Appendix 1

Methods

The supervisor provided assistance with tips and tricks as well as feedback at the end of each session. Each training session was devoted to two trainees and the 3 hours of the sessions were equally divided between the two with roles changing between operator and assistant. Each trainee would progressively perform the exercises as described further on this section. An exercise had to be successfully completed twice according to the supervisor's judgment before a new exercise could be initiated. When a new session began, each trainee would resume their training repeating the last exercise that they ended the previous session with. Once all the exercises of the training program had been completed by a trainee, they were left free to choose which exercises they wanted to practice for the remaining time of their training sessions. Generally speaking, upon completion of the all the exercises of the training program, trainees chose to practice on the most complex exercises such as non-anatomical lung resections, vessel dissection and stapling and lobectomies.
The exercises are detailed here below:

Camera use
In this exercise, trainees are introduced to the 30-degree optic and its proper utilization with focus given on the importance of maintaining the operating field at the center of the image as well as keeping the horizon line stable while changing the optic's angle.

Lung manipulation and hilum exposure
In this exercise, trainees learn ways to manipulate the lung in a gentle way respecting tissue and avoiding lesions. Both simulators (Johnson & Johnson Ethicon Stupnik® Simulator and CK Surgical Simulation Crabtree® Simulator) were used for this task. A non-grasping as well as a grasping technique for lung manipulation was demonstrated. The exercise combines the use of forceps and dissectors for lung handling, allowing an adequate exploration of the entire parenchyma as well as anterior and posterior hilum exposure.

Non-anatomical lung resections
For this exercise, we used the 2D model of the Johnson & Johnson Ethicon Stupnik® VATS Simulator. Trainees learned how to perform diverse non-anatomical lung resections. This is a type of lung resection that does not take into consideration the specific location of distant veins, arteries and bronchus. Different areas of the lung insert are marked. Using the lung manipulation techniques previously acquired, trainees perform different wedge resections of the lung apex as well as the anterior and posterior portion of the inferior lobe using automatic staplers. This exercise familiarizes our trainees with the overall use of staplers including insertion, angulation and secure firing.

Vessel dissection and stapling
In this exercise, trainees learned a systematic approach when dissecting vessels including careful grasping, dissection and vessel control with loop placement and finally stapling. Instruments used for this exercise include graspers, De Bakey endoscopic forceps, endoscopic scissors and Harmonic Ultracision as well as staplers. On the 2D model, the appropriate plane is firstly identified and then held with the De Bakey forceps. Scissors and/or Harmonic Ultracision were used to dissect the vessel away from the underlying plane. Once the vessel is sufficiently prepared, a Crawford is used in order to further liberate the vessel and a vascular loop is placed around it. After being properly angulated, the stapler is introduced through the posterior incision. Once appropriately placed, it is securely fired, stapling and transecting the vessel.

Right and left upper-lobe anatomical resections
For this exercise, the 3D model of the Johnson & Johnson Ethicon Stupnik® VATS Simulator was used for a right upper lobectomy and the CK Surgical Simulation Crabtree® 3D-printed Simulator was used for a left upper lobectomy (*Figure 5*). Here we described the steps of a typical right upper lobectomy that was practiced by trainees under the guidance of the educator. First, using previously acquired skills, the lung is mobilized in order to achieve an adequate exposure of the anterior

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hilum. Dissection is initiated at this level and the venous system is identified, allowing upper lobar vein dissection. The anatomical identification and dissection of the upper venous system constitutes a crucial step in the procedure. The upper lobar vein is completely liberated with delicate gestures in order to avoid injury to the underlying mediastinal branch of the pulmonary artery. Using a Crawford, a vascular loop is placed encircling the vessel. The stapler is then introduced through the posterior incision and placed securely on the vessel. Once in place, the loop is removed and the stapler is fired, stapling and sectioning the vein. The next step consists in dissecting the right pulmonary artery and identifying the mediastinal branch, which supplies blood to the apical and anterior segment of the upper lobe. The mediastinal artery is dissected using scissors or Harmonic Ultracision. Once the vessel is sufficiently liberated from the surrounding tissue, a loop is placed around it and using a stapler the vessel is divided. Attention is drawn to the presence of a posterior branch existing in our model, requiring delicate dissection as well as anatomical knowledge. This smaller vessel is generally clipped and then sectioned with scissors or using the Harmonic Ultracision. Afterwards, the upper lobar bronchus is identified and dissected. It is finally stapled using the parenchymal stapler entering once again from the posterior incision. The parenchymal resection is the final step of the procedure. At this point, the upper lobe is completely detached from the hilum, solely adherent to the parenchyma of the middle and lower lobe through the small and large fissure respectively. The lobe is mobilized inferiorly using Johann forceps or a Duval endoscopic grasper. The stapler is then introduced this time through the utility incision in the 4th intercostal space. It is carefully placed on the fissure with attention paid in order to preserve the middle-lobe vessels. Several firings are usually necessary in order to divide the upper and middle lobe. Finally, the large fissure is divided, allowing extraction of the right upper lobe, completing the exercise.

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