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MEDICAL RADIATION EXPOSURE AND USAGE FOR DIAGNOSTIC RADIOLOGY IN MALAYSIA

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Abstract

A national dose survey of routine X-ray examinations in Malaysia (a Level II country) from 1993 to 95 had established baseline data for seven common types of x-ray examinations. A total of 12 randomly selected public hospitals and 867 patients were included in this survey. Survey results are generally comparable with those reported in the UK, USA and IAEA. The findings support the importance of the on-going national quality assurance programme to ensure doses are kept to a level consistent with optimum image quality. The data was useful in the formulation of national guidance levels as recommended by the IAEA. The medical radiation exposure and usage for diagnostic radiology (1990-1994) enabled a comparison to be made for the first time with the UNSCEAR 2000 Report. In 1994, the number of physicians, radiologists, x-ray units and x-ray examinations per 1000 population was 0.45, 0.005, 0.065 and 183 respectively; 3.6 million x-ray examinations were performed; the annual effective dose per capita was 0.05 mSv and collective dose was 1000 person-Sv. Chest examinations contributed 63% of the total. Almost all examinations experienced increasing frequency except for barium studies, cholecystography, and intravenous urography (-23%, -36%, -51%). Notable increases were observed in computed tomography (161%), cardiac procedures (190%), and mammography (240%).

1. Introduction

There is a continuing need to analyze the frequencies, doses and trends of medical radiation procedures to permit comparison with medical radiation usage in other parts of the world, comparisons with other sources of radiation, and identification of areas of concern. It also helps to assess how the introduction of new techniques, radiation protection actions or quality assurance programs affect the trends. Exposures from medical radiation world-wide have been assessed by the United Nations Scientific Committee on the Effects of Atomic Radiation [1]. Worldwide interest in patient doses has been stimulated by a report of the National Radiological Protection Board (NRPB) [2].

2. National Dose Survey of Routine X-ray Examinations

Malaysia with 2216 persons per physician in 1994 belongs to health care Level II according to UNSCEAR [3]. A national survey initiated by the University of Malaya and the Ministry of Health has been conducted from 1993 to 95 to establish baseline data on patient doses from 7 routine types of x-ray examinations (12 projections) in 12 public hospitals following the protocols of NRPB [4]. For each x-ray room machine specific data such as type, model, waveform, filtration, film-screen combination, and output were recorded. Basic equipment quality control including the processor had been implemented in these hospitals since 1992 [5]. 867 patients with a mean weight around 60 kg (45-75kg) were included in this study. For each patient and x-ray unit the following parameters were recorded: sex, ethnic origin, age, weight, height, body mass index, focus-skin distance, focus-film distance, field size, kVp, and mAs. Entrance skin dose (ESD) was measured using LiF TLD chips (TL-100, Harshaw) calibrated by the Primary Standard Dosimetry Laboratory at the National Radiation Laboratory, New Zealand and the Secondary Standard Dosimetry Laboratory at the Malaysian

Institute for Nuclear Technology Research (MINT) within the recommended precision and accuracy levels [4].

Table 1 compares the ESD values [6] of this survey with established reference dose values from other countries. The reference dose values recommended by the IAEA Basic Safety Standard [9] are based on the Commission of the European Communities (CEC) [10].

Table 1. Comparison of ESD (mGy) with international established reference dose values [6]

Radiograph	Projec-tion	Malaysia (1996) [6] Median Values	USA (1992) CRCPD/CDRH [7] Median values	NRPB (1986) [8] Median values	NRPB (1992) [4]	IAEA Basic Safety Standard (1996) [9]
Chest	PA	0.3	0.17	0.18	0.3	0.4
	LAT	1.2	Not given	0.99	1.5	1.5
Abdomen	AP	9.2	5.6	6.68	10	10
Pelvis/ Hip	AP	5.3	Not given	5.67	10	10
Skull	AP/PA	4.7	Not given	4.20	5	5
	LAT	3.0	1.6	2.19	3	3
Cervical Spine	AP	0.7	1.5	-	-	-
	LAT	1.5	Not given	-	-	-
Thoracic Spine	AP	6.4	Not given	-	7	7
	LAT	15.9	Not given	-	20	20
Lumbar Spine	AP	9.1	6.4	7.68	10	10
	LAT	14.0	Not given	19.7	30	30

