ultrasound probe along the previously marked line at the level of L3/4 by the investigator with minimal rotational movements to obtain the best view." Who decides on the best view? Does the software program help the operator to get the best view? What signal does the machine provide if a good view is not obtained? Can the machine make faulty assumption and give wrong information when the ultrasound image is not optimal?

It seems that identification of the L3/4 interspinous space is important as a reference point. Can the machine software program be fooled to misinterpret the interspinous spaces e.g., L2/3 for L3/4? If yes, how does this happen?

How much can the software program pick up human error especially with regard to poor or suboptimal scanning skill and poor image acquisition? Also, would ultrasound artifact fool the image processing system?

How does the imaging system identify the ligamentum flavum and distinguish it from the dura in the transverse view? Most of the time, we cannot separate the ligamentum flavum from the dura and we call the 2 structures the posterior complex.
Can the machine misinterpret the anterior complex as the posterior complex in some instance? The posterior complex may not be seen universally at a given interspace.

The text says, "Even in normal surgical patients, the neuraxial anesthesia needle insertion first attempt success rate is only about 50 to 60% when the palpation technique is used." While ultrasound visualization of the interspace helps to identify the site of needle access, it may not improve successful needle insertion with the first attempt. Failure can be due to suboptimal needle insertion since this is NOT a real time ultrasound guided technique. We encounter this issue all the time with pre-procedure ultrasound scan during neuraxial needle insertion.

The text says, "the primary hypothesis of the study was that automated spinal landmark identification algorithm using image processing system would achieve a mean 90% first attempt success rate of spinal anesthesia." It is important to state clearly who did the ultrasound scan and spinal needle insertion in this study. Were junior trainees recruited to participate in this study? Surely, as an experienced anesthesiologist, the success of first needle spinal attempt must be > 90% in normal sized young patients with normal spine anatomy. Please clearly state who performed the scan and needle insertion and their level of training in this study.

Please write a full paragraph on the limitations of your imaging processing system. What can fool the machine? What errors can the machine make? What is the margin of error with this system? Has the accuracy been validated against expert evaluation or any other well established imaging tools?

Does this image processing system work for individuals of any age? Have you tested in children and infants?

What does this software show when a scan is performed in an elderly 50 kg person with severe spinal stenosis? While it is easy to identify the spinous processes, the interspinous spaces may be too narrow to be imaged. Can the software still identify the levels properly?

In the Results section, please report the following:

1) Skin to spinous process and ligamentum flavum distance in successful and failed first needle attempt.

2) Detailed information on patient characteristics (e.g., height, weight, BMI), level of operator training, imaging processing result and needle insertion for failed first needle insertion. In other words, what are the common reasons for failure?

3) The text says, "Primary inaccuracy was mainly due to the poor identification of the L5/S1 interspace." Please elaborate on this point. Was this due to poor operator scanning skill, spine anatomy or both?

I still believe figure 2 shows laminae and not spinous processes.
Are the methods appropriate and well described?
If not, please specify what is required in your comments to the authors.

Yes

Does the work include the necessary controls?
If not, please specify which controls are required in your comments to the authors.

No

Are the conclusions drawn adequately supported by the data shown?
If not, please explain in your comments to the authors.

No

Are you able to assess any statistics in the manuscript or would you recommend an additional statistical review?
If an additional statistical review is recommended, please specify what aspects require further assessment in your comments to the editors.

I recommend additional statistical review

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