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Commentary

Letter to the editor: The use of XperGuide® needle guidance software for CT guided thoracic sympathetic block

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ABSTRACT

With the introduction of modern cone beam computed tomography in the operating room, the benefits of imaging modalities in daily practice are recognized by an increasing number of clinicians. Newer generation imaging modalities include CT needle guidance software, which can aid the operator place the needle correctly during percutaneous intervention. This technique has several advantages over traditional percutaneous interventions, especially for high risk procedures like thoracic sympathectomy.

We describe and discuss outcomes and possible advantages of applying CT guided needle placement using needle guidance software (XperGuide®) for percutaneous thoracic sympathetic blockade in 8 patients. Based on our findings, we conclude that the use of high quality imaging and needle guidance software such as XperGuide® may improve patient outcomes, and reduce the risk of adverse effects, providing a relatively easy, safe, and valuable alternative treatment strategy for thoracic sympathectomies.

Dear Editor,

Cone beam computed tomography (CBCT) has become increasingly popular among clinicians for use in percutaneous interventions. Newer generation CT imaging modalities offer 3D reconstruction needle guidance software, which provides information on the needle path, trajectory and target. This software can thereby aid the operator in correct needle placement during percutaneous interventions [1,2]. Specialties such as cardiology, vascular surgery and pulmonology already use these imaging modalities extensively in the performance of various interventions. Within the field of pain medicine, several procedures could potentially benefit from this approach, e.g., high thoracic sympathectomy and percutaneous chordotomy. In this letter to the editor, we aim to demonstrate and discuss the possible advantages of applying CT-guided needle placement using needle guidance software (XperGuide®) for percutaneous thoracic sympathetic blockade (see Figs. 1 and 2).

The sympathetic trunk is a paired bundle of nerve fibers that runs from the base of the skull to the coccyx. The sympathetic trunk lies lateral to the vertebral bodies for the entire vertebral column length. At lumbar level, the sympathetic trunk is more easily accessible for percutaneous intervention. However, its position at the thoracic level is at one-third dorsal of the vertebral body and runs close to the pleura. This procedure requires high-level technical skills, as there is a relatively high risk of causing a pneumothorax if performed incorrectly [3]. To perform a blockade of the thoracic sympathetic trunk ganglia, the needle needs to be positioned at the 2nd and 3rd thoracic vertebra (henceforth referred to as Th2-Th3) as close to the vertebral body as possible [4].

Sympathetic blockade has been beneficial in the treatment of, amongst others, Complex Regional Pain Syndrome (CRPS), treatment of ischemic vascular pain and Raynaud's phenomenon, perniones and palmar hyperhidrosis [5–9]. In the past, and still common practice today, needle placement for thoracic sympathetic blockade was aided by X-ray (C-arm system) [9–11]. The introduction of CT imaging with needle guidance software has shown improvements in the procedure's outcome and has reduced the frequency of severe complications such as pneumothorax and damage to vascular structures [6].

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1. Procedure

One of the main advantages of using XperGuide® when performing percutaneous interventions is imaging quality: a combination of CBCT, X-ray, and 3D needle navigation software (XperGuide®). XperGuide® displays the needle's progress in real-time along a user-defined trajectory. The live fluoroscopy image is layered on soft tissue images to provide real-time 3D guiding and feedback on deviations from the target path. The high quality 3D overlay imaging provides the operator control and confidence when guiding the needle along the correct route. The use of XperGuide® allows the operator to perform a more accurate and safer procedure.

There are two options to plan needle paths: creating a 'virtual path', or defining entry and target locations on separate XperCT, magnetic resonance imaging (MR), or CT slices. XperGuide® automatically calculates the optimal gantry projections and parallax in the needle path. The software also supports multiple needle trajectories and adapts real-time to changes in C-arm angulation and rotation, the field of view, and source-image distance. In the case of a thoracic sympathetic block, the patient is in a prone position with elevated arms. Using XperGuide®, the thoracic spine is imaged and the appropriate level for needle entry can be identified.

In the Spaarne Gasthuis in Haarlem, we performed a total of 14 percutaneous thoracic sympathetic blockades in 8 patients in a hybrid operating room (OR) using a Philips Azurion 7 M20 FlexArm™ (Philips Healthcare, Eindhoven, the Netherlands) between February 1, 2023 and May 1, 2024. We opted for needle entry and target points for computing the needle trajectory using the software's navigational tools. We also used the software to choose a safe pathway, avoiding puncturing vessels and/or organs. Before inserting the needle, the Flex-Arm™ is brought into tunnel vision and the needle entry point is projected on the screen. The operator can place the needle at the designated entry point and advance the needle slowly and safely with the help of X-ray imaging and the XperGuide® software until the target site is reached. Correct needle positioning can be verified by injecting contrast and/or electronic stimulation performing a control CBCT scan using a radio frequent ablation technique.

Image 2.1. (left): Left hand before treatment. Image 2.2. (right): Profound vasodilation after treatment.

