Reduction of Radiation Dose of Fluoroscopic Examinations

Introduction
Radiation dose has been increased by wide use of x-ray examinations in medicine. Although CT is regarded as an important source of radiation, fluoroscopy should not be ignored as it is used more frequently due to increase in need of minimal invasive procedures using fluoroscopy unit.

Methods
From June 2014 to February 2016, Tertiary-care hospital
Two fluoroscopy units

Unit 1 Automatic report (VacuDAP fluoro, Vacutec)

Unit 2 Manual record (VacuDAP fluoro, Vacutec)

Examinations
Fluoroscopic examinations
- Examinations not for GI tracts
- No recorded information (N=59)

2499 examinations
- All images were reviewed
  - Number of total images
  - Spot images
  - Capture images (=last image hold)
  - Cine-fluoroscopy
  - Frame rate
  - Number of images
  - Number of captured video images
  - Magnification
  - Collimation

Results
- 2499 examinations, 10 kinds of examinations
1. Barium swallow (N = 1203)
2. Esophagography, barium (N = 297)
3. Esophagography, water soluble contrast (N = 137)
4. Upper GI series, barium (N = 65)
5. Upper GI series, water soluble contrast (N = 327)
6. Small bowel series, barium (N = 29)
7. Small bowel series, water soluble contrast (N = 212)
8. Colon study, barium (N = 71)
9. Colon study, water soluble enema (N = 90)
10. Defecography (N = 67)

Action
- Instruction for radiographers to use collimation during swallowing test
- Education: residents & radiographers
  - Radiation exposure in GI fluoroscopy examinations
  - How to reduce radiation exposure during fluoroscopic examinations

Contents of Education
- ALARA (as low as reasonably achievable) principles
- How to reduce patient dose
  - Keep a large gap "source- to subject"
  - Use pulsed fluoroscopy rather than continuous fluoroscopy
  - Replace spot or cine image to image captured digitally
  - Avoid magnification and use collimation
  - Shield: other body parts that are not examined
- Radiation protection equipment
  - Equipment must be maintained in good working order with all electrical and radiation safety features within regulatory compliance.
- Radiation safety training for fluoroscopy imaging
  - Awareness
  - Audit

Statistical analysis
- Mann-Whitney U test
  - Before and after education and protocol change
    - Number of images
    - Collimation
    - Magnification
    - Fluoroscopy time, DAP and DAP/time
  - P value < 0.05 : significant difference

Unit 2
Manual record (VacuDAP fluoro, Vacutec)
Gastrointestinal Examinations by Education to Residents and Radiographers

Moon Hyung Choi, MD (cmh@catholic.ac.kr); Seung Eun Jung, MD; Jae Young Byun, MD
Department of Radiology, College of Medicine, Seoul St.Mary’s Hospital, The Catholic University of Korea, Seoul

<table>
<thead>
<tr>
<th>Examination Type</th>
<th>No. of examinations Before</th>
<th>No. of examinations After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defecography</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Colon_gastro</td>
<td>31</td>
<td>11</td>
</tr>
<tr>
<td>Colon_barium</td>
<td>4</td>
<td>67</td>
</tr>
<tr>
<td>SBS_gastro</td>
<td>47</td>
<td>110</td>
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<tr>
<td>SBS_barium</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>UGI_gastro</td>
<td>113</td>
<td>144</td>
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<tr>
<td>UGI_barium</td>
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<td>56</td>
</tr>
<tr>
<td>Esophagus_gastro</td>
<td>10</td>
<td>81</td>
</tr>
<tr>
<td>Esophagus_barium</td>
<td>108</td>
<td>192</td>
</tr>
<tr>
<td>Swallowing</td>
<td>366</td>
<td>409</td>
</tr>
</tbody>
</table>

DAP Before: 41.45 Gy·cm²
DAP After: 30.22 Gy·cm²

**Conclusion**
We achieved significant decrease of radiation dose by educating physicians or radiographers who operated fluoroscopy unit as the collimation and capture image were used frequently after education. We also achieved significant reduction of radiation dose by change of the protocol in an examination. We can conclude that awareness of radiation exposure in fluoroscopy examinations and understating of methods to reduce radiation are very important.