Thoracoscopic Lobectomy in 2015

Can we teach it better?

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Disclosure

• I have no Disclosures
Objectives

• Review models of teaching minimally invasive surgery
• Review types of simulators
• Describe where simulation plays a role
• Describe other effective means of teaching

“As simulated surgical education continues to gain widespread adoption, this should translate into safer surgeons and improved patient outcomes.”
Simulation

• Simulation is now considered integral to surgery training

• Its role has only recently been recognized in thoracic surgery education
  • perhaps due to a lack of widely available, validated simulators for advanced thoracic procedures.
Simulation can be used for many purposes

- Simulation of a case:
  - for planning a complex case
  - for teaching
  - for patient education

- Simulation models
  - for teaching new technology
It is important that we validate our simulation models...

• Important parameters of simulation:
  • Construct validity = ability of the simulator to discriminate between users of different skill levels
  • Content validity = simulator requires same steps and decision-making as a clinical lobectomy
The surgical black box

• Like a pilot, we will also be expected to be fully trained on simulators prior to operating on patients
• Like a pilot, our work may soon be recoverable and recorded for review when something goes wrong
• We will be expected to perform at a high level and increasingly more complex airplanes/patients/equipment
How can we train to prevent mistakes?
VATS Lobe Simulation
Shari Meyerson’s work

Low fidelity system

VATS Lobe Simulation
Shari Meyerson’s work

• Goal: to evaluate the construct, content and face validity of an inexpensive, easily reproducible simulator for teaching thoracoscopic lobectomy.

VATS Lobe Simulation
Shari Meyerson’s work

• Differences between groups were statistically significant for
  • experienced vs. novice (P < 0.001)
  • experienced vs. intermediate (P < 0.04)

• The thoracoscopic lobectomy simulator demonstrated acceptable validity and is a useful tool for teaching VATS lobectomy to trainees or experienced surgeons

VATS Lobe
R. Feins’ work

Table 2. Mean Scores for Component Tasks

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean Score First Repetition (n = 45)</th>
<th>Mean Score Second Repetition (n = 45)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respect for tissue</td>
<td>3.42 ± 0.78</td>
<td>4.09 ± 0.76</td>
<td>0.0002</td>
</tr>
<tr>
<td>Time and motion</td>
<td>3.20 ± 0.97</td>
<td>3.84 ± 0.88</td>
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</tr>
<tr>
<td>Instrument handling</td>
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</tr>
<tr>
<td>Knowledge of instruments</td>
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<td>4.41 ± 0.78</td>
<td>0.07</td>
</tr>
<tr>
<td>Use of assistants</td>
<td>3.42 ± 1.03</td>
<td>4.04 ± 0.95</td>
<td>0.005</td>
</tr>
<tr>
<td>Appreciation of anatomic relationship of hilar structures</td>
<td>3.60 ± 0.94</td>
<td>4.14 ± 0.85</td>
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<td>Quality of vessel isolation</td>
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<td>Quality of vessel ligation</td>
<td>3.91 ± 0.73</td>
<td>4.38 ± 0.72</td>
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<td>Quality of bronchial isolation</td>
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<td>Quality of bronchial transection</td>
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<td>4.36 ± 0.69</td>
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- 64 1st yr CT surgery residents participated in 4 hrs of training on a high-fidelity model

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VATS Lobe
R. Feins’ work

• Immediate assessment performed after completion of the session showed improvements in all graded components.

• The mean total score on a 50-point scale improved significantly between the first and second repetition
  • $36.03 \pm 7.03$ to $41.16 \pm 6.95$; $p = 0.001$

VATS Lobe

R. Feins’ work

• Practice in the boot camp setting improved the ability of residents to perform hilar dissection on simulators using reanimated porcine lung models

• Given these early successes in massed simulation-based surgical education, there is good reason to expect that deliberate and distributed practice on similar simulators would improve resident education in CT surgery

Completed Simulation Courses

• 11 simulation-based advanced surgeon training sessions at STS-U
• 7 resident simulation-based boot camps
• Additional VATS/endoluminal/pulmonary simulation courses
Joint Council Simulation Committee

