



OCCUPATIONAL EXPOSURE TO IONIZING RADIATION FROM THE PERSPECTIVE OF NURSING PROFESSIONALS IN HEMODYNAMICS

EXPOSIÇÃO OCUPACIONAL À RADIAÇÕES IONIZANTES SOB A ÓTICA DE PROFISSIONAIS DE ENFERMAGEM EM HEMODINÂMICA

EXPOSICIÓN OCUPACIONAL A RADIACIONES IONIZANTES EN LA PERSPECTIVA DE PROFESIONALES DE ENFERMERÍA EN HEMODINÁMICA

Adriana Martins Gallo¹, Fernanda Aparecida Camargo de Lima², Lúcia Margarete dos Reis³, Edivaldo Cremer⁴

In order to identify the security measures taken and the control of occupational exposure to ionizing radiation in units of hemodynamic, from the perspective of nursing, this quantitative descriptive study was developed during January and February, 2011. A check-list of binary responses (yes / no) was made based on the legislation and updated literature and it was applied in four hospitals in the northern region of Paraná State. The analysis of the data showed that 29 employees have knowledge about occupational exposure and apply barrier methods effectively to minimize doses of ionizing radiation. The data also showed that employees are participating in ongoing updating on the subject, and that they claim that this participation has a positive effect so that the occupational exposure occurs consciously, and also, the workers did not refuse to participate in any action facing their individual protection.

Descriptors: Hemodynamics; Occupational Exposure; Ionizing Radiation; Nursing.

O objetivo deste estudo foi identificar as medidas de proteção tomadas e o controle da exposição ocupacional às radiações ionizantes em unidades de serviço de hemodinâmica sob a ótica dos profissionais de enfermagem. Para o estudo descritivo quantitativo, no período de janeiro a fevereiro de 2011, foi aplicado em quatro hospitais da região norte do estado do Paraná um *check-list* de respostas binárias (sim/não), construído a partir da legislação e literatura atual. Observou-se que os 29 profissionais possuem conhecimento sobre a exposição ocupacional e aplicam métodos de barreira eficazmente para a minimização de doses frente às radiações ionizantes. Salienta-se ainda que os mesmos participam de atualizações permanentes e afirmam que este fato influencia positivamente para a exposição ocupacional ocorrer de forma consciente e ainda, sem recusa da parte dos trabalhadores no que condiz com sua proteção individual.

Descritores: Hemodinâmica; Exposição Ocupacional; Radiação Ionizante; Enfermagem.

El objetivo fue identificar las medidas de seguridad adoptadas y control de exposición a las radiaciones ionizantes en unidades de servicio de hemodinámica en la perspectiva de los profesionales de enfermería. Para el estudio descriptivo cuantitativo, de enero a febrero de 2011, se aplicó a cuatro hospitales en la región norte del Estado de Paraná una lista de control de las respuestas binarias (sí/no), construidos a partir de la legislación y la literatura. Se observó de los 29 empleados tenían conocimiento sobre la exposición ocupacional y aplicaban los métodos de barrera eficaz para reducir al mínimo las dosis de radiación ionizante. Estos participaron de actualizaciones en curso sobre el tema, y afirman que este hecho tiene efecto positivo para la exposición ocupacional ocurrir de modo consciente y, sin embargo, sin rechazo por parte de los trabajadores en relación a su protección individual.

Descritores: Hemodinámica; la exposición ocupacional; la radiación ionizante; Enfermería.

