Uniportal video-assisted thoracic surgery lobectomy using a novel perfused *ex vivo* simulation model

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Abstract: Simulation may provide a solution to acquire advanced skills in thoracic surgery, however to date there are no reports in the English literature about a perfused *ex vivo* model. We developed a low cost and hi fidelity model using an *ex vivo* in bloc heart and lung specimen from a swine. The swine was previously used in a non-thoracic experiment, so we extracted the lung and heart for this *ex vivo* based model to reduce animal use. The cost of the whole model is 70 USD and it can be reused many times changing the *ex vivo* tissue, so this model may help reduce the costs and animal use associated to this high complexity surgery.

Keywords: Thoracic surgery; video-assisted; simulation training; simulation training; uniportal VATS

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Introduction

Minimally invasive procedures have increased their use in thoracic surgery because of less postoperative pain and faster recovery; being the video assisted thoracic surgery the gold standard for early stage lung cancer surgery (1). Teaching procedures usually follows the classic Halsted methodology of "See one, do one, teach one" (2). However, the increase in legal constraints related to patient safety in addition to residents working hours restrictions, has decreased the acquisition of experience related to clinical cases (3,4). Medical simulation emerges as a complement to traditional teaching and as a powerful educational tool which allows homogeneous training in a controlled and safe environment (5,6). The Universidad Catolica de Chile Simulation Center has become an international reference in Latin America in the training of minimally invasive surgeons with hi fidelity and low-cost simulation models, shortening learning curves and decreasing complication rates in surgical procedures (7-10).

Universidad Catolica de Chile uniportal video-assisted thoracic surgery (VATS) simulation model

The swine is a validated model in thoracic surgery training and it has been used both in a live (11) and *ex vivo* model (12). There are no reports in the English literature about a perfused *ex vivo* model.

We developed a low cost and hi fidelity model using an *ex vivo* in bloc heart and lung specimen from a swine (*Figures 1,2*). The swine was previously used in a non-thoracic experiment, so we extracted the lung and heart for this *ex vivo* based model to reduce animal use. The cost of the whole model is 70 USD and it can be reused many times changing the *ex vivo* tissue.

This model has been used for open surgery simulation (thoracotomy) and minimally invasive surgery. The proposed model was validated during the ALAT 2016 annual congress uniportal vats course by Dr. Diego Gonzalez-Rivas, thoracic surgeon who was invited to participate with informed consent document (*Figure 3*) (13).

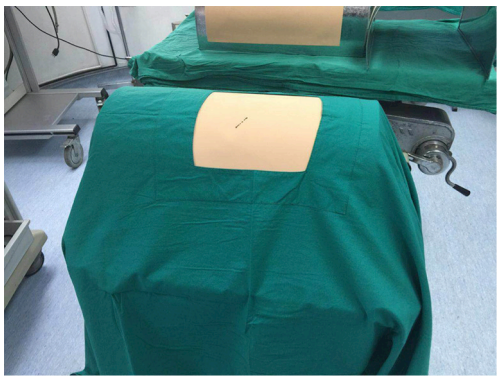

Figure 1 Exterior appearance of video-assisted thoracic surgery (VATS) training model.

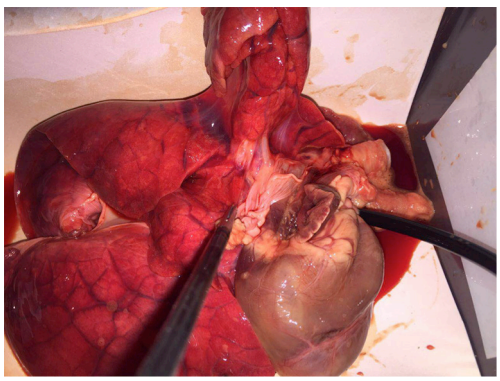

Figure 2 Interior view of video-assisted thoracic surgery (VATS) training model.

Figure 3 Dr. Gonzalez-Rivas uses the model.

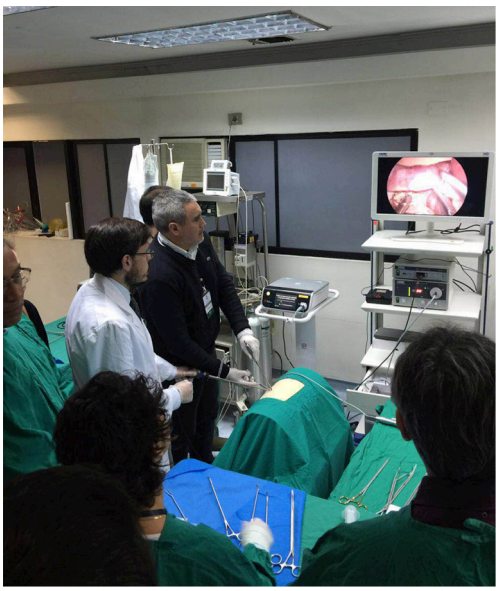

Figure 4 Video-assisted thoracic surgery (VATS) experts using the model.

Model and video description

As in a traditional uniportal human surgery, the model has a 4 cm utility incision. A 30° 10 mm camera was used in the posterior aspect of the incision. First, the left superior lobe is retracted posteriorly for hilum exposure. The anterior structure is the superior pulmonary vein. After opening the mediastinal pleura, dissection of the superior pulmonary vein is performed with blunt dissection and with an energy device. Section of the vein is made with a vascular endo-stapler. This exposes the main pulmonary artery. The next step is to identify the arterial branches for the superior lobe and divide them with a vascular stapler. To finalize, the upper lobe bronchus is dissected and then cut with a medium thickness endo-stapler.

In the video, the setting of the surgeon and his assistant is shown in a comparable fashion to a human uniportal vats surgery (*Figures 4,5*).

By pulmonary artery cannulation, the lung can be perfused with simulated blood allowing a more accurate vascular dissection.

In order to demonstrate how well the system is perfused, a continuous bleeding secondary to an intentional arterial cut was shown. As this is a simulated blood perfused model it allows the operator to dissect the vessels in a more realistic setting (the vessels are not collapsed) and to see bleeding in case of any damage.

Figure 5 Perfused *ex vivo* video-assisted thoracic surgery model. The first section of the video shows Dr. Gonzalez-Rivas performing a lobectomy in the simulated model. Next, an anatomical description of the simulated model is shown. Finally an intentional section of an artery is performed to show an artificial hemorrhage (14).
Available online: http://www.asvide.com/articles/1137

Conclusions

A low cost and hi fidelity perfused uniportal VATS model was validated by an expert thoracic surgeon in uniportal VATS. This model may help reduce the costs and animal use associated to this high complexity surgery.

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Footnote

Conflict of Interest: The authors have no conflicts of interest to declare.

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