Teaching High-Risk Medical Procedures

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Disclosure

- Arrow
- Edwards
- Storz

I have no financial relationships to any company.
Emphasize techniques that allow for the optimization of the learning experience while at the same time maximizing patient safety.
The Days of see one, do one, teach one are over.
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- Curriculum
- Simulation
- Advanced technology
- Repetition
- Certification
- Recertification
Central Line Insertion
Endotracheal Intubation
Goals

• List the risks of central line insertion.
• Discuss the use of simulation in teaching central line insertion.
• Discuss the use of ultrasound in teaching the technique of central venous cannulation.
• Describe the use of tube manometry.
• Describe the learning curve for novices learning the technique of endotracheal intubation.
• Introduce the latest technology that makes teaching ETI safe and efficient.
Central Line Insertion
Risks to the Patient

- Vascular injury
  - Arterial, venous, tamponade, local hematoma
- Pneumothorax
- Arrhythmia
- Thromboembolic
- Infection
- Stress (namely mine)
The source of said stress being trainees combined with:
Double Lumen Introducer and Veno-venous Bypass Cannula
Double Lumen Introducer and Veno-venous Bypass Cannula
Double Stick of the Right IJ
How do we teach students, trainees and faculty to safely insert large bore central venous catheters?
Curriculum and Simulation
WISER course for CVC insertion

• July: Anesthesiology, Surgery and Emergency Medicine residents
• Medicine and Family Practice residents prior to ICU rotations
• Renal Fellows
Simulation

WISER course for CVC insertion

• 2 Hour on-line course followed by a quiz which must be passed prior to taking the course.

• 4 Hours hands on in 5 stations.

• Instructor demonstration followed by participant performance

• Station 1: Demonstration of sterile technique

• Stations 2-4. IJ, SC and Femoral central line insertion without ultrasound.

• Station 5: Ultrasound guided IJ insertion
Simulation

WISER course for CVC insertion

• Participants have the opportunity to perform US on each other to assess for patient to patient variability

• Tube manometry is taught as a standard part of the technique.

• Use of maximum protective barriers (cap, mask, eye protection, gown, sterile gloves) is also emphasized.
Technology
Ultrasound

• Should it be standard of care for all central line placement?
• Should it be standard of care for teaching?
• Milling compared different techniques for ultrasound guidance.(1)
Ultrasound

• Static i.e. “Mark the spot” technique
• Dynamic i.e. Real time use
• Rescue
## Comparison of Techniques

<table>
<thead>
<tr>
<th></th>
<th>Dynamic</th>
<th>Static</th>
<th>Landmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odds ratio for first attempt success compared to LM</td>
<td>5.8</td>
<td>3.4</td>
<td>NA</td>
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<tr>
<td>Overall Success Rate</td>
<td>98%</td>
<td>82%</td>
<td>64%</td>
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<tr>
<td>First attempt success rate</td>
<td>62%</td>
<td>50%</td>
<td>23%</td>
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<tr>
<td>Mean number of attempts</td>
<td>1.7</td>
<td>1.6</td>
<td>3.2</td>
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<tr>
<td>Mean time to cannulation</td>
<td>120</td>
<td>130</td>
<td>150</td>
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<tr>
<td>Complication Rate %</td>
<td>3</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
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All arterial punctures
Static Assessment of the Patient’s Anatomy

- Doubles first-attempt success rate and halves the mean number of attempts as compared to the use of landmarks only.
- Approaches dynamic ultrasound in regards to overall success, first attempt success and number of attempts.
- Requires far less training than dynamic ultrasound and does not require a second operator.
Static Assessment of the Patient’s Anatomy

- Also allows for identification of anatomical abnormalities (4.3%) which may preclude or impair successful cannulation.
- Of the 162 patients who ultimately had US, 5 had no jugular vein on one side, 1 had jugular/carotid transposition, 1 had thrombosis, and 7 had vein size < 5mm.
The Use of US (static or dynamic) during the process of teaching CVC

- Allows for direct visualization of the anatomy and pre-procedure detection of abnormalities
- Improves procedure success rate and efficiency
- Lowers complication rate
- Patients are “less likely to undergo prolonged and uncomfortable attempts at CVC” which may be more likely to result in the trainee being pushed out of the way. (2)
- A possible downside to the trainee is “the potential for ‘deskilling’ in the landmark method that may be required in emergencies” or in settings with no US (2)
The Use of US (static or dynamic) during the process of teaching CVC

- This argues in favor of at least using the scan method to assess the landmarks and then let the trainee proceed with the standard landmark technique.

- Allows for maximization of patient safety and at the same time optimization of success without “deskilling.”

- Despite US being identified as “one of the patient safety practices with the greatest strength of supporting evidence.” it remains not widely used. (3)
The Use of US (static or dynamic) during the process of teaching CVC

• Bailey surveyed members of the Society of Cardiovascular Anesthesiologists (4)
• Of nearly 1500 respondents, 2/3 never or almost never use US and only 15% always or almost always use US.
• Half of the respondents relied on color or pulsatility of blood to confirm venous versus arterial access despite the fact that most of them had experienced vascular complications.
Preventing Vascular Injury During CVC

• Unintended arterial puncture occurs in 2-4.5% of all CVC with large-bore catheter cannulation occurring in 0.1-0.5% of patients. (4)

• Devastating complication that can occur to experienced practitioners let alone trainees.
Tube Manometry
Tube Manometry

• Subsequent to an arterial cannulation in 1991 resulting in death of a patient, the VA leadership mandated the use of tube manometry for all central line insertions.

• In this month’s Anesthesia and Analgesia we publish the results of 15 years worth of mandatory use of manometry for all central line placements.
Preventing Vascular Injury During CVC

- 9348 CVC catheterizations were performed, 3057 of them by trainees.
- Number of arterial injuries were zero.
- Subsequent 1 year follow up study revealed 28 cases of arterial puncture (5%), 4 of which were not identified until tube manometry was performed.
- 2 of these were done by trainees.
Preventing Vascular Injury During CVC

• The performance of tube manometry allows trainees to perform CVC using only the landmark method and at the same time provides a quick, easy to use and reliable method to prevent arterial vascular injury.
Tube Manometry
The Technique for Central Line Insertion: Video
Endotracheal Intubation

In the interest of time

- Curriculum
- Simulation
- Repetition
- Technology
Endotracheal Intubation

What is the Learning Curve for novices learning to Intubate?
Endotracheal Intubation Skill Acquisition by Medical Students

• Poster presentation by a former Pitt medical student of his scholarly project at the 2007 American Society of Anesthesiologists Meeting (6)

• We reviewed the procedure logs of 178 medical students performing ETI during their third year Perioperative Medicine Clerkship.

• Using a definition of baseline proficiency as a predicted ETI success of 90%, we found that this was achieved after 15 attempts.
How do we get to 15 attempts smoothly and efficiently while optimizing the learning experience and patient safety and at the same time lowering stress (namely mine)

Video Laryngoscopy
Videolaryngoscopy as a teaching tool

• Eliminates blinded teaching of ETI where only the novice trainee can actually view the procedure.
• Allows more time for the trainee.
• Everyone in the room can see which lowers everyone’s stress and reduces the incidence of the student being “pushed out of the way.”
• Allows for real-time preceptor guided modification of technique.
• Increased patient safety by reducing trauma from suboptimal visualization resulting in blind attempts, as well as the risk of esophageal intubation.


