PELVIS IMAGING: ACHIEVING DOSE REDUCTION WITH DIFFERENT PATIENT POSITIONS

by

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Scientific paper
https://doi.org/10.2298/NTRP190818037R

The purpose of this research was to determine how dose area product, effective dose, absorbed doses to specific organs, and image quality changed according to different automatic exposure control positions in pelvis imaging. The research was carried out in two parts. The study was conducted on an anthropomorphic phantom and 200 patients referred to pelvic imaging. We measured the dose area product, field size, height, and mass. Then we calculated the effective dose and absorbed dose for individual organs accordingly. Lateral ionizing cells were first positioned in line with the iliac crests (head towards position) and subsequently, with the femoral neck (head away position). All the images were independently evaluated by three radiologists using ViewDEX and objective image analysis was performed measuring contrast-to-noise ratio and signal-to-noise ratio.

We found no significant differences in the Siemens Luminos unit in any of the inspected parameters. However, there was a significant difference in dose area product (37.3 %), effective dose (35.7 %) and average absorbed dose to selected individual organs (36.7 %) when the head away position of the patient was used and the image quality increased. Based on these results, we can propose that the optimal position of the patient regarding the ionizing cells is the head away position.

Key words: pelvis imaging, dose optimization, image quality

INTRODUCTION

In general radiography, the imaging of the pelvis is considered to be one of the examination techniques with the highest radiation burden [1]. According to an all-European study that included 36 countries, the most common dose area product (DAP) value for imaging of the pelvis in general radiography was 300 Gym^2 with a range from 150 up to 700 Gym^2 [1].

There are quite a few studies [2-8] in which the authors investigated different optimization techniques to reduce the dose in pelvic imaging.

Jacobs *et al*. [2], investigated different tube voltages to reduce radiation dose in pelvic imaging. In the study, they investigate a tube voltage from 50 to 135 kV with the use of automatic exposure control (AEC). They have concluded that the best signal-to-noise ratio was with the highest tube voltage (135 kV). They state that the decrease in image quality was up to 5.6 % with the use of optimal tube voltage according to the European Commission guidelines. The other investigated dose reduction technique was to increase the source-to-detector (SID) distance [9-11]. Tugwell *et al*. [3] investigated the increase of SID in pelvic imaging and concluded that the increase from 110 cm to 140 cm resulted in a decrease of entrance surface dose (ESD) value by 41.8 % and effective dose (E) by 50.1 %. The decrease of the dose to the patient can also be achieved using the air gap technique [5].

The use of different ionizing cell selection (AEC) in pelvic imaging can result in different doses being received by patients [4, 6]. The lowest dose was found with the use of both lateral [4, 6] or right lateral cells [4]. This is in agreement with the European guidelines for pelvic imaging [12].

Another optimization technique that can be used is the change of the patient orientation in which the patient is in the supine position in both cases but rotated by 180 degrees. According to theoretical bases [13], images are lower in quality when an object is not positioned at the center of ionizing cells, as the AEC terminates the exposure too quickly and the detectors receive insufficient information. With the head away (HA) orientation, the lateral ionizing cells cover part of the pubic bone, femoral neck and soft tissue, mean-

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ing that exposure may end too soon, which would reduce both the dose and image quality. A wider dynamic range of digital detectors enables the processing of images to a certain extent, so images may still be optimal although of lower quality [14]. This was investigated by a few authors [7, 8]. In the first study, the mentioned position was investigated in a phantom study. The change in position resulted in a decrease in the E dose by 36.8 %. In the second study, the research was carried out on 255 patients that were referred to general pelvic imaging. In this case, the E dose was lower by 31 %. In both cases, a decrease in image quality is described. In none of the mentioned studies was an overview of the organ doses found due to the change of the position.

Based on the literature review, we decided to investigate the different orientation of the patient on two general digital radiography units with a different arrangement of ionizing cells. The position of the ionizing cells may vary from unit to unit.

This research aims to establish how the DAP, the effective dose, and the absorbed organ dose to selected organs change regarding different positions of the patient general radiography of the pelvis. Besides, we were interested in how changing the patient's position affects the quality of the image.