- comprehensive handbook of cardiothoracic surgery simulation
- nationally representative group of 8 academic centers has formed the Cardiac Surgery Simulation Consortium
- completing a 3-year grant funded by the AHRQ, perhaps the largest single study of the role of simulation in residency training done to date
Simulation
Global Assessment of Skill Acquisition

Simulation Courses are important for dissemination…

• Allow supervised simulation
• Didactic sessions
• Feedback and continued mentoring
Simulation

Teaching the team is important as well

• Train the assistant (“Camera Pilot”)  
• Train the others in the room  
• Others should be familiar with thoracic surgery  
• Should have an active thoracic practice
Simulation
Telestration

• Is feasible and safe
• Experienced surgeons performed better with less errors than inexperienced surgeons in telestration tasks

Simulation
Telementoring

• Telesurgical mentoring has evolved as an important subset of telemedicine

• Is used when an experienced surgeon assists or directs another less experienced surgeon who is operating at a distance
Simulation Telementoring

• The images viewed by the operating surgeon can easily be transmitted to a central "telesurgical mentor" and permit an intraoperative interaction.
Simulation
Proctoring in the OR

- Proctor
- Coach
- Mentor
- Teacher
- Instructor

Future of Thoracic Surgeon Solution

- Pro grammatic
- Robotic
- Minimally Invasive (I²)
- Mentoring
- Experience
- PRI²ME
Team Simulation
What have we learned?

• The entire team must simulate
• New technology must be taught not only to the surgeon but to the entire OR
• Teams must practice and do drills
Simulation
Coronary anastomosis

• Goal:
  • Assess the impact of *dedicated instruction* and *deliberate practice* on 4th-year medical students' proficiency in performing a coronary end-to-side coronary anastomosis using a porcine heart model

vs.

nonsimulator-trained senior general surgery residents

Simulation
Coronary anastomosis

• 4th Yr medical students with deliberate and distributed practice of microvascular techniques using the model results in performance comparable to that of senior general surgery residents

• These results suggest that focused tissue simulator training can compress the learning curve to acquire technical proficiency in comparison with real-time training

Simulation ECMO

• Dearani & his team developed & tested a clinical simulation program in the principles and conduct of postcardiotomy ECMO with the aim of improving confidence, proficiency, and crisis management.

• ECMO course involved didactic lectures and hands-on simulation

• A current postcardiotomy ECMO circuit was used in a simulation center to give residents training with basic operations and crisis management

Simulation

ECMO

• Pretraining and post-training assessments concerning confidence & knowledge were administered.

• Before & after the training, residents were asked to identify components of the ECMO circuit and manage crisis scenarios, including venous line collapse, arterial hypertension, and arterial desaturation.

Simulation
ECMO

• Developed a simulation-based postcardiotomy ECMO training program that resulted in improved ECMO confidence in thoracic surgery residents

• Crisis management in a simulated environment enabled residents to acquire technical and behavioral skills that are important in managing critical ECMO-related problems

Simulation
VATS lobectomy simulation training

• Surgical residents were randomized to either virtual-reality training on a nephrectomy module or traditional black-box simulator training

• After a retention period, they performed a VATS lobectomy on a porcine model and their performance was scored using a previously validated assessment tool

• Black-box group was significantly faster during the test scenario than the virtual-reality group: 26.6 min (SD 6.7 min) versus 32.7 min (SD 7.5 min)

Simulation
VATS lobectomy simulation training

• Traditional black-box training was more effective than virtual-reality laparoscopy training

• Thus, a dedicated simulator for thoracoscopy should be available before establishing systematic virtual-reality training programs for trainees in thoracic surgery

Simulation
VATS lobectomy simulation training

Enrollment (n=30)

Randomization (n=30)

SEP virtual-reality training (n=16)

D-BOX black-box training (n=14)

Excluded (n=2)
- Did not show for testing

Test (n=28)

Analysis (n=28)

