Reclaiming Hands-On Ultrasound for Radiology: A Simulation Based Ultrasound Curriculum for Radiology Residents

Krista Elise Suarez-Weiss MD
Warren Alpert Medical School, Brown University, Providence RI, USA

Co-Authors: Michael D Beland MD, FSRU
Heejae Yang BMS

Acknowledgements: John Cronan MD
Introduction

• Hands-on ultrasound skills are important

• Current literature suggests an increase in utilization of and training in ultrasound in non-radiologic specialties (EM, surgery, family medicine, etc) as well as in medical school curricula

• Decline in US interest and training amongst radiologists (lower RVUs, more resource intensive/operator dependent)

• Increased clinical volume results in:
  – Less time for hands on scanning
  – Less time for attending instruction

• Loss of ultrasound is a universal threat to radiology

• Simulation-based training allows for broad, thorough training with minimal time demands on senior trainees and attendings
Study Design

All program residents surveyed prior to course.

Two-week simulation based US course completed by first year residents only.

First year residents surveyed again following course completion.
Pre-Course Survey Results

Survey of all residents \((n = 30)\)

<table>
<thead>
<tr>
<th>Question</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am prepared to technically assist with ultrasound scanning if an ultrasound technologist runs into a problem while scanning and requests my help.</td>
<td>17% Strongly Agree 38% Agree 31% Disagree 14% Strongly Disagree</td>
</tr>
<tr>
<td>I am prepared to independently complete an ultrasound scan on a patient if an ultrasound technologist is not available.</td>
<td>3% Strongly Agree 7% Agree 38% Disagree 52% Strongly Disagree</td>
</tr>
<tr>
<td>I am knowledgeable with Sonographic Anatomy (anatomy seen via ultrasound)</td>
<td>17% Strongly Agree 59% Agree 17% Disagree 7% Strongly Disagree</td>
</tr>
<tr>
<td>I am knowledgeable with Sonographic technique to accurately image body part</td>
<td>3% Strongly Agree 28% Agree 52% Disagree 17% Strongly Disagree</td>
</tr>
</tbody>
</table>

- Not prepared to scan independently
- Unsure of technique
- Not confident
- Anxious
- US skills are important
Daily Schedule

8 am – 9 am
• Abdominal Imaging Rounds

9 am – 12 pm
• Abdominal Imaging Rounds
• Course learning modules (didactic)
• Course virtual simulation
• Course assignments
• Phantom scanning practice

12 – 2 pm
• Conference

2 – 5 pm
• Live patient scanning with sonographer
• Dictate studies scanned
# Course Schedule

## WEEK ONE

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
</table>
| Modules:  
- Fundamentals of US  
- Renal (2)  
  
Simulation:  
- Renal (2) | Modules:  
- Bladder (2)  
Simulation:  
- Bladder (2) | Modules:  
- Aorta/IVC (2)  
- Leg venous  
Simulation:  
- Aorta/IVC  
- Leg Venous | Modules:  
- Liver  
- Pancreas  
- Spleen  
Simulation:  
- Liver  
- Pancreas  
- Spleen | Catch up day |

## WEEK TWO

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
</table>
| Modules:  
- Thyroid  
- Intestinal/Biliary  
  
Simulation:  
- Thyroid  
- Intestinal/Biliary | Modules:  
- MSK (2)  
Simulation:  
- MSK | Modules:  
- Female Pelvis  
- Ob/Gyn  
Simulation:  
- Female Pelvis  
- Ob/Gyn | Modules:  
- Prostate  
- Scrotum  
Simulation:  
- Prostate  
- Scrotum | Catch up day |
Computer Learning Modules

Renal: Anatomy & Physiology

Renal Anatomy & Physiology

Sonographic Anatomy

Question

Which structure on the accompanying ultrasound image represents a renal pyramid?

- A
- B
- C
- D
- E

None of the above

Renal Physiology

- The segmental arteries branch into the interlobar arteries, which travel in parallel routes between the major calyces and branch further into arcuate arteries that run through the cortex and bases of the renal pyramids.
- Blood flow on ultrasound can be traced to the cortex in the right subject.

Renal Blood Flow

Arteries of the Kidney

Color Doppler of Blood Flow in the Kidney

Renal Imaging

- Imaging the Left Kidney

- The left kidney is more difficult to image secondary to a smaller splenic acoustic window.
- Place the transducer between the midaxillary line and the posterior axillary line for initial long-axis imaging.
- Slightly rotate the transducer in a clockwise direction, aiming towards the left aorta.
- Rotate the probe 90 degrees counterclockwise to obtain a short-axis view.

- Arterial segmental artery
- Inferior segmental artery
- Superior segmental artery
- Interlobar arteries
- Medullary arteries
- Arterial segmental artery
- Arterial segmental artery
Simulation: Abdomen Sample

Task: Find all listed structures.

- (1) Liver with six lesions
- (2) Kidneys with one lesion each
- (1) Spine
- (1) Partial lung
- (1) Portal Vein
- (1) Vena Cava
- (1) Aorta
- (6) Ribs
- Surrounding Soft Tissue with two lesions
Post-Survey Results

Only first year residents surveyed ($n = 6$)

- **Substantial improvements:**
  - US anatomy
  - US technique
  - Confidence

- **Didactic modules and simulation cases helpful**

<table>
<thead>
<tr>
<th>Question</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am knowledgeable with Sonographic Anatomy (anatomy seen via ultrasound)</td>
<td>Pre-course 17% Strongly Agree or Agree 83% Disagree or Strongly Disagree Post-course 83% Strongly Agree or Agree 17% Disagree or Strongly Disagree</td>
</tr>
<tr>
<td>I am knowledgeable with Sonographic technique to accurately image body part</td>
<td>Pre-course 17% Strongly Agree or Agree 83% Disagree or Strongly Disagree Post-course 67% Strongly Agree or Agree 33% Disagree or Strongly Disagree Disagree</td>
</tr>
<tr>
<td>How confident are you in your technical skills to accurately perform an ultrasound procedure on a patient?</td>
<td>Pre-course 17% Very Confident 0% Confident 17% Slightly Confident 67% Not Confident Post-course 0% Very Confident 17% Confident 67% Slightly Confident 17% Not Confident</td>
</tr>
<tr>
<td>The SonoSim modules contained helpful information for my level of training.</td>
<td>33% Strongly Agree 66% Agree 0% Disagree or Strongly Disagree</td>
</tr>
<tr>
<td>The SonoSim virtual simulation cases were helpful for my level of training</td>
<td>33% Strongly Agree 66% Agree 0% Disagree or Strongly Disagree</td>
</tr>
<tr>
<td>Practicing with phantoms was helpful for my level of training</td>
<td>0% Strongly Agree 66% Agree 33% Disagree 0% Strongly Disagree</td>
</tr>
</tbody>
</table>
Results

• Survey results suggest a perceived need for hands-on US training amongst radiology residents
• Two-week simulation course contributed to improved perceived scanning knowledge and comfort for participating first year residents
• Phantoms and non-structured scanning were useful; however, computer modules were most beneficial

Discussion

• Radiology-performed exams can remain the gold standard if we ensure high quality US exams
• Hands-on scanning skills are necessary to maintain quality
• More research and experience is needed to explore simulation-based training and other educational methods for trainees