EVALUATION OF OCCUPATIONAL DOSE FROM THE SPECIAL PROCEDURES GUIDED BY FLUOROSCOPY

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ABSTRACT

The purpose of this study was to evaluate the dose received by professional health specialists in a hemodynamic service in a university hospital in São Paulo city. It was necessary to know the profile information of these professional people, in order to carry out a survey for the occupational external dose during the years from 2000 to 2009 and to evaluate the distribution of the effective dose from the special procedures guided by fluoroscopy. A self-applied questionnaire was used to describe the background of the participants, taking into account variables such as gender, age, individual monitoring time, number of jobs and tasks performed in the sector. In addition, an examination was performed on the external individual, monitoring doses from the records of the institution. The annual doses were compared with the limits established by national regulatory authorities. The sample was composed of 38 professionals, 13 males and 25 females, with mean age of (43.0 ± 10.4) years. The average monitoring time of individuals analyzed within the institution was (11.3 ± 9.1) years, considering the period before the study (2000-2009), and 57.14% of professionals reported having more than one job. The minimum record dose level was 0.2 mSv and the maximum dose was 22.7 mSv. The data analysis showed that the physicians and nursing assistants were both more exposed to radiation, due to probably remaining closer to the examination table and X-ray tube during the interventional procedure.

Keywords: Fluoroscopy, effective dose, radiological protection.

1. Introduction

Fluoroscopy uses ionizing radiation to guide small instruments such as catheters through blood vessels or others pathways in the body. The fluoroscopy technique represents a tremendous advantage over invasive surgical procedures, because it requires only a small incision, substantially reducing the risk of infection and the recovery time is made shorter than in standard surgical procedures. These techniques are used by a large number of health care professionals in a wide range of medical positions.

Fluoroscopic procedures require the medical staff to be present in the examination room, usually close to the patient, which is the main source of exposure because of scattered radiation. For every 1000 photons reaching the patient, about 100-200 are scattered, about 20 photons reach the image detector, and the rest are absorbed by the patient [1].

The radiological risk to medical staff involved in fluoroscopic procedures of hemodynamic services is of great concern in occupational radiological protection in a hospital, because of the scattered radiation.

According to the publication of the International Commission on Radiological Protection - ICRP [2], the occupational exposure in fluoroscopy is considered higher when compared with

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occupational exposure to ionizing radiation from other radiological procedure. Therefore the medical staff that performs this type of procedure may receive dose values closer to the occupational limits established in standards [3,4].
Because of these risks, there must be a radiation protection service to implement an adequate system of protection based on national standards [3, 4] and radioprotection international recommendations [2,5]
The purpose of this study was to evaluate the dose received for the health professionals (physicians, nurses, nursing assistants and radiologic technologists) of the hemodynamic service in a university hospital in São Paulo city. It was necessary to know the profile of these professionals, to carry out a survoey of the occupational external doses for the past ten years and to evaluate the distribution of the effective dose from the special procedures guided by fluoroscopy.

2. Methodology

Several special procedures guided by fluoroscopy are performed in the hemodynamic service, such as angioplasty, cardiac catheterization, aortic endoprosthesis and renal angiography and angioplasty. Health professional are shared according to the tasks performed in different occupational categories: radiologic technologists, nursing assistants, nurses and physicians.
The voluntary participation of health professionals in this study was done by signing the consent form (CF) by them, approved by the CEP under No. 1660/09, carried out in two ways, one of the researcher and one of the participant. Collecting and analyzing data and then shared into two stages, which are described below.

Stage 1 - Profile of health professionals

A self-applied questionnaire was used to describe the profile of health professionals, taking into account variables such as gender, age, individual monitoring time, number of jobs and tasks performed in the sector.

Stage 2 – Historical Dose

An examination was performed on the external individual monitoring doses from the records of the institution database from 2000 to 2009. A total of 38 health professionals performed different tasks in the hemodynamic service with potential risk of exposure to ionizing radiation.
The monitored professionals sample of hemodynamic service, which had annual effectives doses analyzed, was composed of: 7 radiologic technologists, 12 nursing assistants, 7 nurses and 12 physicians.
In the external individual monitoring was used thermoluminescent dosimeters, TLD, composed of two crystals, one of lithium fluoride (LiF) and one of Calcium Sulfate (CaSO4), positioned in the chest region of the professional on the lead apron. For the effective dose estimation was applied a correction factor of 1/10.

