Cadavers versus Pigs: Which are Better for Procedural Training of Surgery Residents Outside the OR?

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Background

• Surgical skills acquired on simulators have been repeatedly shown to transfer to the operating room\(^1,^2\)
• Surgery resident skills training outside the operating room has gained widespread acceptance
• ACS/APDS national skills curriculum available
  • 3 phases (basic, procedural, team training)
  • Procedural phase consists of 15 modules
    – Based on cadaver and animal models

\(^1\) Seymour N et al 2002 Ann Surg
\(^2\) Scott et al 2000 JACS
Background

- Animal and cadaver courses still conducted frequently for surgeon training; advantage high fidelity \(^1,\(^2\)
- Administration of such courses is challenging and requires significant infrastructure and cost
- Phase 2 of ACS/APDS skills curriculum has the least penetration in the surgery resident curriculum \(^3\)
- Ethical concerns
- Limited comparative evidence available; ideal model for training unclear
- Army request for proposals 2011

\(^1\) Jacobs LM et al 2003 J Trauma
\(^2\) Mitchell E et al 2011 J Vasc Surg
\(^3\) Korndorffer Jr JR et al (in press)
Study Objectives

• To assess the feasibility, value, and cost required to administer a procedural workshop for general surgery residents based on phase II of the national skills curriculum

• To compare the value of porcine versus cadaveric models for procedural training of general surgery residents outside the OR

• To assess the feasibility of interprofessional team training in this context
Methods

• IRB approved project
• Procedural workshops for general surgery residents (PGY I-IV) based on the ACS/ APDS national skills curriculum were administered during 2 consecutive academic years (2010-2012)
• During each workshop surgery faculty taught residents a variety of level appropriate surgical procedures on 4 training models (2 cadaver torsos and 2 pigs)
• Surgical assist students and faculty participated
Workshop Structure

• Didactic material provided to residents ahead of course
• Educational objectives and expectations clearly defined
• Duration of workshops 8 hours
• Residents divided in 2 groups (AM-PM)
  • Each resident participated for 4 hours
  • 2 residents on each model matched to an attending with expertise in the procedures performed and to 2 surgical assist students
• Multiple carefully chosen procedures performed on each model
• All participants evaluated course and each other
• Faculty provided feedback on resident performance
## Procedures Performed

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Model</th>
<th>PGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open inguinal hernia</td>
<td>Cadaver</td>
<td>I</td>
</tr>
<tr>
<td>Lap cholecystectomy</td>
<td>Pig</td>
<td>I</td>
</tr>
<tr>
<td>Thoracotomy</td>
<td>Cadaver</td>
<td>II</td>
</tr>
<tr>
<td>Lap Heller myotomy</td>
<td>Pig</td>
<td>IV</td>
</tr>
<tr>
<td>Lap colectomy (Right/ Left)</td>
<td>Cadaver</td>
<td>III</td>
</tr>
<tr>
<td>Bowel anastomosis</td>
<td>Pig</td>
<td>I</td>
</tr>
<tr>
<td>Lap ventral hernia repair with mesh</td>
<td>Pig</td>
<td>II</td>
</tr>
<tr>
<td>Vascular anastomosis</td>
<td>Pig</td>
<td>II</td>
</tr>
<tr>
<td>Thyroidectomy</td>
<td>Cadaver</td>
<td>III</td>
</tr>
<tr>
<td>Lap nephrectomy</td>
<td>Pig</td>
<td>IV</td>
</tr>
<tr>
<td>Trauma exposures</td>
<td>Cadaver</td>
<td>III</td>
</tr>
<tr>
<td>Lap Nissen fundoplication</td>
<td>Pig</td>
<td>IV</td>
</tr>
</tbody>
</table>
Resident Assessments

- Residents were asked to rate the quality of the workshop on five criteria using a 10-point Likert scale:
  - Course organization
  - Provided course material
  - Close interaction with faculty and feedback received
  - Training models used
  - Protected time

- Other parameters assessed (5-point scale)
  - Resident preparedness for the procedures
  - Relevance of course content to educational needs
  - Perceived impact on knowledge and skill

- Residents assessed their respective teaching faculty
Faculty Assessments

- Workshop
- Resident Performance (10-point Likert scale)
  - Overall Performance during this Workshop
  - Knowledge of Anatomy
  - Understanding of Key Procedure Steps
  - Proper Instrument Selection and Use
  - Laparoscopic and Open Technical Ability
- Ability to Assist
- Ability to Communicate / Work as a Team
- Receptiveness to Performance Feedback
Student Assessments

• Workshop
• Own performance
  • Preparedness, improvement
• Resident & Faculty Performance
  • Overall Performance during this Workshop
  • Knowledge of Anatomy
  • Proper Instrument Selection and Use
  • Receptiveness to Performance Feedback
• Ability to Communicate / Work as a Team
• Professionalism
Training Model Evaluation

