Lynn & Arnold Irwin

Advanced Perioperative Innovation Lab

University Health Network, Toronto

Procedural Training Phantom Catalogue

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For pricing and further details please contact us at: apil@uhn.ca

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UHN

Department of Anesthesia & Pain Management

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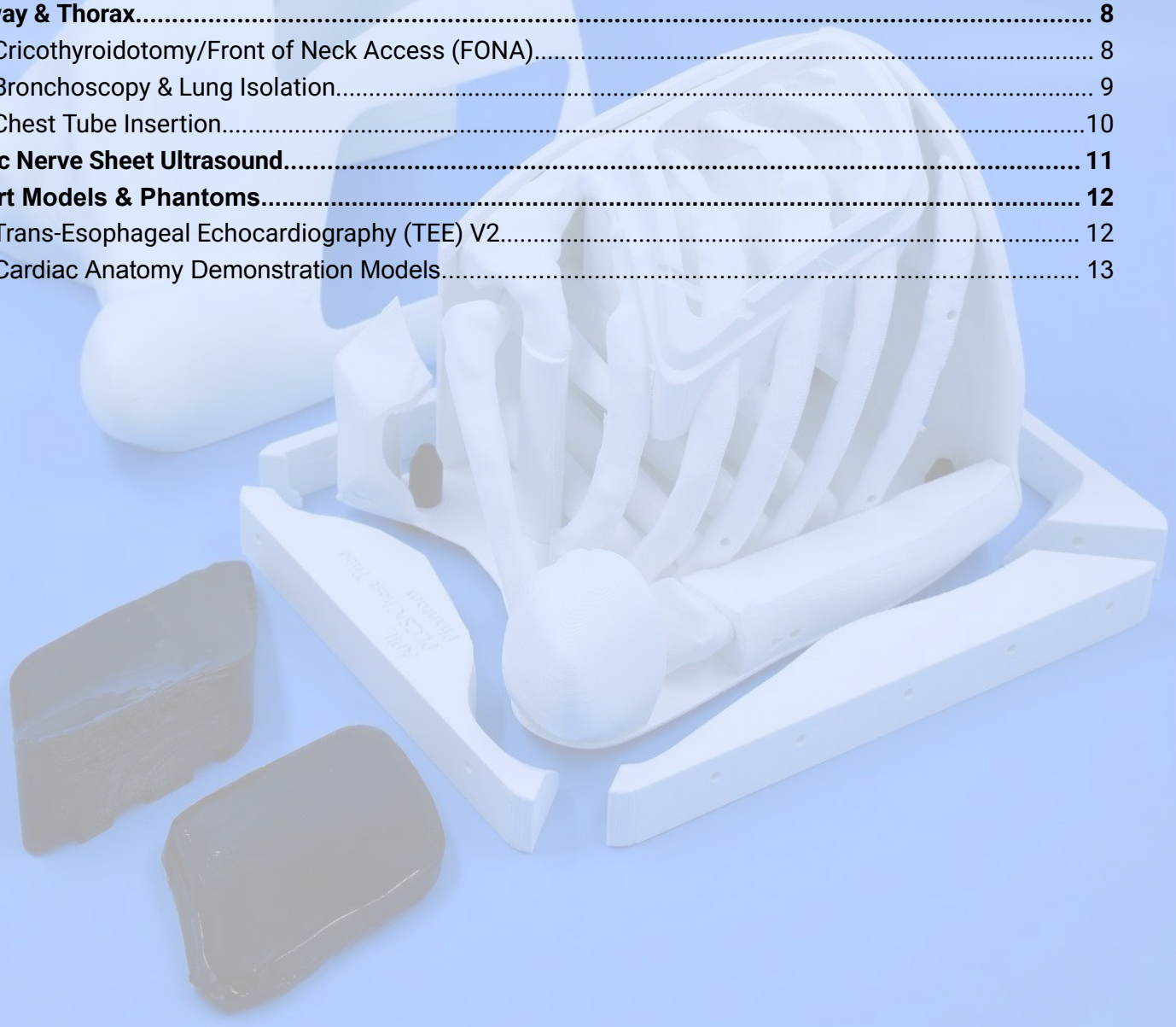


