HR0300059

ABSORBED DOSES TO EMBRYO FROM INTRAVENOUS UROGRAPHY AT SELECTED RADIOLOGICAL DEPARTMENTS IN SLOVAKIA

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INTRODUCTION

Actual legislation used in radiological protection requires introduction of quality assurance program for decreasing radiation load of patients from radiological examinations. To implement the QA program it is necessary to unify and optimise factors influencing on radiation load of patients by various radiological examinations. Increased attention is needed by irradiation of critical groups of population (pregnant women, children).

It is necessary to avoid the unintended irradiation of embryo. However everyday praxis shows, that unintended irradiation of pregnant patients occurs. The risk of prenatal exposure by radiological examinations depends on absorbed dose to embryo and on developmental stage, when irradiation occurs. The highest risk of irradiation is in the critical period 8-15 weeks post conception, when organogenesis occurs [1-4]

Determination of threshold doses of various effects of irradiation is not definitely solved up to this day and therefore is by irradiation of embryo frequently used the so called *critical dose.* Critical dose is estimated on 50 mGy and should not be overloaded during whole pregnancy. On the basis of current scientific knowledge by absorbed doses to embryo under 50 mGy there is no risk of deterministic effects and risk of stochastic effects is less than 1% [3,5,6].

Absorbed doses to embryo from most radiological examinations do not present a significantly increased risk of prenatal death, malformations or mental retardation compared to background incidence of these effects. When the embryo is in direct beam of X-ray, for example by intravenous

urography (IVU), absorbed dose to embryo can be much higher and can overload the critical dose [1-3,5,7].

Absorbed doses to embryo from radiological examinations can be considerably different and they depend on many factors. Factors affecting absorbed dose to embryo are: type of examination (conventional radiography, fluoroscopy, tomography, CT etc.), technical parameters and setup of X-ray unit (exposure time, mAs, kV etc.), number of exposures, field size, parameters and position of patients during examination, distance of embryo to direct beam of X-ray and embryo depth during irradiation. These factors are critical by examinations of lower abdomen and pelvis [1,8].

The aims of study were to estimate absorbed doses to embryo from IVU by patients with unknown pregnancy and to compare the radiation load of embryo between selected radiological departments in Slovakia.

MATERIAL AND METHODS

In the presented study we have performed measurements of entrance surface doses and absorbed doses to embryo from IVU at selected radiological departments in Slovakia. Technical parameters and setup of X-ray units by IVU at 4 radiological departments presents Table 1.

Table 1. Technical parameters and setup of X-ray units by IVU

Technical parameters and setup of X-ray units	Radiological department			
	A	B	C	D
X-ray unit	Chirana Chiralux 2	Chirana Chiralux 2	Siemens Polydoros 50	Chirana MP 15
Generator waveform	12 pulse	12 pulse	multipulse	multipulse
Filtration (mm Al)	3	3	3	0.5
Voltage (kV)	60	60	70	73
mAs (mAs)	100	240	50	80
Exposure time (ms)	1000	750	93	495
Focus-film distance (cm)	100	100	100	90
Field size (cm)	30×40	35×43	30×40	30×40

Absorbed doses to embryo and entrance surface doses have been measured using a phantom simulating pregnant woman in first trimester of pregnancy. Thermoluminescent dosemeters LiF Harshaw 700 were placed at the surface of the phantom and in depth of 6 cm, the mean depth of embryo

in first trimester of pregnancy [8]. Using simulation of conditions by IVU at selected radiological departments, the phantom irradiation was performed in AP projection. Dosemeters were evaluated using TLD reader Harshaw 3500.

RESULTS

Measured values of entrance surface doses per radiograph presents Table 2.

Table 2. Measured values of entrance surface doses per radiograph

Measured values of entrance surface doses (mGy)							
Radiological department							
A	RSD (%)	**B**	RSD (%)	**C**	RSD (%)	**D**	RSD (%)
11.1	±6.4	**13.9**	±5.1	**7.1**	±2.4	**13.9**	±5.0

RSD – Relative standard deviation

Reference level of entrance surface dose by IVU recommended by European Commission [9] is 10 mGy per radiograph. In case of departments A, B and D we observed an overload of reference level of entrance surface dose. High values of entrance surface doses may be connected with performing of nonstandard urographic examinations on selected departments, which are not in accordance with above mentioned recommendations (recommended exposure time by IVU should not exceed 200 ms and recommended voltage by IVU is 75-90 kV).

Measured values of absorbed doses to embryo after 3 exposures (most common number of radiographs by IVU at selected radiological departments) presents Table 3.

Table 3. Measured values of absorbed doses to embryo after 3 exposures

Distance to central axis of X-ray beam (cm)	Mean values of absorbed doses to embryo (mGy)							
	Radiological department							
	A	RSD (%)	**B**	RSD (%)	**C**	RSD (%)	**D**	RSD (%)
0	**13.5**	±6.7	**16.6**	±8.2	**8.7**	±1.3	**20.6**	±7.2
4	**13.2**	±6.2	**15.2**	±7.6	**8.2**	±3.5	**17.6**	±5.4
8	**12.6**	±5.6	**13.7**	±3.8	**5.0**	±2.3	**16.4**	±2.7

The highest value of absorbed dose to embryo after 3 exposures was at department D equal 20.6 mGy. Reported absorbed doses to embryo by other authors are 13.98 [5], 5.8 mGy to 35.2 mGy [6], 3.2 mGy [7] and 8.2 mGy [10].

CONCLUSION

Presented results of our study indicate, that absorbed doses to embryo from IVU were at 4 radiological departments considerably different. It means, that risk of prenatal exposure will be also at various radiological departments different. It depends on technical parameters and setup of X-ray unit used during examination. The selected radiological departments provide nonstandard urographic examinations, which are not in accordance with recommendations of European Commission. We did not observe an overload of critical dose 50 mGy. But in case of department A, B and D it would be enough to overload critical dose if 3 to 4 examinations should be performed during whole pregnancy, providing one examination with 3 radiographs. However the risk of stochastic effect of ionising radiation cannot be underestimated neither by these values of absorbed doses to embryo.

Whenever it is possible, it is necessary to avoid irradiation of embryo and all radiological examinations must be justified. Here belongs also situation when patient has no suspect about her pregnancy. The primary responsibility for identification of such patients is on physician prescribing the examination. By considerations about examination of pregnant patient or potentially pregnant patient may be helpful many references [2-4,11].

On the basis of differences in radiation load between various radiological departments it is necessary to continue in measurements of absorbed doses to embryo at several radiological departments and by several examinations, where the embryo is in direct beam of X-ray. Analysis of risk of embryo irradiation by selected radiological examinations will contribute to unifying conditions of radiological examinations in Slovakia. It also helps to reduce radiation load of embryo by examinations of patients with unknown pregnancy.

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