2. Results

A profound reduction in pain scores and a pronounced vasodilatory effect in the affected limb was observed in all 8 patients treated with this technique. Reduction in pain scores and improvements in secondary outcomes were measured using the Patient Reported Outcome Measures (PROMs). The PROM questionnaires mainly consisted of the following forms: Numeric Pain Rating Scale (NRS), Hospital Anxiety and Depression Score (HADS), Pain Catastrophizing Scale (PCS), and the 12-item Short Form Health Survey (SF-12). No complications arose after these procedures and overall satisfaction levels of patients after treatment were high.

Video 1: Showing needle placement near the sympathetic ganglia at the 2nd and 3rd thoracic level.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.inpm.2024.100439

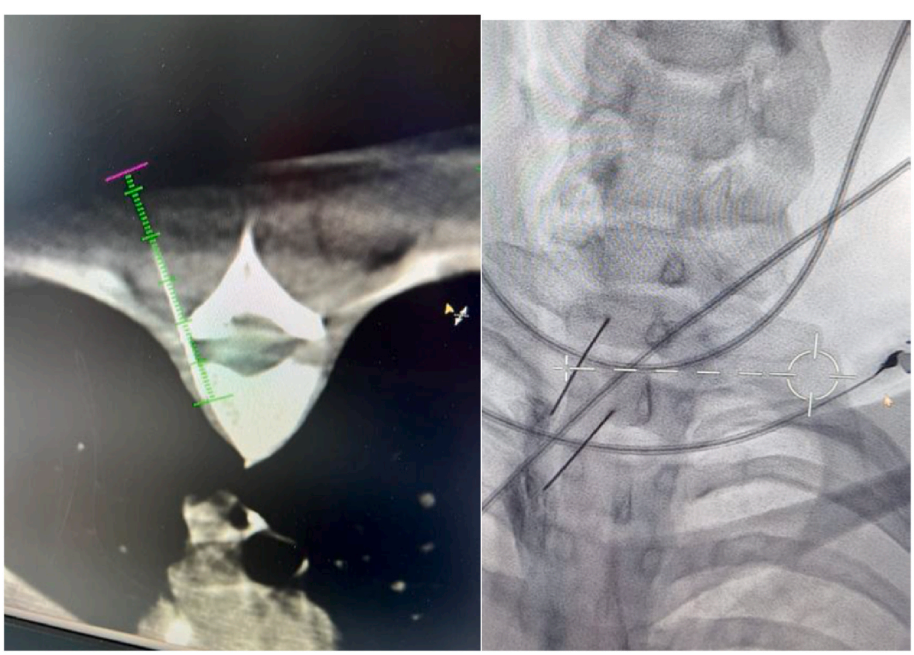

Image 1.1. (left): Computing the needle trajectory using the XperGuide® software. Image 1.2 (right): XperGuide® helps to choose the correct needle trajectory.

3. Discussion

The outcomes of using needle guidance software (XperGuide®) for performing percutaneous thoracic sympathectomy were encouraging. Looking back, there have been many innovations in medical technology over the years that greatly improved patient outcomes within the field of pain medicine and anesthesiology. For instance, the introduction of fluoroscopy has improved outcomes in nerve root blocks and the advent of ultrasound significantly improved the capabilities and outcome of peripheral nerve blocks. In our view, the use of high quality imaging and needle guidance software could greatly improve the outcome of specific high risk percutaneous procedures such as thoracic sympathectomy [10–12]. Furthermore, CT guided intervention is a useful guiding technique due to its precise anatomic delineation, high spatial resolution, good tissue contrast, and the additional guidance software.

We are therefore of the opinion that relatively risky interventions such as thoracic sympathectomy can be performed more precisely and overall, safer with the use of a CT guidance technique. Puffer et al. (2014) and Cooke et al. (2016) have reached similar conclusions for surgical interventions in their fields [13,14].

That said, it must be noted that there are disadvantages to using a XperGuide®. Foremost, there is a significantly higher radiation exposure for patients and practitioners. X-ray doses (dose area product (DAP) value) in common interventions are around 0.2 $Gy.cm^2$. When using the facilities in a hybrid OR, this value increases tenfold. In addition, as with implementing any new technique, the operator will experience a learning curve. This means that when the procedure takes temporarily longer than usual and thus the operator receives a higher radiation load. Similarly, the operational cost of the procedure increases during the operators' training period. Additionally, the running cost of an average OR equipped with a CBCT scanner far outweighs the running cost of a fluoroscope, a technique commonly used in pain practice today. However, in some selected cases, the expected increase in clinical outcomes should outweigh the additional costs and tip the cost-benefit analysis in favour of the CT guided approach. Future research is needed to confirm or disconfirm our hypotheses, but in our experience, using XperGuide® needle guidance software in pain practice has shown positive health outcomes for patients.

4. Conclusion

In summary, the use of high quality imaging and needle guidance software such as XperGuide® could improve patient outcomes, and reduce the risk of adverse effects for demanding interventions that require a highly skilled operator, such as percutaneous CT guided thoracic sympathectomy. This could prove a relatively easy, safe, and valuable alternative treatment strategy for performing thoracic sympathectomies.

Conflict-of-interest statement

All authors listed have no conflicts of interest to declare. All authors have seen and agreed with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication. All authors listed have contributed sufficiently to the project to be included as authors.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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