Neuraxial Anesthesia & Lumbar Puncture

Our spine phantoms are derived from CT images, and built with 3D printed hard plastic (PETG) for the bones and enclosure, encased in a synthetic, shelf-stable, echogenic, gel with a realistic tactile feel. The gel can be recycled/reconditioned to remove any needle holes and tracks after extended use. Reconditioning instructions can be provided on request or models can be sent back to our facilities for reprocessing.

- Ultrasound compatible
- Can be clamp mounted to a table to simulate sitting or lateral decubitus position
- Can be used with an augmented reality headset/tablet to reveal internal structures
- Soft tissue gel can be clear or opaque (black). Optional removable opaque skin layer
- Custom versions can be created from any de-identified CT to replicate specific cases.

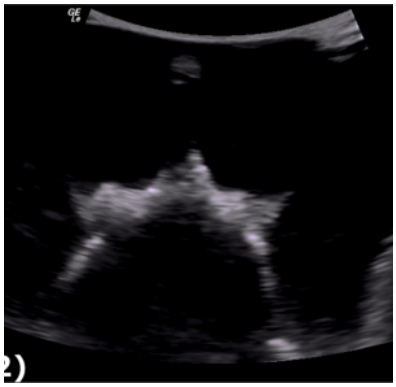
Lumbar Neuraxial Anesthesia Phantoms (T12-S1)

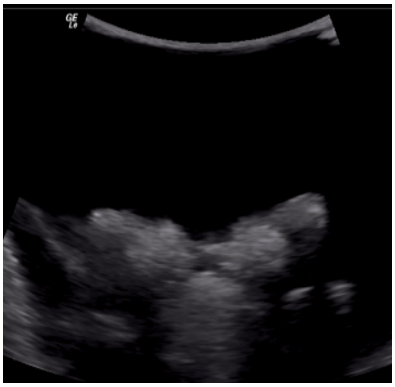
For epidural and intra-thecal injection, drainage and catheter insertion, including loss-of-resistance technique to air or fluid. By default this phantom includes all spaces from T12-S1, but can be customized as needed. Comes in 3 variants:

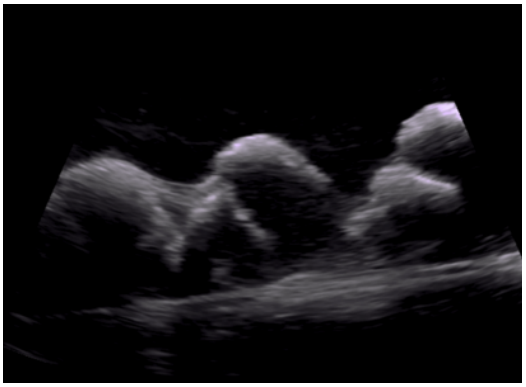
- Normal (shown below)
- High BMI (increased soft-tissue)
- Lumbar scoliosis

The normal version contains a thecal sac with fluid and can also be used for dural puncture (spinal drain, CSE, spinal anesthesia, lumbar puncture). High BMI and scoliosis models can also be made with a thecal sac on request. An earlier version of the lumbar phantom was described and evaluated here: PLOS ONE;13(6):e0191664. https://doi.org/10.1371/journal.pone.0191664

Open Source Repository: https://github.com/tgh-apil/lumbar_epidural_phantom







Thoracic Neuraxial Anesthesia (T6-L2)