3. Medical Radiation Usage and Exposure in Diagnostic Radiology

The medical radiation usage for diagnostic radiology (1990-1994) [11] enabled a comparison to be made for the first time with the UNSCEAR Report 2000 [12]. In 1994, the number of physicians, radiologists, x-ray units and x-ray examinations per 1000 population was 0.45, 0.005, 0.065 and 183 respectively. The increase from 1990 to 1994 for population, number of physicians and radiologists was 10%, 26%, 47% respectively. The total number of x-ray units increased from 889 in 1990 to 1270 in 1994 (43%), with an increase in the number of examinations from 2.88 million to 3.58 million (24%). The average number was estimated to increase from 162 to 183 per 1000 persons (13%). Almost all examinations experienced increasing frequency except for barium studies, cholecystography, and intravenous urography (-23%, -36%, -51%). Notable increases were observed in computed tomography (161%), cardiac procedures (190%), and mammography (240%).

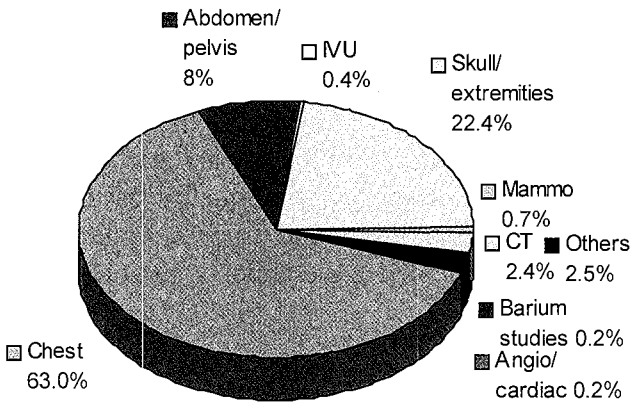

Fig. 1 Frequency of x-ray examinations in Malaysia,1994 [11]

The distribution of the types of x-ray examinations for 1994 [11] is shown in Fig 1. A total of 3.6 million x-ray examinations were performed. Chest radiography was the most frequent examination (63%); followed by skull and extremities (22.4%). On the whole plain radiography accounted for 93.4% of radiological procedures with the others e.g. CT, mammography, making up the remainder.

Table 2 shows the annual examination per capita, effective dose per examination and annual effective dose per capita for various types of x-ray examinations in 1994. The annual effective dose per capita to the population was estimated as 0.05 mSv per person and the collective dose, 1000 person-Sv [13].

Table 2. Exposure from diagnostic medical x-ray examinations in Malaysia (1994) [13]

Examination	Annual exams per capita	Effective dose per exam (mSv)	Annual effective dose per capita (mSv)
Chest	0.115 (63%)	0.03	0.0035
Skull/ extremities	0.041 (22.4%)	0.04	0.0016
Abdomen/ pelvis	0.015 (8.3%)	1.05	0.0159
Barium studies	0.0003 (0.2%)	6.0	0.002
Cholecystography	(0.01%)	1.5	0.000037
Hysterosalpingography	(0.02%)	1.36	0.00007
Angiography	(0.03%)	6.8	0.0004
Cardiac procedures	(0.13%)	6.8	0.002
Intraven. Urography	0.0006 (0.4%)	2.4	0.002
Mammography	0.001 (0.7%)	0.1	0.0001
Computed Tomography	0.004 (2.4%)	4.85	0.021
Others	0.005 (2.5%)	0.1	0.0023
Total	0.183 (100%)	0.275*	0.0503

* value is a weighted average

4. Discussion

The results of this survey provide valuable baseline data for Malaysian patient doses. Survey results arte generally compatible with those reported in the UK, USA and IAEA. Wide variations of typically range over factors between 5 and 30 for individual patient dose suggested that significant dose reductions is possible without adversely affecting image quality [6]. This survey has also led to an increased awareness amongst professionals in

diagnostic radiology in Malaysia of the need for dose management. Since the survey, faster film-screen combinations have been introduced and greater emphasis placed on quality assurance. Furthermore the data would be useful for the formulation of a national guidance dose level for incorporation in the amendments of the 1988 Malaysia Radiation Protection Regulations (Basic Safety Standard). We have also participated in an IAEA coordinated research project on 'Radiation protection and quality assurance in diagnostic radiology'. Information on medical radiation exposure and usage in Malaysia allows appropriate radiation protection measures to be implemented and diagnostic radiology standard to be improved.

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