

ESTIMATION OF EMBRYONIC DOSES IN RADIOLOGICAL EXAMINATION ON UPPER GI-TRACT IN JAPAN

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ABSTRACT

Embryonic doses on X-ray health screening of upper GI-tract of about 100 subjects in five health screening facilities were investigated from viewpoints of optimization of protection in medicine. The embryonic doses were derived from the skin doses of each subject measured with TLDs and the examination procedures of upper GI-tract, i.e. duration times of fluoroscopy, numbers of fluorographies or radiographies, voltage and current during examination. The results are as follows: (1)Embryonic doses and skin doses on the maximum point in each subject ranged from 0.3 to 5.5 mGy and from 8.9 and 210 mGy, respectively, (2)Duration time of fluoroscopies and numbers of fluorographies or radiographies ranged from 0.6 to 7.6 min. and from 7 to 40 exposures, respectively.

INTRODUCTION

Per caput dose of medical exposure in Japan is 1.6 mSv; this is about 5 times higher than that of other advanced countries, i.e. United Kingdom[K1]. Immediate reduction of medical exposure is necessary. The X-ray examinations on upper GI-tract which contribute large effective dose to the population are very popular in Japan. The frequency of these examinations per 1000 population is 175(total number is about 19 million)[B1]. About 44% of these examinations are applied to females and about 10% of the female subjects are under years 30 of age[H1]. From viewpoints of radiation protection of embryo/fetus, exposure from these examinations should be reduced.

Because dose limitation is not applied to medical exposure, reduction of exposure should be performed by justification of practice and optimization of protection. X-ray examinations on upper GI-tract could be regarded as a typical diagnostic procedure. So dose constraint in optimization should be considered too[I1].

In our previous studies it was made clear that doses of X-ray examinations on upper GI-tract were widely different among subjects. In order to estimate the distribution of embryo/fetus doses among subjects and facilities, we investigated the examination procedures of upper GI-tract and the skin doses in more than 100 subjects in five X-ray health screening facilities.

METHODS AND MATERIALS

The types of X-ray equipment investigated in this report in each health screening facility are shown in Table 1. The uterus doses of each subject were estimated by the following information;

- (1)Skin doses of each subject
- (2)Relationship between surface doses and uterus doses estimated by phantom experiments
- (3)Examination procedures of each subject.

The skin doses of each subject were measured by the following methods;

- (1)TLDs : $\text{Mg}_2\text{SiO}_4\text{:Tb}$ (Kasei Optonix) and $\text{CaSO}_4\text{:Tm}$ (Panasonic)
- (2)Reader: Victoreen model 2800M
- (3)Calibration: ionizing chamber(Capintec 192X with model PM-05 probe); 90 and 100 kVp X-ray in free air
- (4)Measuring points: front and back surface at 10 cm below xiphisternum, front and back surface at the position of uterus.

Total error of skin doses by the present methods was about 20%.

RESULTS

The investigated procedures of examinations are shown in Table 1. There were remarkable differences of duration time of fluoroscopies and numbers of exposures in gastro-duodenum examinations among facilities. Distribution of duration time of fluoroscopies is shown in Fig. 1. Duration time of fluoroscopies ranged from 0.6 to 7.6 min.

The points of the maximum skin doses were located at 10 cm below xiphisternum in the side of incident X-ray. The skin doses on the maximum point in each subject ranged from 8.9 and 210 mGy and distribution in each facility is shown in Table 1 and Fig. 2. Distribution of embryonic doses is shown in Table 1 and Fig. 3. The embryonic doses ranged from 0.3 mGy to 5.5 mGy.

DISCUSSION

It was made clear that embryonic doses and skin doses of each subject and facility distributed widely. These differences should be considered in estimation of the per caput dose from medical exposure in Japan. It seems that the different purpose of the X-ray health screening of upper GI-tract gave rise to the wide difference in the number of exposures and duration time of fluoroscopies. X-ray health screening of upper GI-tract is applied to healthy subjects as the first screening. So the purpose and the procedures of these should be reconsidered from viewpoints of justification and optimization.

The widely differing embryonic doses and skin doses on the maximum point indicate the necessity of application of dose constraint to X-ray health screening of upper GI-tract. The value of dose constraint must be considered on the basis of our present results.