MATERIALS AND METHODS

The research was based on a cross-sectional study, using an experimental method. Measurements were taken in two parts. In the first stage, measurements were performed on an anthropomorphic phantom of the pelvis and the lumbar spine. The second stage of the research was expanded to 200 patients referred for pelvic imaging. Both phases were carried out at Novo Mesto General Hospital, where Siemens Ysio (year of production 2015) and Siemens Axiom Luminos dRF (year of production 2011) digital X-ray machines were used. The second X-ray unit offers fluoroscopy guidance which was not used throughout the study.

The Quality assurance tests for both x-ray units were done prior to the study. Radiation output reproducibility, the accuracy of kilovoltage assessment of half-value layer, AEC devices and tests of DAP accuracy were performed.

Phantom measurements

An anthropomorphic hermaphrodite phantom [15] RS-113T that has an attenuation coefficient of a patient with a body mass of 74 kg and a height of 175 cm (Radiology support devices, 2009) was used in the first phase. Twenty images were performed altogether, ten on each unit. For the ten measurements, the phantom was oriented head towards (HT) half of the times, while it was oriented HA for the remainder. For each exposure, the phantom was removed from the examination table and then again positioned in that way the error of the positioning was input into the measurements. For all the images, the DAP and imaging field size were collated, the effective dose was calculated, and all the images were graded by three radiologists.

The standard protocol for pelvic imaging used at Novo Mesto General Hospital was applied, however, the orientation of the phantom was changed at random. The tube voltage of 80.9 kV was constant throughout the whole study, with both lateral cells selected. The selected tube voltage was the same as the protocol where the study was conducted. Besides the tube voltage was in conformity with European guidelines for digital radiography imaging [12]. Source-to-image receptor distance of 115 cm was used, with a large focal point of 1 mm and an additional filtration 0.2 mm of copper. On Siemens Ysio with the position HT the average tube current was 10.7 mAs and with HA position 8.0 mAs. On Siemens Luminos the average tube current was 11.9 mAs with HT position and 11.8 mAs with the use of HA position of the phantom. Phantom and patient orientation were done as described in the previous study [7].

Head towards orientation of the phantom

The phantom was placed on its back on the table. The lateral ionizing cells were positioned in line with the iliac crests, as indicated in the figs. 1 and 2.

Head away orientation of the phantom

In HA orientation, the phantom was rotated by 180°, so that the lateral ionizing cells were in line with part of the pubic bone, the femoral neck, and the soft tissue simulation.

Patient measurements

Measurements on patients were also performed at Novo Mesto General Hospital under the same technical conditions as the measurements on the phantom. The dose was measured in 200 patients, of whom 100 (32 male and 68 female patients) were placed on a Siemens Ysio machine, while 100 (32 male and 68 female patients) patients were on a Siemens Axiom Luminos dRF. A random 50 % of the patients were HT oriented, while the remainder were HA orientated. The random.org web platform was used to make the random selection.

