Impact of Simulator Teaching on Junior Radiology Resident Preparedness for Independent Call

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Introduction

• The demands on the radiology resident have changed dramatically over the last ten years ¹
  – The volume of “after hours” scans has steadily increased to meet the demands of the Emergency Department
  – In addition, there has been a trend towards more complex imaging as the initial imaging modality of choice, such as computer tomography (CT)²

• With the advancement in radiologic image acquisition, there is an increasing number of reconstructions available for evaluation
  – For example, the polytrauma CT scan at our institution contains 5000 images³
  – At trauma centres, often several polytrauma scans are read “after hours”

• To add to the “after hours” workload, some centres require residents to perform and interpret ultrasounds requested for Emergency Department patients

• The possibly life threatening conditions, for which clinicians depend on radiology to help guide management (e.g. suspected aortic dissection, ectopic pregnancy, testicular/ovarian torsion etc.), add to the challenges faced by on call residents
“On-Call” Performance

- There are many factors affecting “on call” performance:
  
  ![Diagram showing factors affecting on-call performance]

  - Distractions
  - Use of Technology
  - Medical Knowledge
  - Level of Alertness

  - All of these factors determine the comfort level of the resident

Traditional Call Preparation

- Call preparation has traditionally included:
  - Didactic lectures
    - At our institution, there are lectures offered by senior residents and attending staff
  - Case-based modules
  - Self-study
  - Mandatory subspecialty rotations
    - At our institution, first year residents are recommended to complete dedicated rotations in neuroradiology, chest and abdominal imaging, as well as at least one ultrasound rotation
  - “Shadow” or “Buddy Call” with senior residents
    - 6-8 “Shadow” shifts are required, split between the two hospitals we cover
  - Exams
    - Canadian National OSCE exam offered to all first year residents across Canada (questions set by program directors)

- However, these call preparation methods do not equip radiology residents with everything that they need to excel during a busy night on call
Simulator-Based Training

- Simulation-based training is used in a variety of medical and surgical residencies to provide residents with technical and critical thinking skills required for independent practice. Examples include simulated lines and tubes sessions for Intensive Care Residents and Fellows, intubation and advanced airway skills for Anesthesia Residents, simulated “Code Blue” situations for interdisciplinary resident teams.

- There is a positive correlation between the fidelity of the simulator-based training and likelihood of transfer to practice. The fidelity, or the degree in which the experience replicates reality, can be divided into these categories:
  - Equipment Fidelity: Does the simulator look real?
  - Psychological Fidelity: Does the simulator make the learner feel that the situation is real?
  - Environmental Fidelity: Does the simulator act real?

Simulator-Based Training in Radiology

- There are many applications for simulator-based training in radiology. Management of contrast reactions, procedures, such as biopsies and line placement, and communication of critical results.

- Simulation has been used in the emergency radiology setting to improve workload management and to prepare learners for call. Subjectively residents reported value in the simulator experience.

- In one published study, simulated cases have been used as a “test” to determine if junior residents are safe to take independent call. Residents who did not meet the established passing mark were required to complete remedial cases.

- At our institution, simulation has not yet been used as part of the preparation for the on call responsibilities of junior residents.

- The purpose of this study was to objectively and subjectively assess the impact of simulator-based training on first year radiology preparedness for independent call.
Methods

- This was a prospective cohort study which was conducted from August 2013 to March 2014

- All 9 first year radiology residents at a Canadian Diagnostic Radiology Residency Training Program participated in a 4 hour mock call shift

- They were presented with 17 standardized computed-based simulated cases consisting of 24 studies
  - Cases were viewed on a fully enabled PACS system common to both hospitals where residents take call
  - Previous images were available for comparison

- Cases were selected by the Radiology Resident Program Director and Chief Radiology Resident
  - Selected with acute and pertinent pathological findings in the “on call” or emergency radiology setting
  - Reference was made to the core curriculum published by American Society of Emergency Radiology
  - Most included studies were positive for pathology
    - 1 CT scan of the head and 1 chest x-ray were normal

Distribution of Cases

- There were 24 studies
  - 21 were CT scans
  - 3 were plain films

10 of these cases were trauma cases
Methods

• Residents were asked to describe the:
  – Study type
  – Protocol used
  – Pathological findings
  – Impression, including the differential diagnosis
  – Management plan
    • Appropriate immediate action and referral

• Resident responses were typed to mimic the “on call resident preliminary report” at our institution

• Responses were scored by a chief resident and medical student using a standardized grading system

<table>
<thead>
<tr>
<th>Question</th>
<th>Marking Scheme</th>
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<tbody>
<tr>
<td>1</td>
<td>0/2 Incorrect modality and protocol</td>
</tr>
<tr>
<td></td>
<td>1/2 One of two is incorrect</td>
</tr>
<tr>
<td></td>
<td>2/2 Correct modality and protocol</td>
</tr>
<tr>
<td>2</td>
<td>0/1 Incorrect body part</td>
</tr>
<tr>
<td></td>
<td>1/1 Correct body part</td>
</tr>
<tr>
<td>3</td>
<td>0/2 Incorrect contrast and phase</td>
</tr>
<tr>
<td></td>
<td>1/2 One of two is incorrect</td>
</tr>
<tr>
<td></td>
<td>2/2 Both contrast and phase correct</td>
</tr>
<tr>
<td>4</td>
<td>?/? One point for each correct finding</td>
</tr>
<tr>
<td>5</td>
<td>0/? Differential doesn’t include ___ or differential is not ___</td>
</tr>
<tr>
<td></td>
<td>?/? Differential includes ___</td>
</tr>
<tr>
<td>6</td>
<td>0/1 Does not recommend ___ or does not indicate discussing with staff</td>
</tr>
<tr>
<td></td>
<td>0.5/1 Does not recommend ___ but indicates discussing with staff</td>
</tr>
<tr>
<td></td>
<td>1/1 Recommends ___</td>
</tr>
<tr>
<td>Total</td>
<td>/ ?</td>
</tr>
</tbody>
</table>