1st Surgical VATS Lobe digital simulator

- Industry’s First Simulated Video-Assisted Thoracoscopic Surgery (VATS) Lobectomy using LapSim laparoscopic simulator
- Provides trainees simulated practice performing each step involved in removing the upper right lung lobe:
  - including the dissection of hilum/vessels
  - vessel identification
  - sequential stapling of veins, arteries, bronchus & fissure
  - presenting structures to stapler
  - bleeding control
VATS Lobe Simulator
VATS Lobe Simulator

VATS Lobectomy

Video-Assisted Thoracoscopic Surgery (VATS) Lobectomy

Surgical Science has released the first Video-Assisted Thoracoscopic Surgery (VATS) Lobectomy procedure module for virtual reality. The VATS module offers training on key steps in the removal of the upper right lung lobe, utilizing a three-port anterior approach.

KEY TRAINING ELEMENTS FOR VATS LOBECTOMY:

- Dissection of hilum/vessels
- Identification of vessels
- Use of elastic vessel rubber loop
- Sequential stapling of veins, arteries, bronchus and fissure
  - Bleeding control
- Avoid critical structures, e.g. the Phrenic nerve

With the addition of VATS, LapSim’s suite of validated fully customizable procedure modules, Surgical Science now offers an even more complete training solution for medical professionals across multiple disciplines.

With clearly defined learning objectives, procedural deconstruction capabilities and endless variations and challenges, LapSim’s library of software modules provides surgeons with unparalleled access to skill practice essential to building surgical proficiency.
VATS Lobe Simulator

- Engine behind the simulator that records all events
- Demonstrates transfer/having an impact into the OR
- Mandated in some countries like board certification
- Tissue stress
- Errors
- Bleeding
Simulation
3-d planning for chest wall reconstruction

- Pre-op surgical planning & intra-op identification of the tumor, and thus the subsequent chest wall reconstruction, was supported using computer-based surgery

- The application of high-resolution 3-d imaging and navigational systems is used in preoperative surgical planning to provide virtual simulations of a patient's skeletal changes and new soft tissue profile

Simulation
3-d planning for chest wall reconstruction

- Intra-op, a mobile navigation probe was used to identify the lesion, matching surgical landmarks and the preoperative computed tomography imaging, achieving the radical resection of the tumour with correct but not excessive surgical margins.

- Application of navigation technology in thoracic surgery should be encouraged because it is easy to use and requires a limited learning curve.

Plato’s Cave
Chest wall resection planning
Chest wall planning: 3D Imaging
Simulation
3-d planning

• Chest wall cases
• Complicated anatomy
• Pancoast cases
Mayo Clinic
3-d printing
Mayo Clinic
3-d printing
Robotic Simulation

- Well-established robotic training system have effectively trained many surgeons across the country
- The current system allows tandem surgeon intraoperative teaching and “pilot” with “co-pilot” controls.

Gaming
What happens when you make it fun?

Welcome to Surgery Squad! Our mission is to make awesome educational surgery games using an interactive, first-hand virtual surgery experience. Everyone knows that medicine and surgery are serious topics, but we believe that our visitors need an enjoyable, goal-oriented interactive experience to fully grasp the complex or frightening concepts of surgery.

Whether you're interested in cancer surgery, childbirth, plastic surgery, or even anatomy, we're positive that you'll find the surgery game you're looking for here on SurgerySquad.com.

Meet Our Doctors
If the thought of performing surgery intimidates you, our virtual physicians, Dr. Jeff and Dr. Sue, are available to assist you through the operations, transfusions, dental procedures, and more.

Can't find the Virtual Surgery you're looking for?
Search Surgery Squad

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Laser Tattoo Removal

Know anyone who regrets getting a tattoo? Tattoos may seem cool at the time, but many become an embarrassing mistake. Fortunately, there is a solution! Zap our patient's horrible tattoo with laser tattoo removal!

Available on Mobile!
Microsoft Hololens
Important Points

• Record every case
• Review events
• Practice for events and how to manage them
• Expect conversions
• Train the team
• 1 learner per case
• Simulation is not a good as a real case
• Take multiple courses if you can
Thoughts on Simulation

- Can we simulate innovation?
- Can we develop a simulation curriculum and not just a few models or a simple course?
- Can we simulate for the Oral Boards?
- Should we simulate during interviews?
- Should we be setting simulation as a priority to more effectively educate and use our time wisely?
- Can simulation make us more efficient?
  - Wouldn’t it be nice to walk into an operating room after your resident has completed a simulation course on the procedure you are doing and already has practiced the steps of the operation over and over and has the “basics” covered- you are now doing more “fine tuning” rather than educating simple basic tasks…
Let's remember why we do this and make it safe...