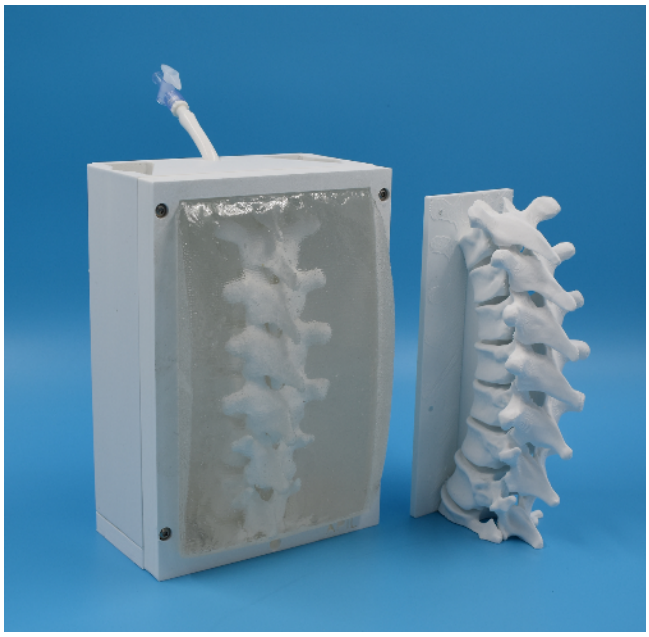
For epidural injection and catheter insertion using loss-of-resistance technique to air or fluid. By default this model includes T6 - L2 and comes in normal and scoliotic variants.

- Both variants can be made with a fluid filled thecal sac on request.
- Can be mounted to a work surface either vertically or horizontally.
- Encasing gel “soft tissue” can be clear (making bony structures visible), or opaque (black). An optional removable opaque skin layer is available.

Variants

- Normal (top)
- Scoliosis (bottom)

Open Source Repository:
https://github.com/tgh-apil/thoracic-epidural-phantom
https://github.com/tgh-apil/scoliosis_epidural_spine_phantom



Regional Anesthesia

Ultrasound-Guided Pectoralis (PECS) Nerve Block

For ultrasound guided PECS blocks, including injection and catheter insertion.

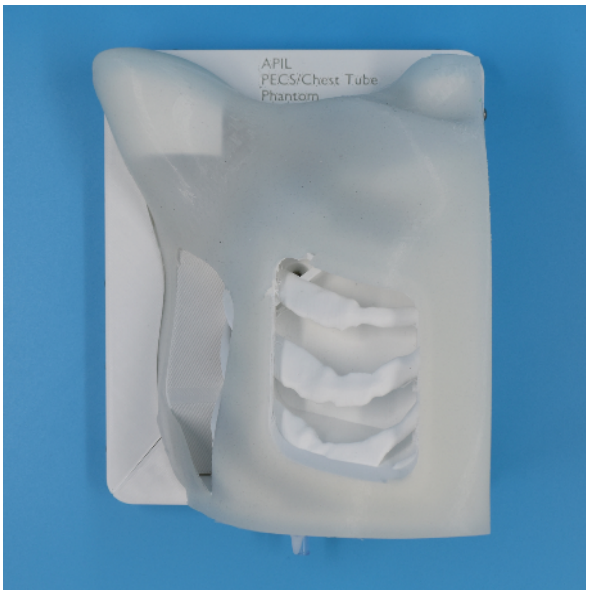
3D printed hard plastic (PETG) and silicone base (permanent) with a replaceable/destructible insert made of a synthetic, shelf-stable, echogenic, opaque gel with a realistic tactile feel. Liquid can be injected between layers in the insert.

The same base will accommodate our replaceable chest tube placements inserts. Image shows both inserts.

This model is used in conferences and workshops organized by the Society of Cardiovascular Anesthesiologists (SCA).

Open Source Repository:

https://github.com/tgh-apil/pecs_chest_tube_phantom



Vascular Access

Ultrasound-Guided Venous & Arterial Vascular Access (Generic)

