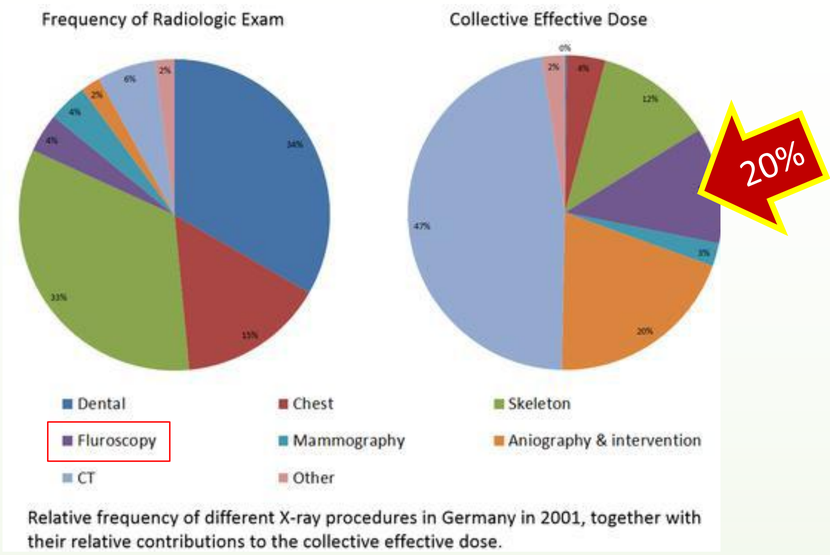
THE CATHOLIC UNIVERSITY OF KOREA
SEOUL ST. MARY'S HOSPITAL

Reduction of Radiation Dose of Fluoroscopic

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.



Relative frequency of different X-ray procedures in Germany in 2001, together with their relative contributions to the collective effective dose.

Methods

From June 2014 to February 2016, Tertiary-care hospital

Two fluoroscopy units

Unit 1 Automatic report

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3    DR            FIXED    ERCP                          ***** Single  30-Dec-14 10:19:16
A  90kV  797mA   90.2ms  0.0CL large 0.0Cu 48cm  203.25μGym²   7.8mGy 179RAO   0CRA   1F

4    DR            FIXED    ERCP                          ***** Single  30-Dec-14 10:19:43
A  90kV  798mA   90.2ms  0.0CL large 0.0Cu 48cm  200.45μGym²   7.7mGy 179RAO   0CRA   1F

5    DR            FIXED    ERCP                              8s   2F/s  30-Dec-14 10:19:54
A  92kV  654mA   90.4ms  0.1CL large 0.0Cu 48cm  2595.4μGym²  100mGy 179RAO   0CRA  15P

6    DR            FIXED    ERCP                          ***** Single  30-Dec-14 10:20:17
A  90kV  797mA   90.2ms  0.1CL large 0.0Cu 48cm  195.93μGym²   7.5mGy 179RAO   0CRA   1F

7    DR            FIXED    ERCP                             15s   2F/s  30-Dec-14 10:20:25
A  92kV  651mA   90.4ms  0.2CL large 0.0Cu 48cm  4873.7μGym²  188mGy 179RAO   0CRA  29P


***Accumulated exposure data***                                          30-Dec-14 10:32:47
Performing Physician:                                    Exposures: 5
Total Fluoro: 00:01:42                                   Total: 9109.2μGym²     349.2mGy
A     Fluoro: 00:01:42   1040.5μGym²       38.4mGy       Total: 9109.2μGym²     349.2mGy
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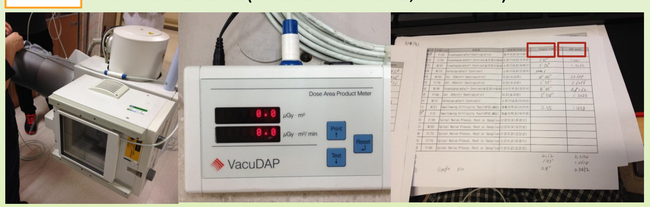
Unit 2 Manual record (VacuDAP fluoro, Vacutec)



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

Action

- June, 2014
- Nov. 2014: Instruction for radiographers to use collimation during swallowing test
- April, 2015: Education: residents & radiographers
  - Radiation exposure in GI fluoroscopy examinations
  - How to reduce radiation exposure during fluoroscopic examinations
- July, 2015: Change of defecography protocol
  - Spot & cine-fluoroscopy image → capture image
- February, 2016