- Train for emergencies with simulation
- Teach on simulators such that learners are not practicing for the first time on patients
- Plan cases with simulation to promote better team communication, coordination, and practice
Unintended consequences of simulation

• Exposure to CT Surgery is limited, and simulation may enhance a student’s interest in the specialty
TSFRE: we must fund simulation projects
Questions & Discussion
The future…


• Like a pilot, we will also be expected to be fully trained on simulators prior to operating on patients
• Like a pilot, our work may soon be recoverable and recorded for review when something goes wrong
• We will be expected to perform at a high level and increasingly more complex airplanes
Simulation
Cardiac curriculum

• Goal was to determine the feasibility of developing a cardiac surgery simulation curriculum using the formal steps of curriculum development.

• Cardiac thoracic surgery residents (n = 6) and faculty (n = 9) evaluated 54 common cardiac surgical procedures to determine their need for simulation. The highest scoring procedures were grouped into similarly themed monthly modules, each with specific learning objectives. Educational tools consisting of inanimate, animate, and cadaveric facilities and a newly created virtual operating room were used for curriculum implementation. Resident satisfaction was evaluated by way of a 5-point Likert scale. Perceived competency (scale of 1-10) and pre-/post-self-confidence (scale of 1-5) scores were collected and analyzed using cumulative mean values and a paired t-test.

• Of the 23 highest scoring procedures (mean score, > 4.0) on the needs assessment, 21 were used for curriculum development. These procedures were categorized into 12 monthly modules. The simulation curriculum was implemented using the optimal simulation tool available. Resident satisfaction (n = 57) showed an overwhelmingly positive response (mean score, > 4.7). The perceived competency scores highlighted the procedures residents were uncomfortable performing independently. The pre-/post-self-confidence scores increased throughout the modules, and the differences were statistically significant (P < .001).

• It is feasible to develop and implement a cardiac surgery simulation curriculum using a structured approach. High-fidelity, low-technology tools such as a fresh tissue cadaver laboratory and a virtual operating room could be important adjuncts.

Simulation CPB

- Developed/tested a clinical simulation program in the principles and conduct of cardiopulmonary bypass with the aim of improving confidence and proficiency in this critical aspect of cardiac surgical care.

- 15 residents from 6 resident-training programs who reported no prior cardiopulmonary bypass observation or simulation-based perfusion experience participated in a cardiopulmonary bypass course involving both didactic lectures and hands-on simulation. A computer-controlled hydraulic model of the human circulation was used in a specifically designed multidisciplinary simulation center environment to give the participants hands-on training with both basic operations and specific perfusion crisis scenarios. Pretraining and posttraining assessments concerning confidence, knowledge, and applications with regard to cardiopulmonary bypass were administered and compared.

  - Likert scale scores on confidence-related items increased significantly (P < .001), from 59% +/- 16% to 92% +/- 8%. Pretraining versus posttraining scores (72% +/- 14%) on similar cognitive items were not significantly different (P=.3636). Scores on similar open-ended application items before and after training improved from 62% +/- 25% to 85 +/- 10% (P < .0001). All subjects agreed that simulation-based cardiopulmonary bypass training was superior to classroom- and clinic-based education and that the scenarios enhanced their learning experience.

  - Simulation-based cardiopulmonary bypass training appears to be an effective technique to build the confidence of thoracic surgery residents regarding knowledge and applications. Scenario-based practice in a specifically designed simulated environment is a valuable adjunct to traditional educational methods and has the potential to improve the training of thoracic residents. Copyright 2010 The American Association for Thoracic Surgery.

**VATS Lobe Simulation**

Shari Meyerson’s work

<table>
<thead>
<tr>
<th>Completion</th>
<th>Yes</th>
<th>No</th>
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<tr>
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