- Participants were asked to compare the cadaveric and porcine models at the end of the workshops using a 10-point Likert scale based on five criteria:
  - anatomic relevance
  - tissue handling
  - ability to dissect and identify planes
  - similarity to live patient surgery and
  - overall value for training
- Participants indicated their model of preference
- Ratings were compared using paired t-test; p<0.05 was considered significant
Results

• 2 workshops conducted; each 8 hr duration

• Participants
  • 9 surgery faculty
  • 30 surgery residents
  • 2 surgical assist faculty
  • 12 surgical assist students
  • 10 support personnel
  • 6 industry representatives

• 23 different procedures performed (4 per resident)
Results

• Overall quality and value of the workshop 8 (7-10)
• 87% of residents and 92% of surgical assist students strongly agreed or agreed that the course content was relevant to their educational needs and that their understanding of surgical techniques improved
• All participants felt that such workshops should be routinely offered in the surgery curriculum
Workshop Assessment

Residents

Protected Time  
Training Models  
Interaction with Faculty  
Precourse Material  
Course Organization

Participant Ratings
Workshop Assessment

Faculty

Protected Time
Training Models
Interaction with Residents
Course Organization

Participant Ratings

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Resident Performance Assessment

- Receptiveness to Feedback
- Communication Teamwork
- Ability to Assist
- Open Skill
- Laparoscopic Skill
- Instrument Selection
- Procedure Knowledge
- Anatomy Knowledge
- Overall

[Bar chart showing faculty ratings for different resident performance aspects, with ratings from 0 to 10.]
Surgical Assist Student Assessment

• Excellent ratings for workshop 9.7 ± 0.4
• Excellent ratings for both attending and resident performance 9.4 ± 0.6
  • Communication 9.6 ± 0.5
  • Professionalism 9.7 ± 0.7
• Self ratings
  • Preparedness for procedures 4.7±0.3
  • Relevance to educational needs 4.7±0.4
  • Improvement in surg tech skill 4.6±0.3
• 100% asked for additional similar experiences
Results

• 47/51 (92%) participants provided comparative ratings on the training models
• There were no differences between resident, faculty, and student ratings of the models
• Most participants (68%) felt that both cadaver and pig models were necessary for such a workshop as each model offered unique advantages and disadvantages for individual procedures
# Model Comparison

<table>
<thead>
<tr>
<th>Parameter Assessed</th>
<th>Pig</th>
<th>Cadaver</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomic Relevance</td>
<td>6.8±2.1</td>
<td>9.1±1.5</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Tissue Handling</td>
<td>8.4±1.3</td>
<td>7.2±2.0</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Ability to dissect/identify anatomic planes</td>
<td>8.6±1.2</td>
<td>6.7±2.4</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Similarity to live patient surgery</td>
<td>7.2±2.2</td>
<td>6.9±2.5</td>
<td>n.s.</td>
</tr>
<tr>
<td>Overall value for training</td>
<td>8.5±1.6</td>
<td>8.5±1.5</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

Ratings on 10-point Likert scale
Model Preference

- Cadaver
- Pig
- Both
- Procedure specific
Participant Comments

- Pigs
  - Liked tissue handling/ live tissues/ bleeding
  - Disliked anatomic differences

- Cadavers
  - Liked anatomic relevance, realism
  - Disliked smell, lack of bleeding

- Workshop
  - Liked one on one interaction with attendings, protected time, feedback, relaxed atmosphere
  - Disliked …… Very Unusual
Resident Participant Feedback

• “This was such a valuable experience. I feel that after today I am better technically and the direct feedback was so helpful. We had wonderful instructors also; they were GREAT. I have used the things Dr X taught me from the last lab several times in the OR and it was so helpful!”
Student Participant Feedback

• “This was much like the true operative experience”

• “I enjoyed the team interaction with residents and learning about new instruments”
Suggestions for Improvement

More

• More of this
• More attendings
• Need more time
• Have more of them
• More time
• More often
• More instruments
Costs and Resources

• Average cost per cadaver appr. $3,500
• Average cost per pig appr. $1,200
• Faculty time
• Supporting staff salaries
• Supplies
• Preparation time (approx. 25 hours) by course director/staff
Conclusions

• Procedural workshops are highly valued by surgery residents

• Based on resident and faculty evaluations both porcine and cadaveric models are necessary and valuable for procedural training outside the operating room

• Resource intensive and costly

• They enable interprofessional team training
Next Steps

• Assess the relationship of resident performance during workshops with that on simulators and in the operating room

• Assess skill transfer to the operating room

• More objectively assess teamwork and debrief the team
Discussion

• Learners engage more when they perceive close similarity to the operating room
• Current available simulators only appealing to junior residents
• Simulators of higher fidelity are needed to engage more mature learners
• Current training paradigm likely should incorporate graduated experiences starting with simulation to procedural workshops and to the OR
Questions?

- www.carolinassimulationcenter.org

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