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RADIATION LEAKAGES FROM PEDIATRIC RADIOLOGY UNITS

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RESUMO. *Fuga de radiação de unidades de radiologia pediátrica.* Em radiologia pediátrica, é necessário que uma pessoa segure os pacientes durante a exposição, já que os pacientes são crianças e recém-nascidos. Portanto, torna-se importante uma apropriada determinação e minimização da radiação de fuga das unidades de radiodiagnóstico.

Fez-se medidas de radiação de fugas em cinco unidades de raios X, sendo quatro unidades produzidas pela mesma companhia. Três das quatro unidades produzidas pela mesma companhia apresentaram uma contribuição anormal da radiação de fuga. Discute-se a não-adequação dos atuais cabeçotes para radiologia pediátrica e apresenta-se sugestões para um novo enfoque em radiação pediátrica.

ABSTRACT. In pediatric radiology, it is necessary that a person stay with the patients, as they are children and newly born, during radiation exposure. Therefore, the proper evaluation and minimization of radiation leakage from radiodiagnostic units becomes important. Measurements of leakage radiation were carried out in five X-ray units, where four of which are manufactured by the same company. Three of the four units produced by the same company, showed an abnormal contribution of the leakage radiation. The inadequacy of the presently available housing tubes for pediatric radiology is discussed. Suggestions regarding new approach in pediatric radiology are presented.

INTRODUCTION

The principal objective of medical radiation protection is to ensure that the dose received by any individual, other than the patient, does not exceed the applicable maximum permissible level. To achieve this objective, many methods have been recommended; namely, by providing sufficient distance between the individual and the source of radiation, limiting the time of exposure, interposing a barrier between the individual and the source of radiation. It is especially recommended that the operator should not personally hold the patient during radiation exposure as the patient is the source of intense secondary radiation.

In some fields of X-ray diagnosis, such as pediatric radiology, neuroradiology, vascular and cardiovascular radiology, it is not possible for the radiologists or the technicians to stay at a convenient distance from the patient or the source of radiation.

Concerning pediatric radiology, the following conditions prevail:

1. Pediatric radiology, in most instances, is performed in children's hospitals where the patients stay mostly without their parents and relatives.

2. During some radiological examinations, where contrasts are used, it is necessary for the radiologist and/or technician to stay close to the patient for administrating or injecting contrast under fluoroscopic control and simultaneously taking X-ray pictures.

3. The existing regulations do not allow the nurses and auxiliary personnel from the wards to stay with the patient during X-ray examination.

4. In pediatric radiological offices, where the patients come with their parents, sometimes the mother is pregnant or in doubt about her pregnancy, thus, makes it impossible for her to stay with the children during X-ray exposure.

5. Modern pediatric radiological apparatuses are equiped with cradles for holding the children with tapes and belts. These can create high risks for small children because they require that the child, especially in the regions of head and abdomen, be firmly tight against the rigid cradle which causes pain and trauma to the child. It is because, if the belts are loosely tight, the child can move inside the cradle by pushing with arms and legs and thus create a bad position for radiography. In daily routine work, restraining small children with a cradle is almost impossible even with accepting the risk involved. Therefore, it is necessary that at least one person (radiologist, technician, or one of the parents) will stay and watch and hold the child during the radiological exposure.

In regards to holding the child in the cradle, the other points need also to be considered. In hospitals, the pediatric patients usually are not in good physical condition in respect to their respiratory tract and abdominal distension, thus belt contraction could cause them problems. The psychological and emotional trauma, that the child under tight straps may be exposed, also need to be considered. From a practical point of view, in pediatric departments, where a great number of examinations are performed daily, the use of cradles become impractical. Therefore, since a person needs to stay with the pediatric patient in the radiological room during radiation exposure, it is important to evaluate and minimize the amount of secondary and leakage radiation that he receives during the exposure.

THE MEASUREMENTS

The leakage measurements were made on five different pediatric radiology units. The measurements have been obtained with the collimator windows completely shielded with 10 HVL of lead, using a Babyline-Nardeux Model 31 ionization chamber. The readings, which are presented in Tables I and II, have been corrected by the time constant of the instruments. The units 1, 2 and 3 were located in a different institution than the units 4 and 5. The units 2, 4, and 5 were alike, and units 2, 3, 4 and 5 were manufactured by the same company.

DISCUSSIONS AND RECOMMENDATIONS

The design of protective tube housing of the diagnostic radiology units are governed by the following recommendations:

Report No. 26 of the National Council on Radiation Protection and Measurements (NCRP) (1) recommends that "the leakage radiation at a distance of 1 m from the target cannot exceed 100 mR in 1 hour when the tube is operated at any of its specified ratings". The report No. 34 of NCRP (2) recommends that "the leakage radiation measured at a distance of 1 m from the source cannot exceed 100 mR in 1 hour when the tube is operated at its maximum continuous current for the maximum rated tube potencial".

The results of the measurements, presented in Table II, show that all the units under study conform with the recommendation of NCRP-34, since the tubes are functioning with lower currents. The results of leakage measurements, made under pediatric operational conditions, which are presented in Table I, show that the units 2, 4 and 5 violate the more stringent recommendation of NCRP-26.

As in the pediatric radiology, the radiologists and technicians must, in most cases, stay with the pa-

TABLE I — Radiation leakages from radiology units operating under routine experimental conditions.

Unit	*Operational Conditions*			*Leakage exposure rate mR/hr*		
	KVP	*mA*	*mA Sec*	*Right Side*	*Front*	*Left Side*
1	70	100	400	1.6	1.1	2.7
2	150	100	80	1530	1960	650
3	90	30	27	100	200	50
4	150	400	152	–	750	–
5	125	160	544	–	600	–

TABLE II — Radiation leakage from radiology units operating under continuous conditions.

Unit	*Operational Conditions*		*Leakage exposure rate mR/hr*		
	KVP	*mA*	*Right Side*	*Front*	*Left Side*
1	–	–	–	–	–
2	117	4	21	63	52
3	–	–	–	–	–
4	–	–	–	–	–
5	110	3	–	60	–

tients during the exposure; we recommend that the pediatric radiology units be designed in accordance to the recommendation of NCRP-26. We would like even go further by stating that most of the presently available pediatric radiology equipments, which are of telecomand type, are not suitable for the pediatric work, and the manufacturing industry must be encoraged to develop new equipments which can be well adopted to the requirements of pediatric radiology.

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O cientista não estuda a natureza porque ela é útil; estuda-a porque se delicia com isso, e ele se delicia porque ela é bela (...) a beleza intelectual é por si mesma suficiente, e é por sua causa, mais talvez do que pelo bem futuro da humanidade, que o cientista se dedica a longos e difíceis labores. É, pois, a busca dessa especial beleza, o sentido da harmonia do cosmo, que nos faz escolher os fatos mais capazes de contribuir para essa harmonia, da mesma forma que o artista escolhe dentre os aspectos de seu modelo aqueles que aperfeiçoam o quadro e lhe dão caráter e vida.

Henri Poincaré.