3. Results and Discussion

Analyzing the information obtained through a questionnaire (stage 1), it was found that 13 health professionals were male and 25 were female, with mean age (40.2 ± 9.3) and (46, 6 ± 9.5) years, respectively. Their ages ranged between 28-63 years. The distribution of these professionals according to the age group for each gender is represented in Figure 1.

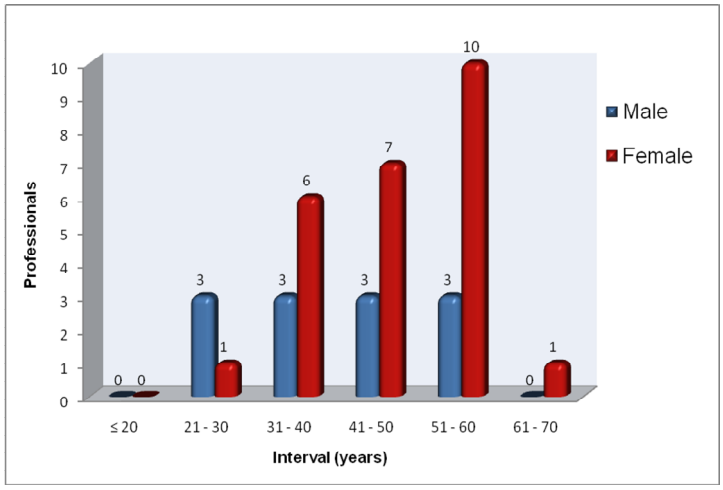

Figure 1: Distribution of health professionals by age group.

The average monitoring time of individuals analyzed within the institution was (11,3 ± 9,1) years, considering the period before the study (2000-2009), which represents staff of wide professional experience. Figure 2 shows that female professionals are also at increased monitoring time when compared to males.

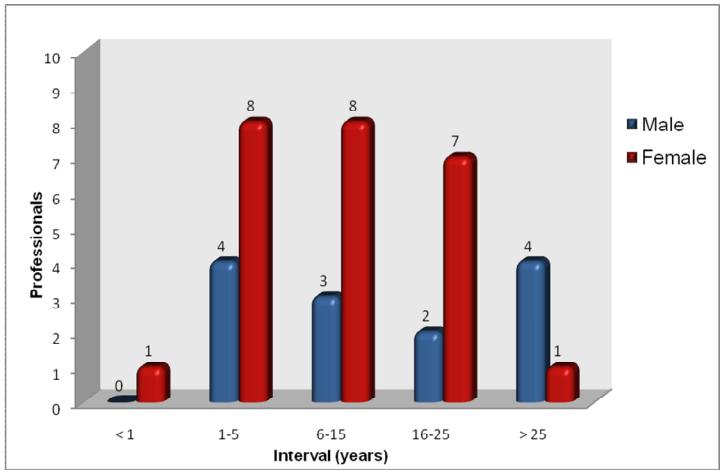

Figure 2: Monitoring time of health professionals.

Among health professionals analyzed, 57.1% reported having more than one job, and 40% of those in positions that also use ionizing radiation. This is an important factor because the work-load is directly proportional to occupational exposures. Moreover, it was verified that the professionals use different dosimeters for every job.

3.1 Analyses of the effective doses

The number of health professionals monitored, as well as their distribution according to the effective dose intervals for each year of the studied period are shown in Table 1. Over the years, the number of professionals increased by a factor of 2.33 due to increased demand for special procedures that involve the use of fluoroscopy. The dose received by health professionals, illustrated in effective dose intervals, shows that over 80% received an effective dose values lower than 5mSv/year, i.e., below the limit specified in national[3,4] and international[2,5] standards.

The highest doses recorded were 20.2 mSv for only one professional and 22.7 mSv for another professional in the years 2003 and 2008, respectively. There were no records in the database of the institution to justify these doses, but it can be attributed to the workload of the professionals. Despite having been exceeding the average annual limit of 20 mSv (weighted average of 5 consecutive years, provided they do not exceed 50 mSv in any year), none of the professionals has exceeded the annual limit of dose [3,4].

Table 1: Number of health professionals monitored and their distribution according to the effective dose intervals for each year of the studied period.

Year	Monitored Professionals	Number of monitored professional by effective dose intervals - E				
		$0 < E \leq 5$ (mSv)	$5 < E \leq 10$ (mSv)	$10 < E \leq 20$ (mSv)	$20 < E \leq 50$ (mSv)	$E > 50$ (mSv)
2000	15	14	1	0	0	0
2001	16	14	1	1	0	0
2002	19	16	3	0	0	0
2003	21	17	2	1	1	0
2004	21	15	4	2	0	0
2005	24	19	3	2	0	0
2006	24	20	3	1	0	0
2007	26	21	5	0	0	0
2008	28	26	1	0	1	0
2009	35	31	4	0	0	0

The collective doses of these professionals and the average annual individual dose, with their respective standard deviations are presented in Table 2.