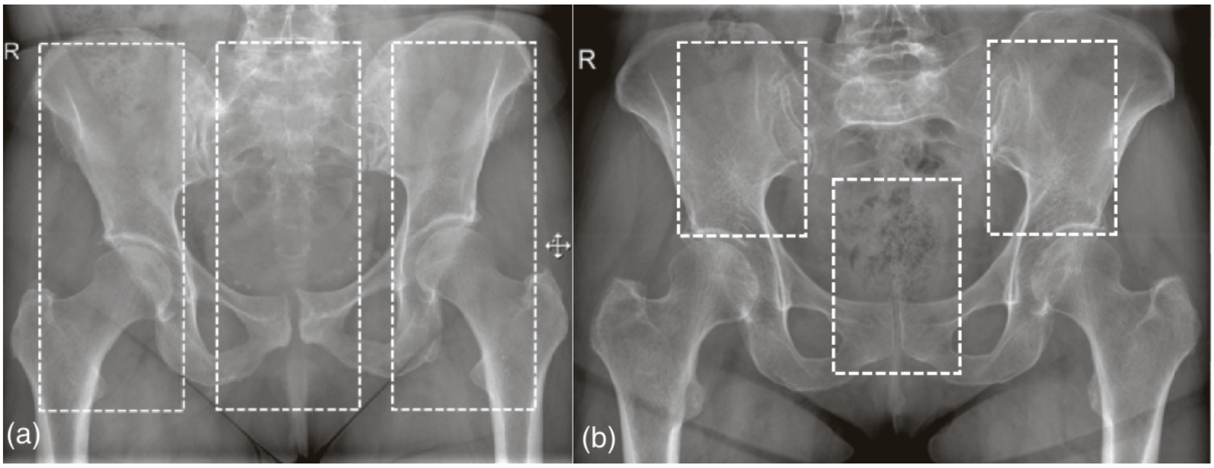

Figure 1. Position demonstration of the pelvic bones according to the ionizing cells on Siemens Luminos (a) and Siemens Ysio (b)

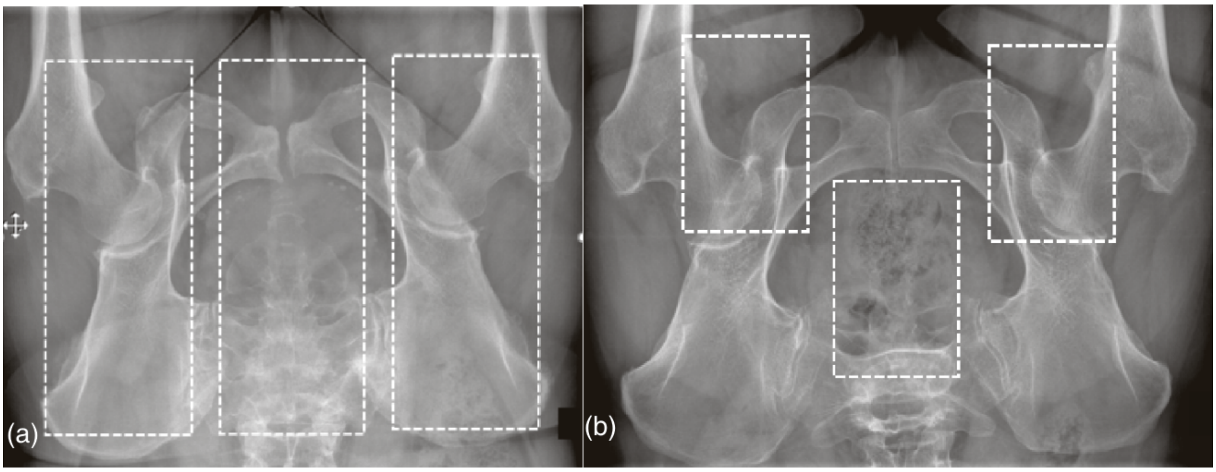

Figure 2. Position demonstration of the pelvic bones according to the ionizing cells on Siemens Luminos (a) and Siemens Ysio (b)

The approval of the National Medical Ethics Committee was obtained prior to the study, all the participants were informed about the purpose of the study and gave written consent to participate in the study. None of the patients declined participation in the study.

Image quality evaluation, dose and data analysis

The images obtained were evaluated by three radiologists, each with a minimum of seven years of experience in skeletal reporting. A blind randomized study was used, and all images were assessed on the same diagnostic monitor using the ViewDEX program. According to the recommendations of the European Commission [12, 16], the criteria for an optimal image that apply to the anterior-posterior projection of the pelvis are as follows:

– Symmetrical reproduction of the pelvis,
– visually sharp reproduction of the sacrum and its intervertebral foramina,
– visually sharp reproduction of the pubic and ischial rami,
– visually sharp reproduction of the sacroiliac joints,
– visually sharp reproduction of the necks of the femora which should not be distorted by foreshortening or rotation, and
– visually sharp reproduction of cortical and trabecular structures including the trochanters

The ratings were given by applying a three-step scale, with 1 – indicating a diagnostically unacceptable image, 2 – a diagnostically acceptable image, and 3 – an optimal diagnostic image. The ratings according to all criteria were added up for every image, so the lowest total rating of an image was 6 and the highest 18. In this way, each assessor contributed three different ratings for each image; then the mean rating, which was the final rating of an image, was calculated.