¹Master in Collective Health by Universidade Sagrado Coração. Nurse of the Hemodynamic Service in Arapongas. Apucarana, PR, Brazil. E-mail: adriana.gallo@bol.com.br

²Specialized in Cardiology nursing by Pontifícia Universidade Católica. Nurse at Hospital Evangélico de Curitiba. Curitiba, PR, Brazil. E-mail: fernandalima.1@hotmail.com

³Master's student by the Universidade Estadual de Maringá. Maringá, PR, Brazil. E-mail: luciamargarete@gmail.com

⁴ Master in Collective Health by Universidade Sagrado Coração. Professor Assistant Professor in the Sector of Health and Education of the Universidade Estadual do Norte do Paraná, Bandeirantes, PR, Brazil. E-mail: edivaldocremer@hotmail.com

INTRODUCTION

The scientific advance occurred in the 20th century was one of the landmarks which brought significant discoveries on all the fields of science and technology. This fact was also noticed for the area of diagnosis by image, especially for the Hemodynamic Services Units (HSU) and interventionist radiology, so the professional qualification, the technical responsibility for the performance of the service, the knowledge on the current legislation showed to be necessary, but above all the need of attention to specific precaution due to the exposure of the worker to ionizing radiation. Analyzing those aspects, this study aims to identify the measures of protection taken and the control of the occupational exposure to ionizing radiations in HSU, under the prism of nursing professionals.

The expectation to live longer with quality and the innovations in the area of health contributed in a positive way so that the man could distinguish what is good and what is bad, which is justified and necessary for his own life. In this scenario of discoveries and also of technological advancement it is possible to observe the mysticism related to ignorance on specific subjects. So, this must be always be fought in the name of science, in order to conceive what is better not only for the person, but for the whole society in a general way.

A great part of the exposures of persons to ionizing radiation is originated in medicine, both in the diagnosis as well as in the treatment of diseases. However, the largest number of professionals exposed to these radiations comes from radiodiagnosis, once the amount of the radiation used to produce the diagnosis information or to lead a procedure of interventionist radiology can not be reduced definitely without damaging the intended result⁽¹⁾.

Notably regarding the Hemodynamic Services Units (HSU), an increase in the amount, the type and the complexity of the interventionist procedures has

been observed, which are performed using percutaneous approach, substituting or complementing the surgical treatment which use fluoroscopic images⁽²⁾. More modern and powerful equipment have been used, so the number of health professionals working at the area grows and the number of units of hemodynamic (HSU) with diversified methods, sometimes brief and precise, thus offering less risk for the patient⁽³⁾.

Regarding the therapeutical coronary prolonged and complex procedures, they contribute in a significant way for a higher exposure to radiation, nevertheless, the planning and the adequate training can reduce the degree of exposure, once the radiological equipment have been developed and the easy access to that equipment has been widened⁽⁴⁾.

Aiming at the control of radiation in the services of health, the government established the administrative rule MS/SVS no. 453, as of June 1st 1998, that approves the technical regulation which establishes the basic guidelines of radiologic protection in medical and odontological radiodiagnosis⁽⁵⁾, and so, the control of occupational exposure is particularly important. The individual monitoring is a mechanism of control, which makes it possible to check and evaluate the doses received by the health professionals of all the health team working in the HSU^(1,6).

The hospital environment presents a diversification of health professionals and workers able to perform different activities always aiming at preserving the life of the patients, among those the nursing team has the large representativeness of personnel, and thus, it is believed to be the biggest class of health professional exposed to occupational risks

In this sense, it is important that the competences of the nurse be well defined, such as planning, coordinating, implementing and supervising the activities of the radiological protection service in order to

guarantee the fulfillment of their basic requirements, and also that the services of coordination of the nursing team reflect on the profile of the nurse they want to hire, so that their actions are according to the values, mission and vision of the organization in order to reach the target⁽⁷⁻⁹⁾.

METHOD

A qualitative descriptive study was made in four distinct HSU units, outsourced to the public net of health services, located in the northern region of the state of Paraná, two of them are in the county of Londrina, one in the county of Arapongas and one in the county of Umuarama. The development happened after the formal authorization of the administrative directors of the companies. The four HSU are located within hospital units and the procedures called hemodynamic studies are made in them and those procedures emit ionizing radiation. The criterion of choice of these units happened due to the fact that they are located in counties that help patients coming from several regions of the state of the Paraná and consequently they make a high number of hemodynamic procedures involving health professionals directly linked to the irradiated rooms.