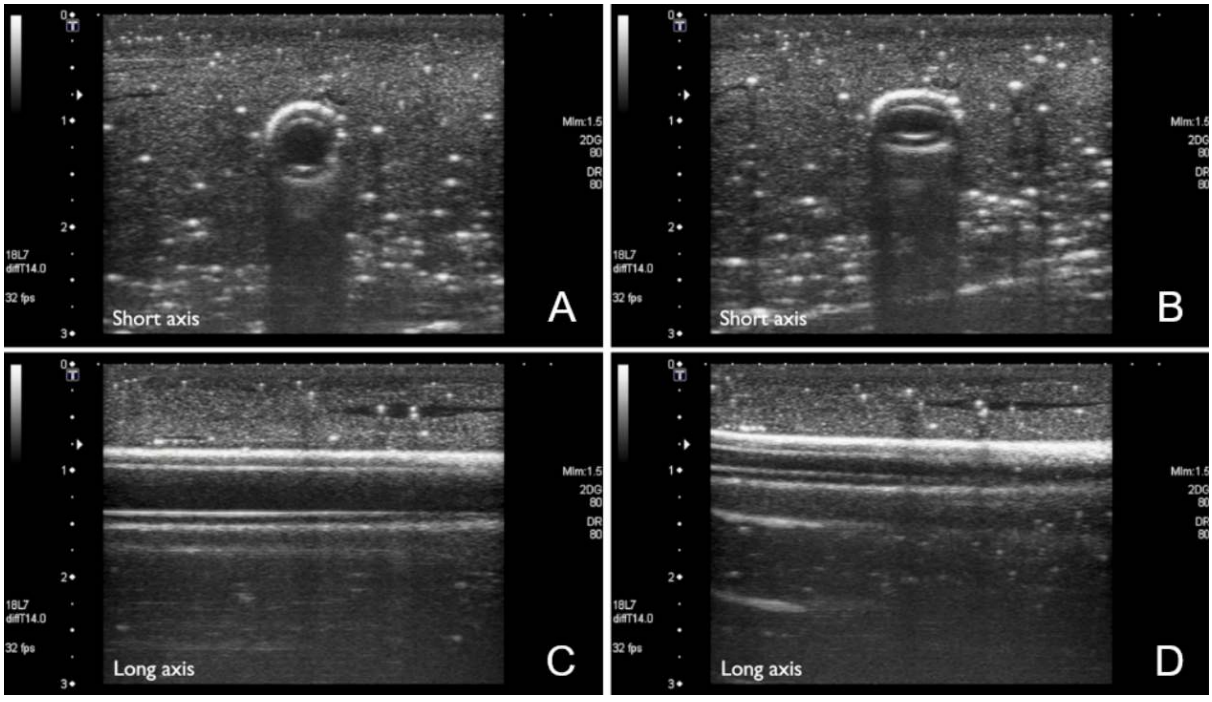
For training in ultrasound-guided arterial and venous access. The default configurations contain three vessels (7 mm outer / 4 mm inner diameter) as listed below. Vessel size, depth, and path can also be customized as needed.

1. Configuration A: 3 straight path vessels, 4 mm from surface
2. Configuration B: 3 straight path vessels, 4mm, 6.5 mm, and 9 mm from surface

Hard plastic (PETG) base with surface grip feet, silicone tubing and compressible shelf-stable echogenic gel tissue. The gel can be reconditioned to remove needle holes and tracks. Reconditioning instructions provided. Models can also be sent back to our facilities for reprocessing.

Can be connected to an IV set and a pressure bag to simulate arterial flow into the needle.

Open Source Repository:
https://github.com/tgh-apil/general_needlework_phantom



Ultrasound views: A: short axis, B: short axis compressed, C: long axis, D: long axis compressed.

Ultrasound-Guided Subclavian Central Venous Access

For ultrasound- or landmark-guided insertion of subclavian venous access.

Developed with Dr. Sharon Peacock at Mount Sinai Hospital, Toronto. Made of hard plastic (PETG) base with surface grip feet, silicone tubing and compressible shelf-stable echogenic gel tissue. The phantom can be returned to our facility for reconditioning to remove needle holes and tracks after extended use.

This phantom was described and evaluated in Tanwani et a. (2023) ATS Scholar 4(3):344–53. https://doi.org/10.34197/ats-scholar.2022-0104IN

Airway & Thorax

Cricothyroidotomy/Front of Neck Access (FONA)

For emergency cricothyroidotomy training. Compatible standard techniques. Ultrasound compatible.