Beside subjective (visual grading) image analysis an objective image analysis was performed measuring contrast-to-noise ratio (CNR) and signal-to-noise ratio (SNR). The measurements were performed using imageJ software. The CNR and SNR were then calculated based on the next two formulas [17]

$$CNR = 20 \log_{10}[m1-m2)/std2]$$

$$SNR = 20 \log_{10}(m/std2)$$

where m1 is average ROI1, m2 – the average ROI2 (background), m – the average value from the complete image, std2 – the standard deviation from ROI2.

To calculate the effective and absorbed dose to selected organs, PCXMC software (STUK, Radiation and Nuclear Safety Authority in Finland) was used. The program enables the dose received by patients in medical X-ray examinations to be calculated by applying a Monte Carlo simulation. The weight, height, imaging field size, DAP and total filtration were inserted into the program for each patient separately. During the simulation, the maximum energy of photons was set (90 keV) and the number of photon particles tracked was 1 000 000.

Data were analyzed using IBM SPSS STATISTICS 25 software. To determine the normal sample distribution, the Shapiro Wilk test was first applied. With a normal sample, the independent sample T-test was conducted, while the Mann-Whitney U-test was applied with a non-normal distribution. To process the agreement levels of raters, the Cohen Kappa coefficient and Spearman Correlation coefficient was performed. The significance of $p < 0.05$ was used for all the tests.

RESULTS

Results of measurements on the phantom

The basic statistical characteristics of 20 phantom-based measurements are presented in tab. 1 (Siemens Axiom Luminos) and tab. 2 (Siemens Ysio). No statistically significant differences in the size of the imaging field ($p = 1.000$), the DAP ($p = 0.690$), effective dose ($p = 0.222$) or mean image rating ($p = 0.310$) were found for the Siemens Axiom Luminos. For the Siemens Ysio, the DAP was 9.5 % ($p = 0.032$) lower in HT orientation. There were no statistically significant differences concerning other parameters on the mentioned unit: field size ($p = 0.841$), effective dose ($p = = 0.836$) and mean image rating ($p = 0.994$).

Results of the measurements on patients

The examinations of patients included recording their BMI, the size of the imaging field, the DAP, effective dose, absorbed dose to selected organs and image ratings. The results of 200 statistical measurements on patients are presented in tab. 3 (Siemens Axiom Luminos), tab. 4 (Siemens Ysio), and figs. 3 and 4.

First, the BMI was checked, whereby no statistically significant differences were found for either the Siemens Axiom Luminos dRF ($p = 0.990$). Moreover, no statistically significant differences with regard to the size of the visual field ($p = 0.391$). That meant that the possible changes in the doses measured would be due to the change of the patient position. With the Siemens Luminos, the DAP, effective dose and absorbed dose to selected organs were not statistically significant ($p = 0.951$; 0.836; 0.994).

For the Siemens Ysio, BMI and image field size showed no statistically significant difference ($p = 0.267$; $p = 0.534$), respectively, but there was a statistically significant DAP reduction of 37.3 % with HA orientation

Table 1. Basic statistical characteristics of the phantom study on Siemens Luminos

	Orientation	Mean	Std	Median	Minimum	Maximum	p-value
Imaging field size [cm^2]	HT	1548.00	67.98	1548.00	1462.00	1634.00	1.000
	HA	1548.00	67.99	1548.00	1462.00	1634.00	
Dose-area product [μGym^2]	HT	57.84	3.37	58.65	52.59	61.88	0.690
	HA	56.28	5.75	56.02	50.67	64.51	
Effective dose [μSv]	HT	90.92	12.35	99.08	77.21	100.40	0.222
	HA	84.67	10.04	85.99	74.43	97.56	
Mean image estimation	HT	16.73	0.50	16.67	16.00	17.30	0.310
	HA	16.47	0.30	16.67	16.00	16.70	