Table 2: Collective dose and average annual individual dose of health professionals.

Year	Collective Dose (mSv.pessoa)	Average Individual Dose (mSv)
2000	16,9	1,1 ± 1,9
2001	36,5	2,3 ± 3,1
2002	33,6	1,8 ± 2,8
2003	56,5	2,7 ± 5,3
2004	60,5	2,9 ± 4,1
2005	57,4	2,4 ± 4,2
2006	56,4	2,4 ± 3,8
2007	46,4	1,8 ± 2,5
2008	48,5	1,7 ± 4,5
2009	55,7	1,6 ± 2,6

Noticing the behavior of collective doses presented in Table 2, it appears that the doses increased by a factor of 3.29 between 2000 and 2009, while the number of professionals monitored increased by a factor of 2.33 (Table 1). Note that the increase in the collective dose is not only related with the increasing number of professionals. The increasing demand for fluoroscopic procedures in the hemodynamic service of the hospital was also responsible for the increase in the collective dose over the years analyzed.
However, noticing the average annual individual doses, it was verified that there was not a significant increase therein, which remained practically constant with dose values close or equal to 2.4 mSv / year. This is the register level of dose [3], in other words, for dose values below or equal to it the dose is considered insignificant.

3.1.1 Effective doses by professional category
Radiologic technologists are responsible for the operation of fluoroscopic equipment. These professionals remain in the examination room only to provide support if necessary, if requested by the physician. Thus, the doses given for this professional category are consistent with this fact, remaining below the registered level over the years.
Nursing assistants received during the study period, average annual doses in the range of (1.8 ± 2.5) mSv to (6.6 ± 7.8) mSv, and the maximum annual dose received was 20.2 mSv. Although the maximum dose presents a value above the average annual limit, Figure 3 shows that the average annual doses present values below to the investigation level (6.0 mSv) [3], with the exception of 2003. This may be related to the permanence of these professionals within the examination room during the entire procedure providing support to the staff, but not so close to the patient and the X-ray tube.

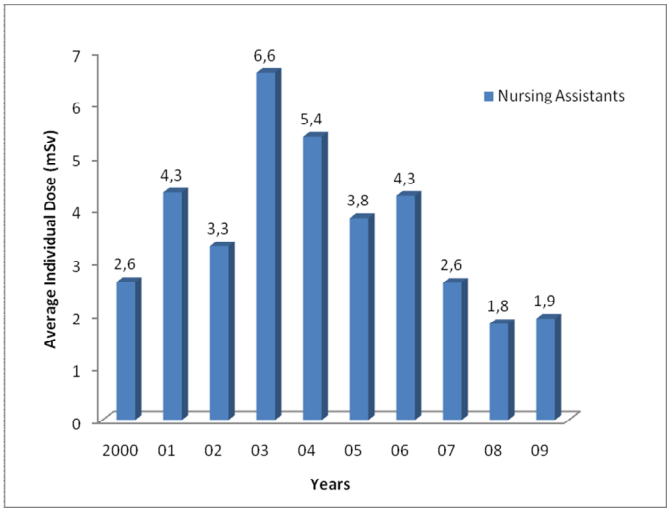

Figure 3: Average individual dose of nursing assistants.

For fluoroscopic procedures more specialized, nurses are required when attending the physician. Thus, these professionals tend to receive lower doses than the rest of the staff, except when compared with the radiologic technologists. Figure 4 shows that the average annual dose received is in the range (0.3 ± 0.5) mSv and (4.1 ± 5.1) mSv, and the maximum annual dose was 12.1 mSv.

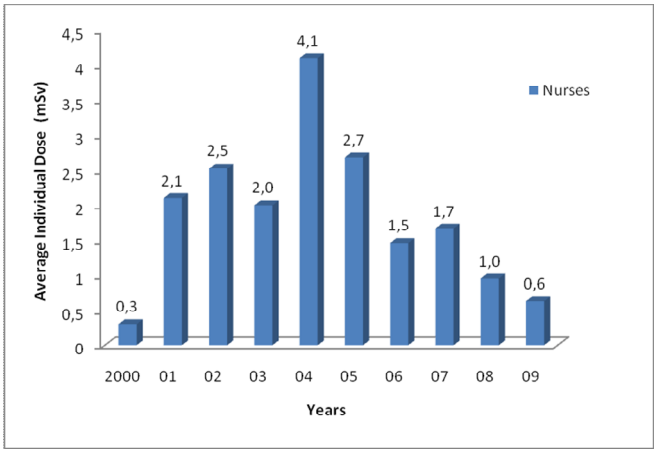

Figure 4: Average individual dose of nurses.