The data collection was made in January and February, 2011. The instrument of collection, of binary answers (YES/NOT) was made up from resolutions, publications on the theme, legal precepts of the National Nuclear Energy Commission (NNEC) and the current legislation^(1,5,7,10-11).

The instrument of data collection was divided into three parts, having as objective the identification of measures of control adopted by the radiological protection of the service under the responsibility of the employer:

- a) The first one of demographic matters and Professional profile, applied to supervising nurses and nursing technicians;
- b) The second one on the measures of control to the exposure of ionizing radiation adopted in a practical way by the technical professionals who work in the examination rooms;
- c) The third one on the administrative and supervision matters according to what the legislation proposes to the supervisors of radiological protection, that is the nurses.

In accordance to the ethic rules, the project passed through the Committee of Ethics in Research of the Universidade Sagrado Coração – USC from Bauru, SP, and was approved under protocol no. 171/10. All the persons were approached so that they could show or not their interest of participating in the project, the objective of the study was explained, presentations, and request of signature on the Informed Consent Form (ICF).

The data were compiled in an electronic chart using *Microsoft Office Excel 10.0* software, and further, the data processing and analysis were made, through absolute and relative frequency and the results were presented in charts.

RESULTS

A total of 29 (100%) health professionals participated in the study, 25 of those are working in auxiliary functions, nurse technicians and four of them are nurses who perform the function of supervisors. The sampling was composed of workers who accepted the participation in the study. There was no refusal, so, 100% of the workers of the four companies participated.

A little more than half of the interviewees (17 – 58.6%) are women with a predominant age range between 21 and 30 years (15 – 51.7%) and most of them (20 – 69%) considered themselves white. Regarding to their education, most of them are

technicians (22 – 75.9 %), graduated for more than 5 years (16 – 55.4%) according to Table 1.

Table 1 – Distribution of the sample regarding social demographic characteristics. Londrina, Arapongas and Umuarama, PR, Brazil, 2011

Variables	N	%
Gender		
Male	12	41,4
Female	17	58,6
Age		
21-30 years	15	51,7
31-40 years	11	38,0
41-50 years	2	6,9
Above 51 years	1	3,4
Race		
White	20	69
Black	7	24
Dark	2	7
Education		
Auxiliary	1	3,4
Technician	22	75,9
Graduated	6	20,7
Time of Graduation		
Less than 1 year	1	3,4
Between 1 and 2 years	7	24,0
Between 3 and 4 years	5	17,2
More than 5 years	16	55,4
Subject in Radiation in the Course		
Yes	5	17,2
No	24	82,8

Table 2 presents data referring to the labor characteristics of the health professionals and 11 (37.9%) have been working for more than 5 years, that is they are considered experienced, professionals in the post held. Previous experience is not required by the four services once 26 of them (89.7%) had had no previous experience before starting their activities in this job. All the health professionals work in only one HSU and only one of them works in more than one job which provides radiodiagnosis attendance, but it

is not an HSU but another type of work in diagnosis by images.

The working day of the nursing professionals is distributed in a varied way, more than half (16 – 55.2%) are on duty six daily hours from Mondays to Fridays besides twelve more hours on the weekends. The work is made in shifts and the exposure to radiation is controlled so that it occurs between four to five hours a day (12 – 41.4%).

Table 2 – Distribution of the sample regarding labor characteristics. Londrina, Arapongas and Umuarama, PR, Brazil, 2011

Variables	N	%
Current experience in Hemodynamics		
Up to 6 months	4	13,8
From 7 months to 1 year	2	6,9
From 1 to 2 years	8	27,6
From 3 to 4 years	4	13,8
More than 5 years	11	37,9
Previous experience in Hemodynamics		
Yes	3	10,3
No	26	89,7
Working in only one Hemodynamics		
Yes	29	100,0
Working in another radiodiagnosis		
Yes	1	3,4
No	28	96,6
Working Hours		
6 hours a day + on duty for 12 hours	16	55,2
8h48m from Mondays to Fridays	13	44,8
Hours a day exposure to radiation		
Less than 1 hour	4	13,8
From 2 to 3 hours	5	17,2
From 4 to 5 hours	12	41,4
From 6 to 7 hours	8	27,6
Average of exams made a month		
51-100 exams	4	13,8
101-200 exams	17	58,6
201 to 300 exams	8	27,6