Table 2. Basic statistical characteristics of the phantom study on Siemens Ysio

	Orientation	Mean	Std	Median	Minimum	Maximum	p-value
Imaging field size [cm^2]	HT	1076.93	146.82	1066.06	882.50	1296.00	0.841
	HA	1057.33	161.45	1075.12	907.21	1296.00	
Dose-area product [μGym^2]	HT	60.72	12.17	61.98	55.65	64.43	0.032
	HA	54.98	4.45	53.76	49.75	61.70	
Effective dose [μSv]	HT	133.39	14.92	139.51	107.48	144.02	0.548
	HA	157.26	87.59	118.48	110.11	313.22	
Mean image estimation	HT	16.00	0.41	16.00	15.30	16.30	0.151
	HA	15.67	0.24	15.67	15.30	16.00	

Table 3. Results of the patient study on Siemens Luminos

	Orientation	Mean Std	Median	Minimum	Maximum	*p*-value
Body mass index	HT	29.05 4.96	29.49	20.31	44.06	0.964
	HA	29.06 5.00	29.17	20.37	41.14	
Imaging field size [cm^2]	HT	1275.06 129.75	1333.08	1030.92	1428.00	0.391
	HA	1303.10 161.99	1312.68	999.00	1614.54	
Dose-area product [μGym^2]	HT	97.18 62.18	83.10	33.70	385.60	0.951
	HA	95.64 51.64	87.70	30.02	256.05	
Effective dose [μSv]	HT	157.91 93.47	138.86	20.99	569.62	0.836
	HA	156.31 76.55	143.80	49.40	365.79	
Mean image estimation	HT	15.68 1.65	16.00	10.70	18.00	0.994
	HA	15.61 1.78	16.00	10.30	18.00	
CNR	HT	32.23 1.85	32.82	26.82	34.24	0.970
	HA	32.50 1.29	32.89	28.86	34.83	
SNR	HT	30.02 1.53	30.26	26.64	31.91	0.553
	HA	30.11 0.93	30.23	27.61	31.66	

Table 4. Results of the patient study on Siemens Ysio

	Orientation	Mean Std	Median	Minimum	Maximum	*p*-value
Body mass index	HT	26.15 4.28	25.05	19.03	36.44	0.267
	HA	26.55 3.81	26.36	18.21	34.60	
Imaging field size [cm^2]	HT	1506.20 101.15	1508.50	1156.00	1720.00	0.534
	HA	1529.44 94.43	1512.86	1284.50	1711.40	
Dose-area product [μGym^2]	HT	94.89 ± 75.80	79.11	20.67	414.10	0.002
	HA	59.52 ± 27.42	55.85	9.30	154.40	
Effective dose [μSv]	HT	154.74 114.89	126.86	35.50	626.61	0.002
	HA	99.51 43.38	94.15	15.97	251.81	
Mean image estimation	HT	15.26 1.91	15.50	10.00	18.00	0.041
	HA	16.06 1.38	16.67	12.30	18.00	
CNR	HT	31.74 1.72	32.16	25.71	33.99	0.011
	HA	32.45 1.61	32.80	26.63	34.60	
SNR	HT	28.45 1.66	28.76	25.98	31.14	<0.001
	HA	29.96 1.48	30.40	25.85	32.78	

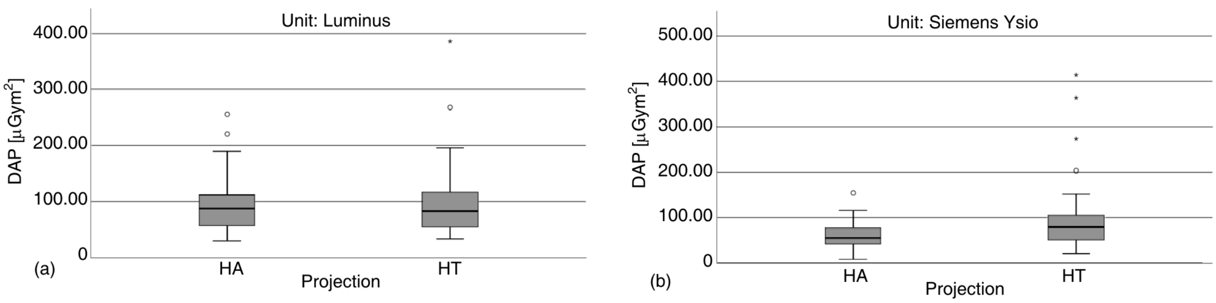

Figure 3. The comparison of the DAP according to patient orientation HA or HT on Siemens Luminos (a) and Siemens Ysio (b)

(p = 0.002) and lower effective dose by 55.23 μSv (35.7 %) (p = 0.002).

