THE IMPACT OF ENTEROCLYSIS ON PATIENT’S RADIATION DOSES

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INTRODUCTION

The knowledge of doses under practical conditions used for variety of diagnostic examinations, serves not only for verification of compliance with recommended guidance levels but also for stimulation of the awareness of medical staff to aspects of radiation protection of the patient, i.e. of variations in doses delivered to patients due to variations in technical conditions of the equipment used and the diagnostic procedures applied.

About 14% of all radiological investigations undertaken in SR involve fluoroscopy. Because of the exposure parameters used in these examinations, particularly the screening time, they contribute a substantial proportion of the overall population dose from medical examinations. [4]

The objective of our study was to collect data on patient doses obtained during the conventional and digital fluoroscopy examinations of small intestine. In both cases the examinations were performed by the same radiologist, for excluding the individual variations in the used diagnostic methods. Two techniques for small intestine examinations were examined: the barium follow-through and enteroclysis. Our preliminary results are based on the dose-area product measurements and take into account all significant parameters influencing the irradiation dose observed during the two techniques used for diagnostic examinations.

MATERIAL AND METHODS
For our investigations two X-ray equipment were used. The conventional one was Swiss Ray unit with X-ray tube Comet BX 10018-22, image intensifier Piptelan, HVL = 3,8Al at 80 kV tube voltage. The digital unit was Clinodigit Italray (fig.1) with X-ray tube Varian A-292, image intensifier ITH.

One of the possibility to reduce the patient doses during fluoroscopic examinations is to convert the conventional system to digital one. The main advantages of digital radiography are:
• high conversion gain of the image intensifier
- electronic transmission of digital images
- availability of viewing images on a TV monitor
- reduction of the exposure of staff
- exclusion of artefacts
- reduced needs for storage space

Fig. 1. The digital equipment Clinodigit Italray

Collection of patient doses during barium follow-through procedures and enteroclysis was performed using dose-area product (DAP) meter Diamentor E (PTW Freiburg) with a flat transparent ionisation chamber No. 57523 (17×18.5×1.7 cm) mounted directly on the X-ray tubes. The ionisation chamber was calibrated at Slovak Metrological Institute. The cumulative DAP value was recorded and DAP values for each radiograph determined.

In the survey following details of the patient and of the examinations were collected: name, age, sex, weight and height of patient, kV, time of examination, number of radiograph and the name of radiologist.

The uncertainty in the dose-area product reading is ± 3%, the overall uncertainty of the published results is ± 10%.
RESULTS

Figure 2 summarises the values of DAP, fluoroscopic time, number of images and weight of patient for enteroclysis examination at both diagnostic units. Enteroclysis has advantages of examining the small intestine in the distended state through a tube passed via the mouth to the duodenum and than using fluoroscopy it proceeds through the small intestine where radiographs are taken. DAP meter integrates the total exposure throughout the examination.

![Graph of Figure 2](image)

**Fig.2.** Distribution of DAP, fluoroscopic time, No. of images and weight of patient for enteroclysis

The second option of the small intestine examination is the barium follow-through procedure. The results of DAP measurements are given in figure 3 for conventional and digital X-ray units.

The plots of DAP against patient weight for barium follow-through procedures are given in figures 4. (for conventional X-ray unit) and in figure 5. (for digital X-ray unit).
Fig. 3. Distribution of DAP, fluoroscopic time, No. of images and weight of patient for barium follow-through

Fig. 4. DAP vs patient weight for barium follow-through procedures (conventional X-ray unit)
For enteroclysis the plot of DAP against patient weight demonstrates a correlation between two parameters only for heavy patient.

Results of DAP intercomparison for enteroclysis and barium follow-through procedures in conventional and digital mode are given in table 1. There are introduced the 1st quartile, median and 3rd quartile DAP values, as well as, the minimum and maximum measured values.

Tab.1. Summary of the results for small intestine

<table>
<thead>
<tr>
<th>Type of examination</th>
<th>No. of patients</th>
<th>DAP (Gycm²)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>min</td>
<td>1st quartile</td>
<td>mean</td>
<td>median</td>
<td>3rd quartile</td>
<td>max</td>
<td></td>
</tr>
<tr>
<td>enteroclysis (C)</td>
<td>14</td>
<td>7,9</td>
<td>18,2</td>
<td>24</td>
<td>21,5</td>
<td>32,4</td>
<td>44,6</td>
<td></td>
</tr>
<tr>
<td>enteroclysis (D)</td>
<td>5</td>
<td>6,4</td>
<td>15,7</td>
<td>22,1</td>
<td>18,1</td>
<td>18,3</td>
<td>52,0</td>
<td></td>
</tr>
<tr>
<td>barium follow-through procedures (C)</td>
<td>24</td>
<td>2,9</td>
<td>11,2</td>
<td>13,3</td>
<td>12,2</td>
<td>15,2</td>
<td>26,7</td>
<td></td>
</tr>
<tr>
<td>barium follow-through procedures (D)</td>
<td>25</td>
<td>2,4</td>
<td>5,0</td>
<td>10,1</td>
<td>6,5</td>
<td>9,3</td>
<td>39,5</td>
<td></td>
</tr>
</tbody>
</table>

C – conventional; D - digital
DISCUSSION

The dose reference level (DRL) for small intestine examination is 25 Gycm². The mean DAP values for both monitored X-ray units as well as for the two types of examinations (enteroclysis and barium follow-through procedures) are less than DRL for all observed cases, but they are quite high, showing only small reduction of doses by using digital technique. This is due to the integral time of the examination, which is longer for the digital examination (tab.2.)

<table>
<thead>
<tr>
<th>Type of examination</th>
<th>Screening time (min)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>range</td>
<td></td>
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<tr>
<td>enteroclysis (C)</td>
<td>3,6</td>
<td>0,2-6,6</td>
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<tr>
<td>enteroclysis (D)</td>
<td>4,74</td>
<td>2,25-8,42</td>
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<tr>
<td>barium follow-through procedures (C)</td>
<td>1,7</td>
<td>0,8-3,7</td>
<td></td>
</tr>
<tr>
<td>barium follow-through procedures (D)</td>
<td>1,22</td>
<td>0,34-3,72</td>
<td></td>
</tr>
</tbody>
</table>

C - conventional
D - digital

Applying the conversion coefficients to give effective dose from dose–area product (mSvGy cm⁻²) published by Hart at all. [5] for AP and PA projection of small intestine and for used potential and filtration during examinations, our results give effective doses of approximately 4,76 mSv and 4,32 mSv for digital and non-digital systems, respectively, for the enteroclysis and similarly, values of 2,18 mSv and 2,40 mSv for barium follow through procedures.

CONCLUSION

The preliminary results, presented in our paper for comparison of radiation load of patients examined by digital and non digital X-ray units, have shown:

- the DAP measured during our survey have shown substantial variation and it is not easy to quantify and to standardise all parameters influencing the patient’s dose
- because of the most important factor influencing the exposure of patient, which is the screening time, it is important to optimise the number of radiographs as well as the fluoroscopy time in order to achieve the required diagnostic results with a dose as low as reasonable achievable
- it is recommended that measurements of DAP are performed regularly during all examinations to check compliance wit DRL and to evaluate the need for optimisation of the procedure
in spite of the fact, that the obtained results of the DAP during digital and conventional examinations were similar, it is important, that digital fluorography offers significantly higher diagnostic information that the conventional one.

REFERENCES