The specific questionnaire on the measures of occupation of control was applied to 25 health professionals who work in exam rooms (25 - 100%), the supervising nurses were excluded. The sample for the variables specified in Chart 3 is of de 25 participants (25 - 100%) and the biggest concern of the health professionals is turned to the use of lead apron (25 - 100%), thyroid protector lead (88%) and the use of dosimeter (25 - 100%). The lead aprons which protect the front and the back of the body cover a total of 84%.

Related to the dimensioning of the personnel, there is a schedule of shifts based on the working hours

an in the exposure to x-rays in the four services analyzed (24 - 96%), most (88%) of the health professional have access to the monthly reading of the dosimeters, which are mostly (84%) used on the lead apron.

Some workers, four (16%) and one (4%), use dosimeter of the collar area and extremities, respectively. The use of lead gloves, the use of dosimeters in the waist area under the lead apron and the use of dosimeter in the forehead area have not be mentioned by any of the health professionals inquired.

Table 3 – Frequency of the measures of operational control and knowledge of the nursing team. Londrina, Arapongas and Umuarama, PR Brazil, 2011

Variables	Yes	%
Use of lead apron	25	100
Use of dosimeters	25	100
Schedule of shifts based on the working hours and exposure to x-rays	24	96
Use of lead protectors of thyroid	22	88
Signature and knowledge and acceptance of the health Professional in the reading of the dosimeters	22	88
Covering of the lead apron in the front and back parts	21	84
Use of dosimeters in the area of the trunk on the lead apron	21	84
Keeping the body, as much as possible, during the exam, the farthest from the primary beams of x-rays	18	72
Keeping the hands, as much as possible, during the exam, the farthest from the primary beams of x-rays	18	72
Exchange of information with supervisor of the health professionals Who work in more than service of radiodiagnosis in order to minimize this worker to the exposure of the x-rays	12	48
Use of lead glasses	10	40
Use of dosimeters in the area of the trunk under the lead apron	4	16
Use of dosimeters in the area of the collar on the lead apron	4	16
Use of dosimeters or extremity (bracelet or ring)	1	4

In Table 4 the concerns of the nursing team regarding the patient and the available means in the services to help minimize the exposure to ionizing radiation and his risks were noticed.

The four companies comply with the requirements (100%) of the use of dosimeters by the health professionals; it is the way of having monthly control of the radiation doses received by the workers. In 80% of the situations, the supervising nurses check the correct use of the dosimeters by the health professionals and report any irregularities to the administrative head of the company, in written.

It was found that in the four services during the user's absence, his dosimeter is stored with the standard dosimeter, which is an exemplary dosimetry kept in a place away from sources of radiation and serves as reference source.

About the periodic examinations, 23 (92%) of the interviewees said that the company annually forwards them to the laboratory tests of control, this procedure being complementary to individual monitoring program, apart from those periodic examinations ordered by the physician work clinic health worker.

On the information provided to patients about the dose of radiation emitted during the procedure, 44% stated that they communicate to patients that they will receive x-rays and even 56%, questioned women about the possibility of pregnancy at the time of initial treatment, that is, in the waiting room, moments before entering the room radiated.

Ten (40%) of professionals, reported that there is a manual service in the form of Standard Operating Procedure (SOP), which describes the standardization of all activities, including the activity inside the examination

room and the precautions that professionals should taken facing the exposure to ionizing radiation.