Sample Case 1

• 38 year old male found down

• Left anterior communicating artery stroke
## Sample Case 1 – Grading

<table>
<thead>
<tr>
<th>Question</th>
<th>Key Points</th>
<th>Points</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Modality: CT (1) Protocol: Non-contrast CT head (1)</td>
<td>/2</td>
</tr>
<tr>
<td>2</td>
<td>Head (1)</td>
<td>/1</td>
</tr>
<tr>
<td>3</td>
<td>Non-Contrast (1) Phase: Non-contrast, none</td>
<td>/1</td>
</tr>
<tr>
<td>4</td>
<td>Findings: Left anterior communicating artery (ACA) stroke: 1. loss of grey white differentiation along left parafalcine area 2. No hemorrhage or mass effect 3. Low attenuation in the left caudate head and anterior left lentiform nucleus</td>
<td>/3</td>
</tr>
<tr>
<td>5</td>
<td>Impression: Acute left ACA ischemic stroke</td>
<td>/1</td>
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</table>

**Total /10**  

## Sample Case 2

- 48 year old woman with right lower quadrant pain

* Acute appendicitis with perforation and small abscess
Sample Case 2 – Grading

<table>
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<tr>
<th>Question</th>
<th>Key Points</th>
<th>Score</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Modality: CT (1) Protocol: CT Abdo/Pelvis with oral and IV (1)</td>
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</tr>
<tr>
<td>2</td>
<td>Abdomen and Pelvis</td>
<td>/1</td>
</tr>
<tr>
<td>3</td>
<td>IV and oral contrast (1) Phase: Portal Venous (1)</td>
<td>/2</td>
</tr>
<tr>
<td>4</td>
<td>Findings: • Appendix mildly distended at 6mm, presence of submucosal enhancement and 7mm appendicolith • Enhancing fluid collection with air fluid level adjacent to appendix • Trace amount of free intraperitoneal fluid</td>
<td>/2</td>
</tr>
<tr>
<td>5</td>
<td>Impression: Acute appendicitis with abscess</td>
<td>/1</td>
</tr>
<tr>
<td>6</td>
<td>Recommends: 1. Report findings by phone 2. Recommend general surgery consult</td>
<td>/1</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>/9</td>
</tr>
</tbody>
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Methods

- Resident self-reported preparedness was evaluated at three time points:
  1. Before participating in the simulated call shift
  2. After 3 months of taking independent call
  3. After 9 months of taking independent call

- Survey responses were recorded using a 5 point Likert scale:

<table>
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<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

- Survey questions were designed to include these areas:
  - Overall comfort level
  - Knowledge of “on call” pathology
    • Subdivided into findings, impression, and appropriate recommendations
  - Use of technology including PACS workstation and preliminary reporting system
  - Use of time (e.g. I was able to complete all the call cases in the allotted time)

- Survey responses were statistically analyzed using ANOVA test
  - One residents who participated in the simulator experience did not continue in the program and therefore this individual's responses to the pre-simulator were not included for analysis
Results – Individual Resident Scores

Average Score 75.6%  (95% CI: 70, 81)

Results – Scores By Subspecialty

* There was no significant difference in performance across subspecialties:
Results – Survey Responses

- Comfort Beginning Call
- Knowledge of On Call Pathology
- Comfort with PACS
- Comfort with Describing Imaging Findings
- Comfort with Forming an Impression

Results – After Taking Independent Call

- All residents felt that the cases simulated real cases that they would encounter on call

- Residents had mixed impressions of the effectiveness of the simulated cases to teach radiology findings
Results – After Taking Independent Call

• At 9 months post-simulator experience, residents agreed that their overall comfort with “on-call” responsibilities was increased as a result of the simulated cases.

Limitations

• Small cohort of participating residents
  – The simulated call experience was only offered for one year, and included 8 residents
  – Future years will also participate

• No standardized pre-call curriculum
  – Variability regarding individual studying and exposure
  – Recommended but not mandatory pre-call rotations

• At our institution, residents cover two different hospitals with variable complexity of cases and variable “after hours” staff coverage
  – Tertiary care hospital with staff coverage until 10 pm
    • Preliminary reads by residents from 5 pm to 8 am; however, studies performed between 5-10 pm are dictated out within 1 hour by staff and the resident is notified immediately if there is a discrepancy
  – Quaternary Level 1 trauma centre with 24/7 staff coverage
    • Preliminary reports are issued by residents for all inpatients and scans ordered by specialists
    • All cases ordered by emergency physicians are reviewed and dictated immediately

• It is unclear how staff coverage influences junior resident preparedness for call
Limitations

• Not all variables affecting “on call” performance were evaluated in this simulated call shift:

Conclusions

• With an increase in utilization of “after hours” imaging there is increased demand on residents to interpret studies quickly and accurately

• Patients are often very sick and there is increased pressure on radiology from referring clinicians to help direct patient care

• Although more and more institutions have 24/7 staff coverage for Emergency Department patients, many of the “after hours” imaging is still the responsibility of residents (e.g. when covering smaller centers and inpatients)

• Traditional, primarily didactic call preparation does not adequately prepare residents for all the factors that affect “on call” performance
  – Primarily assesses medical knowledge

• Residents reported that the stimulated call module was an effective educational tool and helped prepare them for beginning independent call

• More data, however, is required to better understand the factors that affect “on call” junior resident performance, which will be assessed in futures studies
References