Absorbed dose to selected organs for both X-ray units are presented in tabs. 5 and 6.

There was no statistically significant difference found in Siemens Luminos on the absorbed dose to selected organs between positions HT and HA.

We showed statistically significant differences in favor of the HA position of the patient in colon (p = = 0.007), pelvic bones (p < 0.001), urinary bladder (p < 0.001), uterus (p = 0.003) and ovaries (p = 0.003). The results are presented in fig. 5.

The average rating of images in either HT or HA orientation are not statistically significant with regard

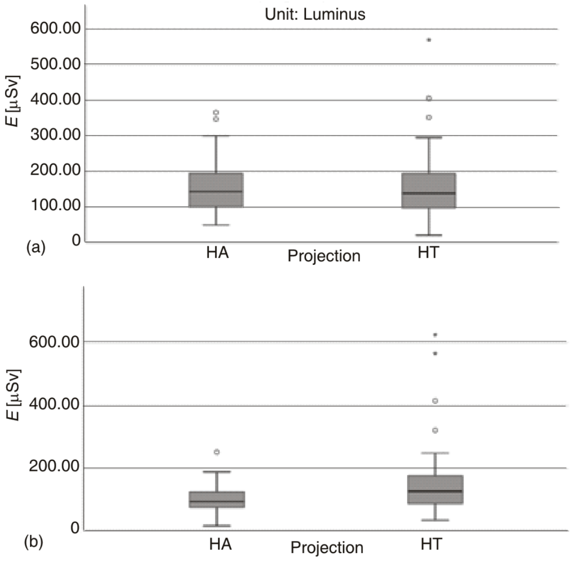

Figure 4. The comparison of the effective dose according to patient orientation HA or HT on Siemens Luminos (a) and Siemens Ysio (b)

to the Siemens Axiom Luminos dRF (p = 0.994), but we found a statistically significant difference in the Siemens Ysio (p = 0.041) in favor of the HA patient position.

Cohens Kappa coefficient showed very low matching between the assessors. With greater precision, the Spearman correlation coefficient between the assessors shows a medium positive correlation with the Siemens Axiom Luminos dRF (p = 0.472, p = = 0.494, p = 0.486), while with the Siemens Ysio, the correlation between raters is medium positive (0.474), strongly positive (p = 0.759) and slightly positive (p = = 0.220).

DISCUSSIONS

This study involved 200 patients that were referred to pelvic imaging and were evenly distributed among two different radiography units. Our purpose was to establish how the DAP, the effective dose, and

Table 5. Results of absorbed dose to selected organs on Siemens Luminos

Organ	Projection	Mean	Standard deviation [µSv]	Median [µSv]	Minimum [µSv]	Maximum [µSv]	p-value
Colon	HT	248.89	152.49	217.51	97.81	855.66	0.535
	HA	216.42	92.47	198.83	80.47	498.87	
Small intestine	HT	177.13	152.68	125.11	38.13	833.12	0.352
	HA	124.66	64.95	102.04	54.79	357.76	
Pelvic bones	HT	446.84	176.65	409.08	207.39	1049.51	0.659
	HA	424.47	154.24	410.56	166.31	810.89	
Urinary bladder	HT	937.38	541.92	837.18	346.97	3569.03	0.929
	HA	933.93	484.77	873.08	262.35	2324.18	
Uterus*	HT (n = 34)	436.99	223.53	368.55	188.56	1117.31	0.883
	HA (n = 34)	441.34	211.21	413.53	154.95	962.79	
Ovaries*	HT (n = 34)	302.92	167.87	250.95	33.89	791.60	0.556
	HA (n = 34)	313.03	142.43	291.87	111.00	669.32	
Testicles*	HT (n = 16)	844.73	473.91	721.74	457.50	2468.69	0.642
	HA (n = 16)	766.62	345.99	689.53	378.33	1718.27	
Prostate*	HT (n = 16)	1919.32	1319.45	1617.32	872.23	6512.61	0.696
	HA (n = 16)	1715.18	881.05	1507.95	822.33	4116.13	