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

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

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)

- 9 radiologist residents + 1 pediatric radiologist
- 3 departments : radiology, ENT, rehabilitation medicine

Gastrointestinal Examinations by Education to Residents and Radiographers

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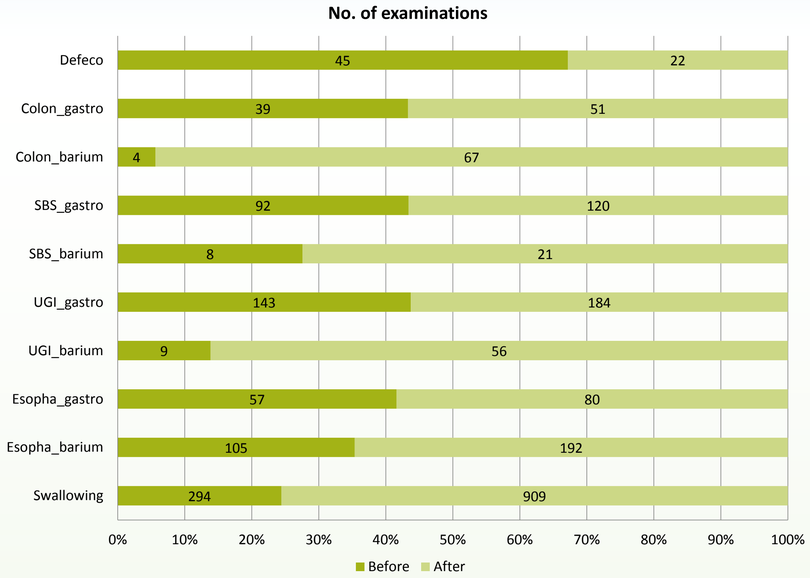
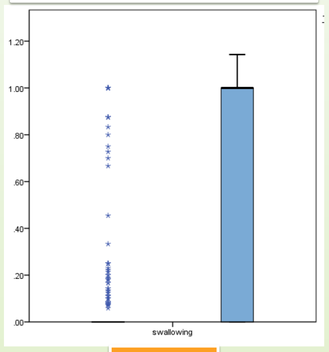