Physicians are professionals who remain closest to the patient and the X-ray tube for a long period of time and thus are more exposed to scattered radiation and can receive annual doses close or above to the limits established in the standards.
In Figure 5, it appears that the average annual individual doses remained below expectations, that is, below to the register level for some years, conversely the above in the preceding paragraph. The average annual individual doses received by physicians are in the range between 0 and (5.7 ± 11.4) mSv, and the maximum annual dose was 22.7 mSv.

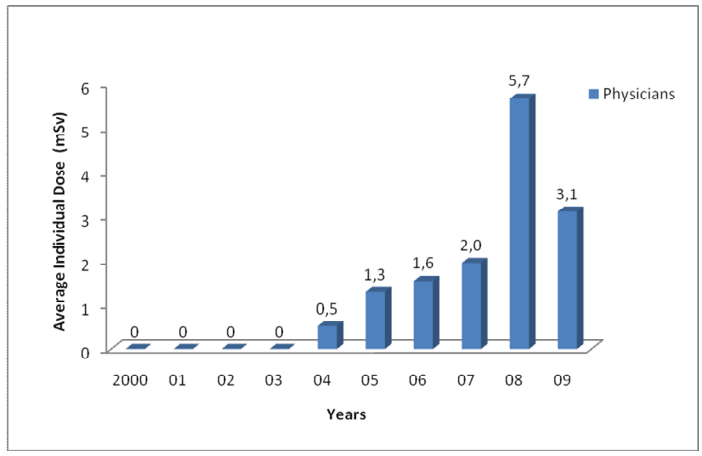

Figure 5: Average individual dose of physicians.

Figure 6 shows that the nursing assistants received higher collective doses over the years, when compared to other professionals of staff. This is because the number of nursing assistants is greater than the number of professionals from other categories.
The collective doses of physicians showed results below to the expected in the years preceding 2007, with a significant increase in the last two years of the study (2008-2009), as shown in Figure 5 and Figure 6. This suggests that the dosimeters may not have been used correctly during the procedures in this period.

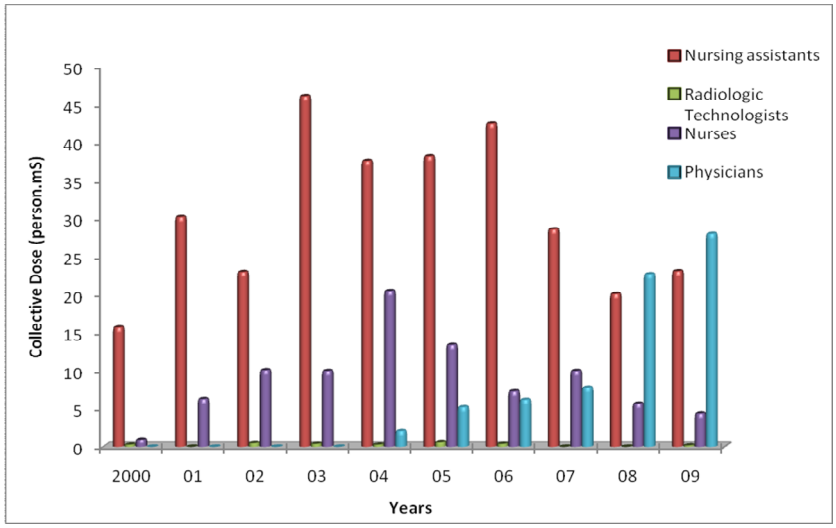

Figure 6: Collective doses by professional category.

4. Conclusion

The health professionals active in hemodynamic service of the hospital examinated were composed mostly by female professionals who also have more monitoring time when compared to male professionals.

The number of jobs is an important variable, but should take into account that the health professional cannot spend the total time of their workday performing fluoroscopic procedures. For a trust relation of the workload with the dose received by the professional is necessary to know the actual exposure time for each procedure.

During the period studied, no health professional exceeded the effective dose of 50 mSv, the maximum admissible value for the worker in a single year.

The constant training of health professionals and implementation of procedures for reducing the doses are measures that will result in adequate control of exposure to radiation. However it should be a commitment of health professionals and the institutions to which they meet the standards of safety and security, to safeguard the health of these professionals.

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