EBUS Phantom Fabrication For Clinical Training

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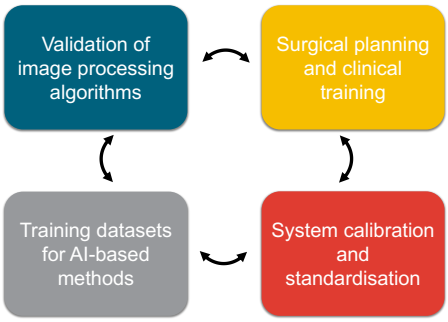
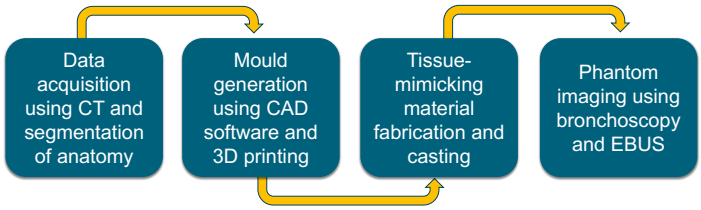
Why do we need imaging phantoms?



Introduction

- Endobronchial ultrasound (EBUS) requires considerable training to attain proficiency in navigation and ultrasound image interpretation
- Tissue-mimicking phantoms are essential for training in bronchoscopy as they replicate aspects of human anatomy and are well-suited for learners to gain necessary procedural skills.
- However, there are limitations in currently available EBUS training models, which include limited anatomical complexity, prohibitive costs, and incompatibility with needle insertions.
- Here, we present a new framework for developing anatomically realistic EBUS phantoms that are designed for mediastinal lymph node sampling.

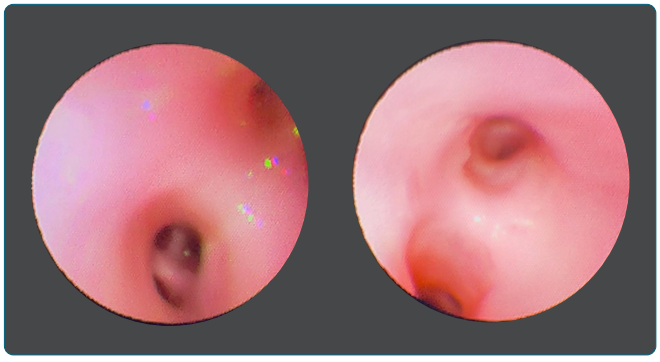
Methods



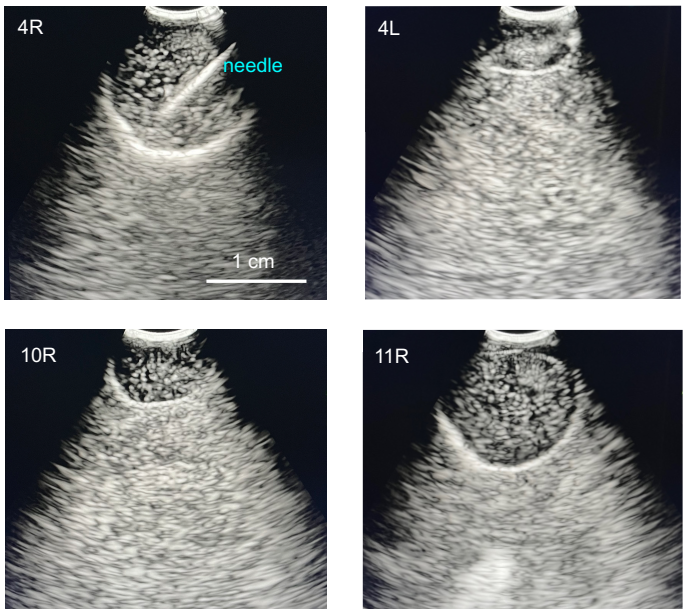
- Lymph node structures of various sizes were created with 3D-printed moulds and tissue-mimicking materials (TMMs) with soft mechanical properties.
- Additives were added to imbue the TMMs with ultrasonic scattering at concentrations that were specific to different tissue structures.

Results

Bronchoscopy



Endobronchial Ultrasound (EBUS) with needle aspiration



- An EBUS phantom for mediastinal lymph node sampling based on polyvinyl alcohol as tissue-mimicking material was fabricated.
- Evaluation included identification and aspiration of lymph nodes of the paratracheal, subcarinal and hilar regions.
- EBUS imaging and bronchoscopy were performed using an Olympus probe and a 22G needle.
- Lymph nodes appeared as homogenous, hypoechoic structures with distinct margins that could be readily differentiated from the relatively hyperechoic surrounding mimicking lung parenchyma.
- Needles could clearly be visualised, and the phantoms allowed for practicing multiple aspirations of lymph nodes as needle tracks were not visible due to the unique self-healing property of the material

Conclusions

- The fabricated phantom had realistic endobronchial and acoustic appearances, as assessed with clinical bronchoscopy and EBUS imaging.
- This study addresses a prominent gap in EBUS training with novel methods for fabricating anatomically realistic lung phantoms.
- The framework developed in this study will lead to high-performance training phantoms that have strong potential to improve EBUS training.

Acknowledgements

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References

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