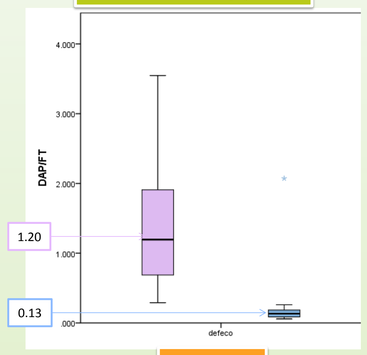
DAP 41.45 Gy·cm² → 30.22 Gy·cm²

Swallowing test - collimation



P < 0.001

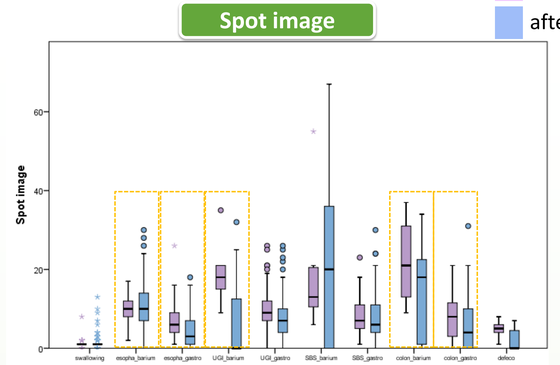
Defecography DAP/fluoroscopy time



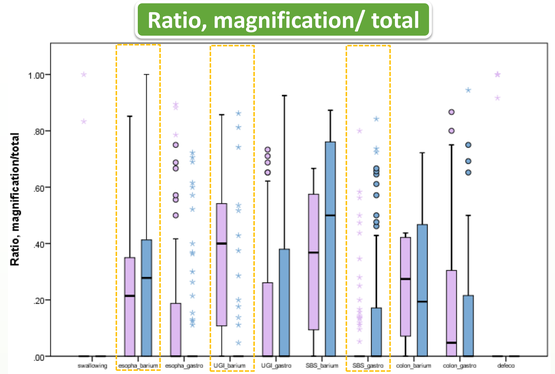
P < 0.001

before
after

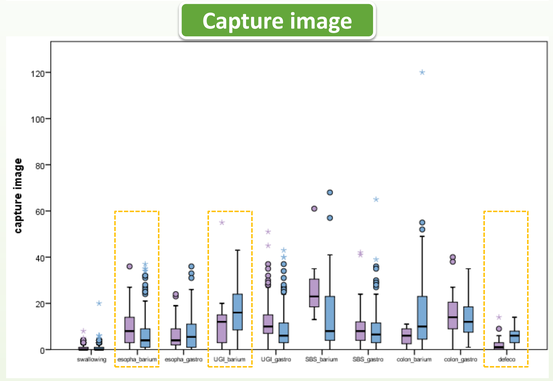
Spot image



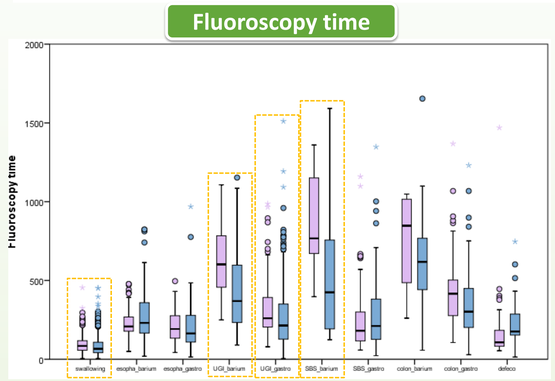
Ratio, magnification/ total



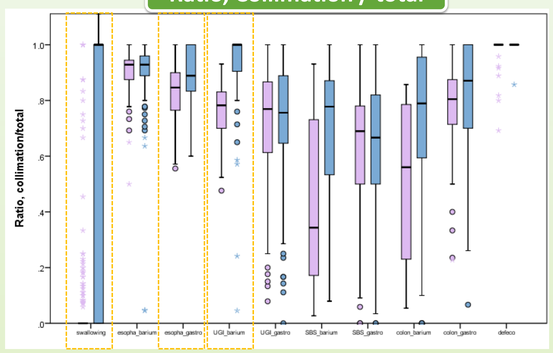
Capture image



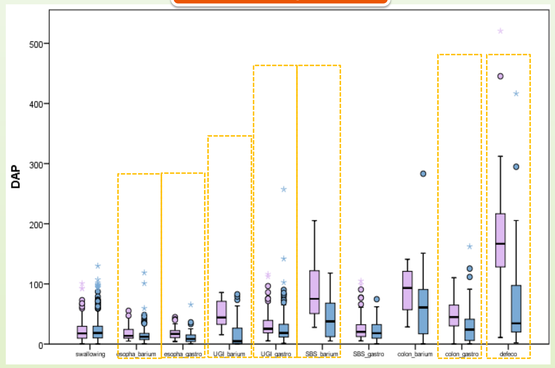
Fluoroscopy time



Ratio, Collimation / total



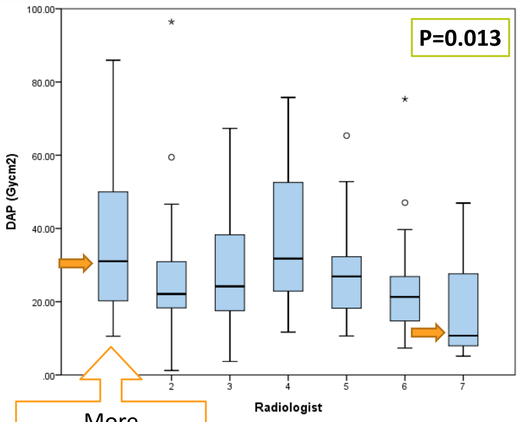
Dose area product



1. Swallow	2. Esophagography, Barium	3. Esophagography, WSC	4. Upper GI series, Barium	5. Upper GI series, WSC
6. Small bowel series, Barium	7. Small bowel series, WSC	8. Colon, Barium	9. Colon study, WSC	10. Defecography

WSC, water soluble contrast

UGI – Difference in DAP among radiologists



More
Magnification
Less Collimation
More spot
Less capture

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.