Radiation Exposure, Reduction Techniques, & Standardization of Swallow Study Evaluations

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INTRODUCTION

- Swallow Study Evaluation – Fluoroscopic Procedure
  - Most frequent fluoroscopic procedure performed in radiology department
  - Patient drinks contrast while being assessed under real-time X-ray
  - Required a Team: (1) Radiology resident who controls the radiation; (2) Fluoroscopy technician who controls the positioning of the X-ray machine; and (3) a speech pathologist who administers the contrast

- Long-term exposure to ionizing radiation from fluoroscopic procedures can lead to side effects1
  - Standardization of lead aprons and thyroid shields
  - However the eyes are currently the most at-risk organ

- No literature on residents’ cumulative radiation exposure over the course of training
  - Badge-dosimeter is inconsistent and thus unreliable

- Personal protective equipment recommended by Occupational Safety and Health Administration (OSHA)2
  - Lead aprons/vests, thyroid shields, lead gloves, and safety goggles

PURPOSE

To retrospectively establish a fluoroscopic radiation exposure baseline and monitor prospective reduction techniques.

METHODS

- Interventions
  - Replaced/Provided personal protective equipment per OSHA guidelines to all medical personnel involved in swallow study evaluations (eg, new leaded glove for speech pathology; radiation safety goggles for the fluoroscopy technicians)
  - Developed a standardized swallow study evaluation flowchart in conjunction with the speech pathology department
    - Barium contrast is the agent of choice as its effects (if aspirated) are lesser than other contrast agents, (eg, gastrografin)
    - Patients trial different consistencies of thin liquids, nectar-thick liquids, honey-thick liquids, puree, barium pill, and crackers in order to evaluate risk of laryngeal penetration or aspiration
    - Aspiration increases the risk of developing pneumonia

  - Data Analysis
    - Baseline: Swallow studies performed by 1 resident during Oct 2018 & Feb 2019
    - Midpoint: Completion of Clinical Learning Environment Quality Survey (CLEQS) to evaluate teamwork and at midpoint
    - Post Intervention: Swallow study evaluations performed by same resident in Sept 2020 + CLEQS

RETROSPECTIVE AND PROSPECTIVE RESULTS

- Swallow Study Flowchart

| Nectar-thick liquids (teaspoon, cup, straw) | Heavy-thick liquids (teaspoon, cup, straw) | Thick-consistency liquids (teaspoon, cup, straw) | Puree (teaspoon) | Barium-coated cracker |

**Patient Radiation Exposure**

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Radiation (mGy)</th>
<th>Runs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>1.9</td>
<td>7.9</td>
</tr>
<tr>
<td>Median</td>
<td>1.8</td>
<td>7.2</td>
</tr>
<tr>
<td>Range</td>
<td>0.3 – 4.3</td>
<td>1.5 – 24.3</td>
</tr>
</tbody>
</table>

**Resident Radiation Exposure**

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Radiation (mGy)*</th>
<th>Extrapolated Exposure per 4-week Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>183.7</td>
</tr>
<tr>
<td>Average</td>
<td>1.8</td>
<td>8.3†</td>
</tr>
<tr>
<td>Median</td>
<td>1.9</td>
<td>7.8†</td>
</tr>
<tr>
<td>Range</td>
<td>0.4 – 3.3</td>
<td>1.9 – 21.8</td>
</tr>
</tbody>
</table>

**Clinical Learning Environment Quality Survey (CLEQS)**

<table>
<thead>
<tr>
<th>Radiology</th>
<th>N supported by leaded suit SDA - 5 SA</th>
<th>Treat each other as patient, insist on SDA - 5 SA</th>
<th>IP Team Work Effectively Collaborative DBM unacceptable outcome, 1=AZ, 2=TB, 3=too much, 4=too little, 5=too much, 6=too little</th>
<th>Access to info, Resources Equip SDA - 5 SA</th>
<th>Teams &amp; my Roles &amp; Expectations as lead SDA - 5 SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>MidPoint</td>
<td>18</td>
<td>4.0</td>
<td>4.1</td>
<td>3.7</td>
<td>4.3</td>
</tr>
<tr>
<td>Post</td>
<td>17</td>
<td>4.2</td>
<td>4.3</td>
<td>3.8</td>
<td>4.4</td>
</tr>
<tr>
<td>Δ</td>
<td>0.2</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**REFERENCES**

1. Mooney et. al. Absorbed dose and deterministic effects to patients from interventional neuroradiology. British Journal of Radiology. 10.1259/bjr.73.8711108949630

DISCUSSION

- **Key Findings**
  - Implementing a standardized swallow study flowchart did not have a significant effect on decreasing fluoroscopy time or care team member radiation exposure
  - Providing fluoroscopic technologists with radiation safety goggles in addition to individually and directly promoting radiation safety awareness did not increase goggle usage, and thus, radiation exposure to their eyes did not significantly change
  - Radiation dosimetry badges were unreliable (eg, responsible department not collecting/recording data, technologists wearing resident leads without changing the badges, incorrect monthly badge updates/turn-ins)

- **Limitations**
  - Speech pathology perceived Swallow Study Flowchart as an over-simplified restraint instead of as an efficiency tool
  - Limited use of radiation safety goggles due to COVID PPE (face shields)
  - Radiation exposure side effects occur long-term; safety ignored

- **Next Steps and Sustainability**
  - Improve badge-dosimetry reporting and documentation
  - Continue to encourage proper use of radiation safety equipment