Table 4 – Concerns and precautions of the nursing team. Londrina, Arapongas e Umuarama, PR, Brazil, 2011

Variables	Sim	%
Obligation on the part of the company's use of dosimeters	25	100,0
Storage of dosimeters together with the standard dosimeter	25	100,0
Register in NNEC of the lab that makes the record and monthly reading	25	100,0
Replacement and / or complementation of periodic examinations of professionals to monitor health	23	92,0
Submission of a worker to a program of health control based on the general principles of occupational health	22	88,0
Inspecting supervisors about the use of dosimeters	20	80,0
Formal completion of the question "Are you pregnant or suspect?"	14	56,0
Informing the patient about the dose received in exams	11	44,0
Existence of SOP manual describing the activity that involves radiation and the precautions that should be taken against the employee exposure	10	40,0

DISCUSSION

When the approach is made with nursing professionals, there is a tendency to find female professionals, however, along the time, the professional profile of nurses has been adapting to the reality and the need for men and women, and prejudice has been ignored as men are entering colleges and the job market and showing ability to develop activities that were hitherto considered indistinct to them⁽¹²⁾.

In regard to training, most are professionals with technical level, graduated for more than five years. Professionals who completed the course less than two years ago claimed to have studied disciplines covering radiation protection in radiodiagnosis, which was not present in the curriculum so far.

The time of work showed the professional experience in nursing team. Since this is a specific area and in need of experienced people, radiology units encourage their professionals to graduate and then incorporate as nurses to complete their undergraduate degree in nursing⁽⁸⁾. Note also that the mid-level professionals must perform nursing actions to clients

undergoing ionizing radiation under the supervision of a nurse⁽¹⁰⁾ that according to the administrative rule MS / SVS no. 453, of June 1st 1998⁽⁵⁾ has already graduated at the university, with knowledge, training and experience in radiation physics and radiation protection in the diagnostic radiology area, designated by the head of the service to take specific tasks within its competence.

One of the crucial points, considered as an indicator of essential performance for the health services is the sizing of staff⁽¹³⁾. There are limits of daily exposure to ionizing radiation recommended by NNEC⁽⁷⁾ and in this sense, it is important that the sizing of the staff is planned and analyzed.

The dosimeter, also called individual monitor, must be used by the professional when exposed to radiation, it is used to measure the effective dose received by the worker, it is used in the area of the trunk which is more exposed and should be replaced monthly⁽⁴⁾.

Particular attention devoted to the preparation of the work schedule with limited time and exposure to

ionizing radiation. This study was perceived by the document evidencing monthly reading dosimeters, that is, each employee had their time of radiation exposure within the borderline of effective doses established by law⁽⁵⁾.

In a program of occupational monitoring, the points of greatest concern for workers exposed are: working hours, staff training, periodic training, personal dosimetry and routine medical examinations⁽⁶⁾.

The specific questionnaire regarding occupational control measures was applied to the 25 technical professionals, who work directly exposed to radiation, which is inside the examination room, thus excluding nursing supervisors.

A major concern of professionals is directed to the use of lead aprons, thyroid lead protectors and use of dosimetry, which portrays, as well as other findings⁽¹⁴⁾ low resistance from professionals regarding the use of equipment for their safety, hence the adoption of control measures.

The adhesion to the use of lead apron covering the front and back of the body is contrasted to what was found in the literature⁽⁴⁾, that is, resistance of the technical professionals, justified on account of the weight, which creates discomfort after backache periods of use of this garment.

Regarding the existence of schedules of shift based on working hours and exposure to x-rays in the four services examined, the concern about exposing minimally the professionals and also comply with the standards set out in existing publications was highlighted^(5,15). The rates of radiation exposure are checked monthly by professionals after being examined by a company responsible for dosimetry, and it is emphasized that most know the maximum doses prescribed by the National Nuclear Energy Commission (NNEC)⁽⁷⁾.

The professionals' knowledge also extends to the correct use of lead apron and positioning of the

dosimeter on the apron as established by administrative rule no. 453/98⁽⁵⁾. Thus, in the analysis of monthly dosimeters, a correction factor of 1/10 to estimate the effective dose received by the user under the apron is used.

The use of lead gloves was not found in any of the four services. This absence of lead gloves is justified due to the non mobility they provide. Similar results were found in the literature⁽¹⁾, once the lead gloves are thicker than surgical gloves and can jeopardize the quality of hemodynamic procedures.