*The organ doses for these organs were calculated only for the relevant sex

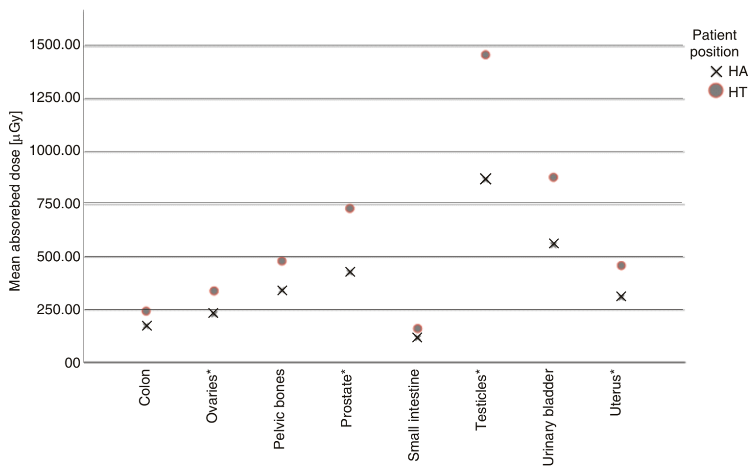

Figure 5. Comparison of absorbed dose between the HT and HA projections by selected organs on Siemens Ysio unit (*mean was calculated only for the relevant sex)

Table 6. Results of absorbed dose to selected organs on Siemens Ysio

Organ	Projection	Mean Standard deviation [μSv]	Median [μSv]	Minimum [μSv]	Maximum [μSv]	*p*-value
Colon	HT	244.51 171.88	206.88	63.63	887.63	0.007
	HA	174.20 97.75	157.71	24.99	639.49	
Small intestine	HT	161.57 110.00	132.91	35.07	541.97	0.054
	HA	117.48 62.20	107.55	15.98	295.04	
Pelvic bones	HT	492.79 337.13	428.79	126.10	1827.94	0.001
	HA	330.18 133.35	310.61	48.35	738.15	
Urinary bladder	HT	879.96 654.90	718.02	183.27	3474.44	0.001
	HA	559.08 250.15	521.27	92.66	1419.23	
Uterus*	HT (n = 32)	460.96 294.79	395.13	107.09	1730.74	0.003
	HA (n = 36)	309.99 135.22	288.92	58.60	746.27	
Ovaries*	HT (n = 32)	340.48 205.59	299.25	81.47	1194.11	0.003
	HA (n = 36)	230.23 93.54	215.99	41.26	510.55	
Testicles*	HT (n = 18)	1461.58 1353.77	1101.36	436.42	6056.48	0.267
	HA (n = 14)	869.52 397.55	779.88	144.04	1772.64	
Prostate*	HT (n = 18)	732.12 644.69	567.33	253.73	2864.30	0.220
	HA (n = 14)	428.82 175.46	407.40	69.34	795.70	

*The organ doses for these organs were calculated only for the relevant sex

the absorbed organ-specific dose changed with the patients in different positions, and how this affects image quality.

With the Siemens Luminos, there was no statistically significant difference with regard to DAP and an effective dose between the HT and causal orientation of the patient. The results can be explained by the shape of the ionizing cells, which are distributed across the entire visual field. However, there are statistically significant differences in the DAP between the HT and HA orientations with the Siemens Ysio X-ray unit, both with the phantom, for which the difference was 9.5 % and in patients, for whom the difference was 37.3 % in favor of the HA orientation. The smaller difference in the phantom can be explained by the fact that the size of the phantom does not vary, unlike the 200 patients. We found that the DAP values on both units were lower than the most common value for the DAP (300 μGym^2) in all European study [1].

Moreover, with the Siemens Ysio, the effective dose was reduced by 35.7 % if the patient was oriented HA rather than HT. These results were found to be consistent with earlier studies in which the decrease of the effective dose was 36.8 and 31 % respectively [7, 8]. There was no statistically significant difference in effective doses between HT and HA positions in the Siemens Axiom Luminos dRF, either with regard to the phantom or with patients. The cause for that is the same as for the DAP value, which is the shape of the ionizing cells.

