REDUCTION OF PATIENT DOSE IN DIGITAL RADIOGRAPHY

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Introduction

About 30%–40% of all diagnostic X-ray examinations are reported to be a chest X-ray [1].

The estimated contribution of individual patient dose in chest X-ray to the collective dose is about 18% [2].

Thus, the optimization of image quality and radiation dose in digital radiography has become an important area of research over the last decade [3, 4].

Under- or overexposure is likely to occur in digital X-ray, because the increase in a dynamic range makes it more difficult to recognize [3, 4].
Aim and goals

- To analyse conditions of patient overexposure during chest X-ray procedure;

- To apply the methods of patient’s dose reduction;

- To prepare the recommendations for dose reduction in the X-ray department.
Method

Primary research - 132 patients: DAP, ESD

<table>
<thead>
<tr>
<th>PA chest projection</th>
<th>LAT chest projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.05 mAs – 11.5 mAs</td>
<td>2.5 mAs – 41.5 mAs</td>
</tr>
<tr>
<td>X-ray tube voltage was set 125 kVp</td>
<td></td>
</tr>
</tbody>
</table>

ESD simulation for 177 X-rays.

Follow-up research - 105 patients: DAP, ESD

<table>
<thead>
<tr>
<th>PA chest projection</th>
<th>LAT chest projection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.86 mAs to 14.8 mAs</td>
<td>7.8 mAs to 81.9 mAs</td>
</tr>
<tr>
<td>X-ray tube voltage was set 125 kVp</td>
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</table>

ESD simulation for 100 X-rays.
100 radiographic images for the final analysis: 50 – chest PA projections and 50 – chest LAT projections. Average standard patient was 65.4 years old and his/her weight was 70 ± 10 kg [5,6,7].

Distribution of all studied patient‘s thickness
Primary results

Dose-area product values for PA chest and LAT chest projection before applying dose reduction methods

LAT mean DAP value - 0.966 Gy*cm^2
PA mean DAP value - 0.182 Gy*cm^2
Entrance skin dose for PA and LAT chest projections before applying dose reduction methods

LAT  mean ESD value - 0.818 mGy
PA   mean ESD value - 0.155 mGy
Dose reduction methods

Various methods might be applied for reduction of patient dose and for the radiographic image quality optimization [8]:

- Increased the X-ray beam filtration;
- Increased the X-ray tube voltage (kVp);
- Improved the screen sensitivity;
- Reduction of exposure parameter (mAs);
- Improved X-ray field collimation;
- Application of software tools for image processing, resolution and quality improvement.

We have applied these methods:

- X-ray beam filtration was set to 0.1 mm Cu;
- Particularly precise radiation field collimation for an individual patient was used.
Follow-up results

Dose-area product values for PA chest and LAT chest projection after dose reduction methods were applied

LAT  mean DAP value - 0.716 Gy*cm^2
PA   mean DAP value - 0.135Gy*cm^2
Follow-up results

Entrance skin dose for PA and LAT chest projections after dose reduction methods were applied. Skin entrance dose for LAT projection of chest radiography is 1.7 mGy.

- LAT mean ESD value - 0.071 mGy
- PA mean ESD value - 0.142 mGy
Conclusions

Dose-area product (DAP) and entrance skin dose (ESD) measurements of frontal and lateral chest radiographies showed that:

- Proper X-ray beam filtration is very important for dose reduction in chest radiography;

- Collimation of radiation field size for every patient personally is very effective way to reduce DAP dose;

- Doses to patients during X-ray chest examinations highly depend on technician’s skills.
Acknowledgements

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References

5. LR sveikatos apsaugos ministro 2013 m. sausio 15d. Įsakymas Nr. V-38 „Dėl Lietuvos Respublikos sveikatos apsaugos ministro 2011 m. Rugsėjo 22 d. Įsakymo nr. V-865 „Dėl rekomenduojamų medicininės apšvitos lygių, taikomų medicininių diagnostinių ir gydymo procedūrų, kurioms naudojama jonizuojančioji spinduliuiotė, metu, patvirtinimo“ pakeitimo.
Thank You for your attention