PATIENT DOSE EVALUATIONS FROM MEDICAL X-RAY EXPOSURE IN ITALY: AN ANALYSIS OF NEXT DATA

Marchetti Andrea, Paganini Fioratti Mario, Susanna Antonio (Comitato Nazionale per l'Energia Nucleare, Viale Regina Margherita 125, Roma)
Calicchia Angelo, Salvadori Paolo (Istituto Superiore di Sanità, Viale Regina Elena 299, Roma)

INTRODUCTION

The average annual whole body dose to individuals is currently about 182 mrem; the contribution due to medical usage is about 73 mrem per year (1).

From a study of CNEN (National Committee for Nuclear Energy) and ISS (Istituto Superiore di Sanità), it was found that the radiographic films used in Italy during 1975 amounted to more than 90 millions, with an annual increasing rate of 8%. The estimated contribution to the genetically significant dose, due to radiographic examinations, was about 40 mrem (2).

Such non negligible values of genetically significant dose are due to the same factors as for other countries: maximum voltage and half value layer are two or three times the least value; current by time product for the same examination ranges up to two orders of magnitude. But as one of the most determining factors, usually beam dimensions are considerably wider than film dimensions.

Therefore, it can be drawn that the ICRP Publication 26 suggestions, as far as patient radiation protection is concerned, are not taken into due account, in Italy as elsewhere.

NEXT PROGRAM DESCRIPTION

NEXT is an acronimous for Nationwide Evaluation of X-ray Trends (3). It is a program aimed at collecting all the available information on the different techniques used when performing 12 selected radiological examinations.

During a NEXT survey, the facility operator is asked to set up the X-ray apparatus as though he were going to perform the most frequent examination for a patient with standard dimensions. The inspector records information about the type of facility and apparatus, workload, operator training; he also records the indicated voltage, current intensity, time, film size and then he measures the source-film distance, the exposure at a fixed distance, the exposure with three increasing aluminum thicknesses and the beam size. The ionization chamber used for the exposure measurements is calibrated by the central authority; a special apparatus is supplied to ensure the reproducibility of the exposure

measurements.

From the registered parameters and the reported measurements, it is then possible to calculate the half value layer, the skin entrance exposure and the gonad dose for all the inspected facilities.

Radiological techniques that cause too high gonad doses are easily picked out, by comparing the recorded, measured and computed parameters for the techniques used in a facility with those used in all the inspected facilities.

Each facility may then revise its wrong techniques; each local administrations may choose the most adequate program to improve the patient radiation protection.

NEXT PROGRAM IN ITALY: FIRST RESULTS

NEXT program was fitted to italian conditions and, after a pilot study, it was presented in May 1977 to the competent Regional Administrations.

As central authorities, CNEN and ISS reserved to themselves the data processing and instrument calibration. All the NEXT surveys should be performed by regional operators.

Regional Administrations have been operating in Italy only since 1975 and economical, social, organization problems have been braking their working.

Therefore, it must be considered as a great success that the Umbria Regional Administration immediately begun to collect the data for the NEXT program. After a few months, the Emilia Regional Administration made the NEXT program start in the territory of one of its provinces.

The program is now going to be completed in Emilia; three other Regional Administrations are very likely to include the NEXT program in their health programs.

Table 1 shows the most relevant results for the recorded parameters and for some selected projections; in particular it should be stressed that the current by time product ranges from 2 mA.s up to 200 mA.s for the chest P/A projection.

For the same projection, the voltage varies between 40 kV and 90 kV; the half value layer ranges between 0.9 Al mm and 4.0 Al mm and the beam area to film area ratio ranges from 0.6 to 8.2.

The other projections are less frequent than chest P/A projection and, therefore, less data are related to them; although, the involved parameters are spread over wide intervals.

Table 2 shows the minimum, maximum and weighted mean values for the computed parameters, such as skin entrance exposure, ovarian and testicular doses. The parameters range in remarkably wide intervals; though the weighted mean values are closer to least

values, nevertheless it should be stressed that the patient in radiographic examinations keeps receiving non negligible doses in a great number of cases.

CONCLUSIONS

The NEXT program has been carried out up to now only in two regions, slightly representative of the health conditions in Italy; a southern Regional Administration at least would be necessary.

Nevertheless, the results shown here are enough to indicate that often patient doses are unjustified and non optimized techniques are chosen. NEXT results show as well the fields where local Administrations should operate to reduce patient dose and to improve radiological techniques.

TABLE 1 - Minimum and maximum values of some registered parameters for a few selected radiological projections

Projection	Voltage kV		mA.s		SSD(°) cm		B/F(°°)		HVL Al mm	
	min	max	min	max	min	max	min	max	min	max
Chest P/A	40	90	2	200	90	200	0.6	8.2	0.9	4.0
Abdomen A/P	60	100	12	160	74	120	1.0	2.3	1.6	4.5
Cervical Spine A/P	52	70	25	200	80	136	1.2	2.8	1.4	2.2
Lumbar Sacral Spine A/P	55	100	20	200	75	114	0.9	3.5	1.5	5.0
Dental Bitewing P	50	60	2	11	9	13	1.7	2.3	1.1	1.6

(°) Source - Skin Distance

(°°) Beam area to Film area ratio

TABLE 2 - Minimum, maximum and weighted mean values of the computed parameters for a few selected projections

Projection	Skin Entrance Exposure mR			Ovarian Dose mrem			Testicular Dose mrem		
	min	max	mean	min	max	mean	min	max	mean
Chest P/A	8	375	56	0.5	26	3	0.5	15	0.5
Abdomen A/P	391	3328	1222	55	644	252	1	57	13
Pyelogram A/P	285	1808	784	34	418	153	1	20	6
Lumbar Sacral Spine A/P	187	3173	1311	21	538	286	0.5	46	15

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