Hard plastic (PETG) base, including thyroid cartilage and tracheal rings, with moulded, echogenic shelf-stable gel for soft tissue and replaceable insert to hold duct tape or similar materials for the cricothyroid membrane.

Comes in normal and thicker soft tissue variants.

The model can be returned to our facility for reconditioning of the ballistic gel.

Open Source Repository: https://github.com/tgh-apil/cricothyroidotomy_phantom

Bronchoscopy & Lung Isolation

A multipurpose airway training phantom based on real CT data. For bronchoscopy and lung isolation training via mouth opening or tracheostomy. Includes a mechanism to compress the tracheobronchial tree at various points. All components are permanent. No destructible inserts.

Open Source Repository:
https://github.com/tgh-apil/multi_airway_phantom

Chest Tube Insertion

For chest tube placement.

Hard plastic (PETG) and silicone base (permanent) with a replaceable insert made of a synthetic, shelf-stable, gel with an additional fabric layer to simulate the pleural membrane. The chest tube insert covers two rib spaces and can accommodate up to three chest tubes per level.

The same base will accommodate our replaceable PECS block inserts (see Regional Anesthesia Section). Image shows both inserts.

This model is used in conferences and workshops organized by the Society of Cardiovascular Anesthesiologists (SCA).

Open Source Repository:
https://github.com/tgh-apil/pecs_chest_tube_phantom

Optic Nerve Sheet Ultrasound

A transorbital ultrasonographic optic nerve sheath phantom, for training in the measurement of optic nerve sheath diameter through noninvasive ultrasonography. The silicone eyes and nerve sheath (in 4.5mm, 5.5mm, and 6.5mm diameters) are suspended in shelf stable echogenic gel and encased in a hard plastic shell.

This phantom is based on the model described in Hajat et al., 2020, Journal of Neurosurgical Anesthesiology; 32(3):256–262, and has been modified to add a facial structure and to improve the longevity and accessibility of the materials and components.

Open Source Repository:
https://github.com/tgh-apil/Optic-Nerve-Sheath-Phantom

Heart Models & Phantoms

Trans-Esophageal Echocardiography (TEE) V2

For 2D and 3D trans-esophageal echocardiography.

Model based on cardiac CT images. Made of a variety of echogenic, shelf-stable gels, encased in a hard plastic (PETG) base with surface grip feet. The box can be closed to conceal the contents during practice. Also permits limited trans-thoracic scanning.

An earlier version of this phantom was evaluated in Journal of Cardiothoracic and Vascular Anesthesia (2021): 35(1):208–15 https://www.sciencedirect.com/science/article/pii/S1053077020306388

Cardiac Anatomy Demonstration Models

A series of demonstration models for teaching cardiac anatomy, used at our center for echocardiography training for cardiovascular anesthesia fellows.

Made with 3D printed hard plastic or photoresin from a model derived from cardiac CT images.

Heart base (fibrous skeleton and valves): a simple and powerful teaching aid for 3D visualization of cardiac structures. Includes all valves and leaflets, the insertion of the interatrial septum and coronary sinus as well as the membranous septum. Available in full or pocket-sized versions.
See our Cardiac anatomy for TEE video that builds the whole heart around his base model.

Whole heart bloodpool models: full or pocket-sized models of chamber and vessel cavities with all the muscles and walls removed in order to make key anatomic relationships visible. Models can be taken apart and reassembled (with some difficulty given the interlocking forms).

- Normal (includes heart base)
- Congenital Heart Disease Models including Tetralogy of Fallot (Adult, unrepaired) and Fontan circulation (intracardiac and extracardiac) as well as other pathologies from our collection. You can view all available models in our 3D viewer: https://apil-slice.web.app

Slice Models: scaled down models showing common echocardiography imaging planes: 4 chamber, LV/AV Long-axis, Short axis stack (AV, basal, mid-papillary and apical short axis). Hard plastic (PETG) held together with small magnets.