REFERENCES

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Table 1. Specification of X-ray examination Procedures and Summary of Results

	A	B	C1	C2	D	E
MODELS of X-ray equipment*	DT-AV	DDW-30A	DBW-30A	DAW-30A	ZU-A4M	DPT-500A
Types of procedures**	FL	RD	RD	RD	FL	FL
Total filtration (mmAl)	1.6	2.0	2.5	2.5	3.3	2.5
Subjects of investigation	55	20	11	10	23	48
Examinations of esophagus area						
Duration of fluoroscopy (min)	0.3±0.1	0.4±0.1	0.3±0.1	0.4±0.2	-	0.2±0.1
Number of exposure	1.0±0.0	3.8±0.6	2.8±1.0	2.0±0.0	-	1.8±0.8
Examinations of gastro-duodenum area						
Duration of fluoroscopy (min)	1.9±0.5	2.6±0.6	5.6±1.0	5.3±0.6	1.8±0.4	0.8±0.2
Number of exposure	8.6±0.8	20±1.7	27±3.2	28±2.4	7.0±0.0	8.3±0.7
Subjects measured with TLDs	50	19	11	10	15	-
Maximum skin doses(mGy)	20±8.9	36±21	76±36	123±52	99±45	-
Embryonic doses(mGy)	0.8±0.6	1.2±0.6	1.1±0.5	3.7±1.4	1.8±0.7	-

* DT-AV, SSW-30A and DAW-30A were under-tube type equipment of TOSHIBA, and DBW-30A(TOSHIBA), ZU-A4M(HITACHI) and DPT-500A(TOSHIBA) were over-tube type equipment.

** FL: fluorography, RD: radiography

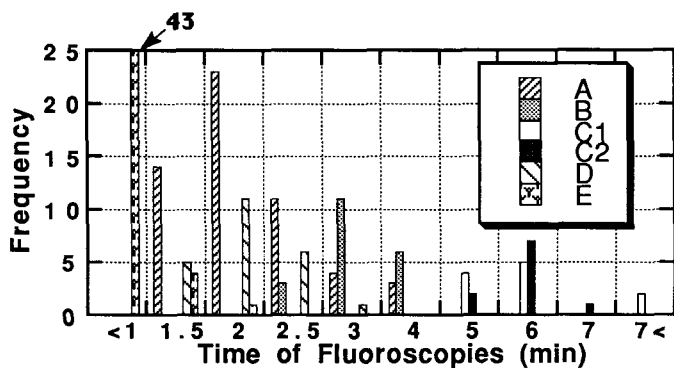


Fig.1 Distribution of duration time of fluoroscopies in gastro-duodenum area examinations

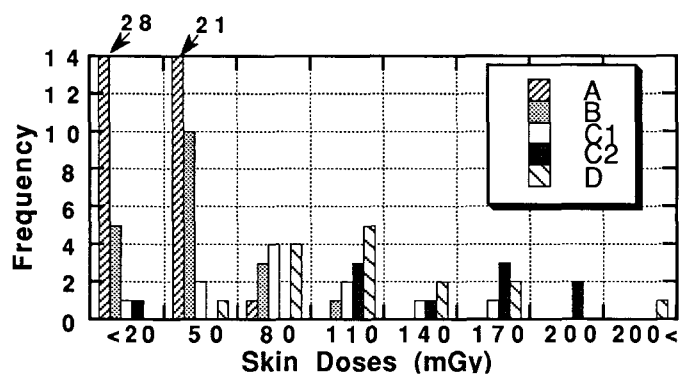


Fig.2 Distribution of skin doses on the maximum point of each subject in X-ray examination on upper GI-tract

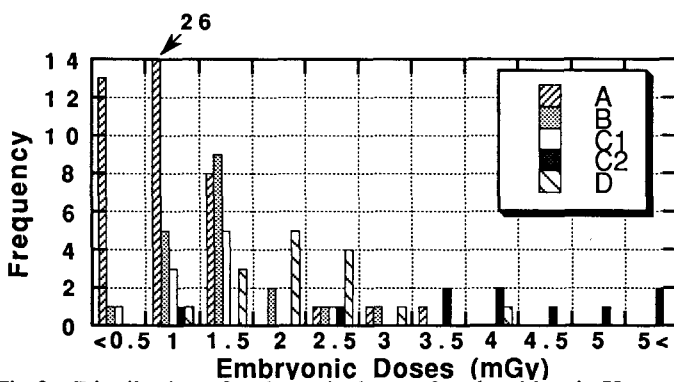


Fig.3 Distribution of embryonic doses of each subject in X-ray examination on upper GI-tract