Doses absorbed by selected individual organs were also examined in greater detail. The highest dose was received by the testis and bladder, and the lowest by the colon. For the most part, measurements on the phantom did not reveal statistically significant differences between HT and HA settings on either the Siemens Ysio or the Siemens Axiom Luminos dRF. With the measurements on patients, there were statistically significant differences in favor of the HA position in the average dose absorbed on the Siemens Ysio in the following organs: the bladder (36.5 %), lower colon (35 %), pelvic skeleton (33 %), uterus (32.8 %), ovaries (32.4 %), and the colon (28.8 %).

Every dose reduction technique can affect image quality [8]. According to our research, there were no statistically significant differences in the quality of the images between the HT and HA positions of the phantom and the patients on the Siemens Luminos. That was also confirmed with the use of objective measurement analysis of CNR and SNR. However, statistically significant differences were found between the positions on the Siemens Ysio, for which the rates are 2.5 % higher when patients were in the HA position. These results were also supported by the objective measurement analysis CRN and SNR. The study conducted by Harding *et al*. [8] revealed a statistically significant lower image quality of 7.5 % with HA compared to HT orientation, but they state that the images were still optimal for diagnostic purposes. The differences were most apparent in the public and ischial rami, femoral neck and, the last criterion, which rates the symmetrical reproduction of spongiosa and corticalis.

CONCLUSIONS

A comparison of the two X-ray units inspected in the study leads to the conclusion that there are no statistically significant differences for the Siemens Axiom Luminos according to any measured parameter due to the position or shape of the ionizing cells. In contrast, for the Siemens Ysio, with the usual position of ionizing cells, it has been shown that the HA orientation on the DAP is reduced by 37.7 % the effective dose by 35.7 % and average absorbed dose to selected organs by 31.8 % respectively. In addition, image quality improves. Based on that, we can propose the HA position of the patient regarding the position of the ionizing cells in general radiography pelvic imaging.

ACKNOWLEDGMENT

We would like to thank the entire radiology team of the General hospital Novo Mesto for enabling the performance of this study, and for their support in carrying out the practical part of the research.

AUTHORS' CONTRIBUTIONS

Preparation of the research plan, ViewDEX and ImageJ programs for image evaluation have done by N. Mekiš and J. Žibert. Data collection and preparation for data analysis has done by A. Resnik. All the authors have contributed to data analysis and article preparation.

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Received on April 26, 2019
Accepted on September 12, 2019

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СЛИКАЊЕ КАРЛИЦЕ – ПОСТИЗАЊЕ СМАЊЕЊА ДОЗЕ СА РАЗЛИЧИТИМ ПОЗИЦИЈАМА ПАЦИЈЕНАТА

Сврха истраживања је била да се сазна како се производ дозе и површине, ефективна доза, апсорбована доза за одређене органе и квалитет слике мењају у складу са различитим позицијама код сликања карлице. Студија је била спроведена у два дела. Први део је изведен на антропоморфном фантому, а други део на 200 пацијената, који су имали сликање карлице. Мерили смо производ дозе и површине, величину поља, висину и масу. Израчунали смо ефективну и апсорбирану дозу за одређене органе. Стране јонизујуће ћелије су прво биле постављене на илиакалним врховима карлице (НТ положај), а касније на врату бутне кости (НА положај). Све слике су независно процењене од стране три радиолога користећи програм ViewDEX и објективна анализа слике је извршена мерењем односа контраст-шум и односа сигнал-шум. Значајне разлике код апарат Siemens Luminoc нису биле пронађене у било којем од испитиваних параметара. Међутим, нашли смо разлике између производ дозе и површине (37.3 %), ефективне дозе (35.7%) и просечне апсорбиране дозе за изабране појединачне органе (36.7 %) када је коришћен НА положај пацијената, а и квалитет слике се повећао. На основу ових разлика можемо предложити, да је оптимална позиција пацијената у односу на јонизујуће ћелије НА положај.

Кључне речи: сликање карлице, оптимизација дозе, квалитет слике