The worker in the area of health knows the risks to his health in a superficial way, often come from everyday practice and not from continuing education or that there is an occupational health service within the institutions⁽⁹⁾. This contributes to the fact that knowledge is not enough to transform into safe actions of prevention of accidents and occupational diseases. Likewise, the present study highlights that the acting professional in the HSU knows the potential risks they may be exposed to when not using their protection instruments of work properly, but these do not cause them to assume a defensive and preventive posture. It is the responsibility of employers to establish mechanisms to facilitate the exchange of information and cooperation among all the interested parts regarding radiological protection and also the optimization of radiation protection, always following the safety recommendations^(7,16).

The recommendation to store the dosimeter together with the standard sample⁽⁵⁾ was effectively accomplished by professionals, in addition, the laboratory performing the reading and calculation of radiation doses is registered with the NNEC⁽⁷⁾ and every month workers have access to the amount of individual doses received, and in case of disagreement, they may resort to the supervisors, posts given to graduated nurses in the four HSUs⁽¹⁰⁾.

Periodic examinations do not replace the annual examinations necessary to ascertain the health of individuals occupationally exposed⁽⁵⁾ and to monitor health-related radiation exposure tests that are performed apart from that routine occupational health.

The study showed that few workers are those who care to question about a possible pregnancy, which draws attention to the need for action by supervisors because the nursing team that acts in HSU requires specific skills and expertise, always identifying risks to their health and also the patients⁽¹⁴⁾.

All activities / procedures that involve ionizing radiation, as well as the routines of nursing should be documented in manual routine called Standard Operating Procedure (SOP) and is the responsibility of the nurse to formulate and implement operational technical manuals for nursing team in the various sectors of activity⁽¹⁰⁾, it was checked with the supervisors of four HSUs about the existence of these manuals, but there are other professionals that do not have full access to them. The technical manuals serve to minimize different forms of professional conduct both for university professionals as well as technical professionals, and when they are standardized they reflect an organized way to contemplate the whole process of nursing, pushing the organizations for the development of the improvement of their processes and consequently their results^(14,17).

Despite its importance for clinical practice and its potential risk to users, services that involve ionizing radiation such as hemodynamic are still poorly studied, mainly from the perspective of nursing, particularly in Brazil and Latin America, however, there is an important international production of evaluation of programs of guarantee of quality in radiotherapy and radiodiagnosis focused in the aspect of exclusively medical procedures.

CONCLUSION

The profile of nurses working in the HSU demonstrated that there is homogeneity between some characteristics: most are young and as they entered the units, they did not have experience in this area, however today most have more than five years in average. Professional training was held within the HSU along the time of work of each one, and it was firstly stimulated the knowledge of the theory, subsequent of the assistential practices with the patients.

From the perspective of the employees of HSU, it is common for them to know most of the occupational risks existing there, since the risk exposure to ionizing radiation were focused as study object. Regarding the measures of safety and security, it was observed that workers, in most cases, restrain to the measures related to ergonomic and biological risks in the detriment of the others.

It was noticed that the protective measures and control of occupational exposure to ionizing radiation have been described by professionals as primordial, especially on measures of barrier that must be adopted by each such use of protective lead and knowledge to the monthly report of the dosimeter. No refusals were identified on the part of professionals as to the use of personal protective equipment, especially those related to radiation protection.

It is also reported that the control measures in existing equipment as quality assurance and occupational exposure, are present in all four services examined, some are performed biannually and others every four years, as it is required by existing ordinances and also the NNEC. This contributes for the professionals do not have any doubts regarding the work environment, thus contributing for the security of their occupational health. However, during periodical training the supervisor requires their attention to the

concern of exposure of patients as well, even those who receive minimal doses during the procedure.

The professionals' knowledge about the risks they are exposed to and also the measures of control to this exposure is a primordial importance not only for the

company but for themselves, for there is no evidence of doubts regarding the work process and its consequences and it is claimed that there is no support for safe work within the context of ionizing radiation.

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