LIFETIME DOSE OF PERSONS WORKING IN RADIOGYNAECOLOGICAL DEPARTMENTS

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1. INTRODUCTION

Ever since 1936 when the National Oncological Institute opened its gates radiogynaecological treatments have been systematically carried on, meaning severe radiation loading for persons working in the field. As a result of the very favourable recovery, radium therapy continued in many institutions of Hungary further on, we decided the determination of lifetime dose values of persons who actually worked in this special field for 40 years by means of the high amount of radioprotection measuring data, available. Since, in the course of the past ten years, ICRP has, on several occasions significantly decreased the maximum permissible dose values and in this sense we developed ever newer, more efficient radioprotective equipments, the lifetime doses were determined by summing partial values, evaluated for each period of time. Apart from this, we examined how data of film-dosimeters carried on at cardiac regions, as well as integral dose values calculated on whole-body, demonstrate the ever better efficiency of our radioprotective equipments in the various periods.

2. PHASES OF THE DEVELOPMENT OF OUR RADIOPROTECTION

From the point of view of the radioprotective equipments development of the radium operating theatre, three phases can be distinguished as follows:

1) From 1936 to 1947, the radioprotective armamentarium of a gynaecological department consisted only of a wall-storage and a simple lead-shielded working table with forceps and pincers.

2) From 1947 to 1957, after the preparation of the patient a 6 cm thick, railed lead-shield was pulled in between the sitting physician and patient on one hand and a lead-wall with 12 cm thickness was built in front of the surgent's assistent on the other, from which radium tubes were lifted out only in the last moment (1).

3) From 1957 to 1976, there was built a 10 cm thick, rolling lead-shield between the assistent and patient, moreover, the lead-shielded working table was developed by a surmounted, even head protecting lead-shield with a double mirror-system, automatic washing apparatus, sterilizer and a railed, radioprotected delivery truck serving for the delivery of sterile tubes in the operating theatre. Finally, a special lead-shielded truck was constructed for radioprotected carrying of radium tubes back from the sick ward.

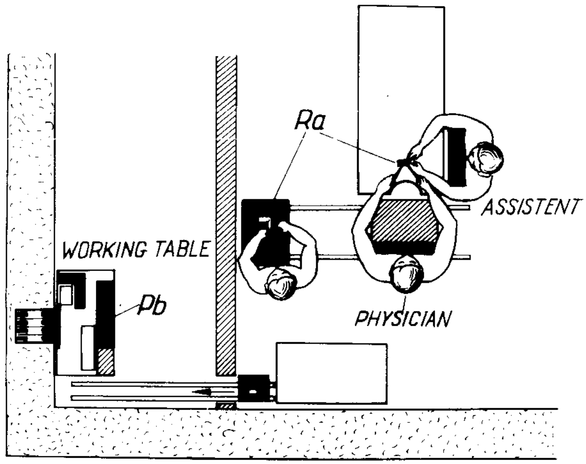

Figure 1. Lead-shield pullable in between the physician and the patient, assistant and the patient, lead-well, radium delivery truck and radium working table

3. THE DETERMINATION OF LIFETIME AND INTEGRAL DOSES

The dose loading of workers performing duties in the fourth most severa radiation loading place of the gynaecological department was measured in the three periods, several times by film-dosimeters placed on various parts of the body.

3.1 Dosimeter-data on cardiac region

Since 6-9 pcs of 10 mCi radium tubes were inserted a patient and the time of insertion alternated from 1,5 to 10 min. according to cases, we calculated the average values on 1 Ci radium and on an average insertion time.

	PERIOD			Lifetime dose	
	I.	II.	III.	1936-76	1957-97
Physician	7,5R/year	1 R/year	1 R/year	102 R	40 R
Surgeon's assist.	21 "	5 "	4 "	350 R	160 R
Assistent	31 "	28 "	0,6 "	600 R	25 R
Carrier of patients	8 "	8 "	8 "	300 R	300 R

TABLE 1 Average annual doses and lifetime doses in four most exposed working spheres

In Table 1 we demonstrate the R/year values referring to the three subsequent periods calculated on the personal dosimeters data on cardiac region and lifetime dose values determined with respect to the past 40 years. As for physicians, two in the first period and three in the second and third period, resp. effected insertion for 3 months in regular turns, thus values of the Table indicate the physicians. In the other three working spheres personal turns were irregular, consequently values in the Table are calculated on the total, annual 100 Ci radium, disregarding the number of persons who received it. In the last column of the Table extrapolated values are figuring according to the data of the third period which, according to the improved radioprotective conditions are significantly lower than the data relating to the past 40 years figuring in the previous column. The only exception here is the hospital attendant whose case the dose cannot be lowered but by means of a personal change only. There are 50 persons altogether at the department working in 4 shifts. The distribution of 12 most exposed persons' annual dose-loading in the course of 8 years, that is between 1967 and 1974, is demonstrated in Table 2. From among 12 persons, there is a physician working for 40 years and 2 physicians working for 29 years at the same working sphere. Lifetime dose on these persons, as well as others working in other departments of the Institute for 40 years is indicated in Table 3.

mR/year	cases
0,25 - 0,5	35
0,5 - 1	22
1 - 2	21
2 - 3	10
3 - 4	4
4 - 5	4

TABLE 2 Average annual dose-distribution at 12 most loaded workers between 1967 and 1974

Profession	Department	Work-time	Lifetime dose
Physic.1.	Gynaecologic.	40 years	102 R
Physic.2.	"	29 "	36
Physic.3.	"	29 "	32
Surg.assist.	"	30 "	140
Physic.4.	Radiologic.	40 "	25
Physic.5.	"	40 "	38
Physicist 1.	Physical	40 "	80
Physicist 2.	"	40 "	30

TABLE 3 Lifetime doses at eight most oldest workers of the Institute

3.2 Comparison between cardiac region and integral doses

For the sake of efficiency establishment of recently developed radioprotective equipments we made some measuring during the working process of the same persons (inserting 1 Ci radium), either at the cardiac region or at further 10 points of the body for the determination of the integral dose. Measuring results and the integral dose values obtained under different working conditions in three periods are figuring in Table 4. Integral doses have been calculated partly according to the Mayneord-formula, partly on other methods.

	1936-46		1947-57		1958-76	
	mR/Ci	gR/Ci	mR/Ci	gR/Ci	mR/Ci	gR/Ci
Physician	100	7,800	10	2,800	10	2,600
Surgeon's assist.	150	14,000	35	6,800	30	6,800
Assistent	300	12,800	280	11,300	6	6,100
Carrier of pats.	80	11,600	80	11,000	80	11,000

TABLE 4 Doses relating to inserting of 1 Ci radium and integral doses in the three phases of the development of radioprotective equipments

On this manner (Fig.2) the effect of the lead-shield to be placed in front of the physicial can be determined either on the cardiac region or in the integral dose.

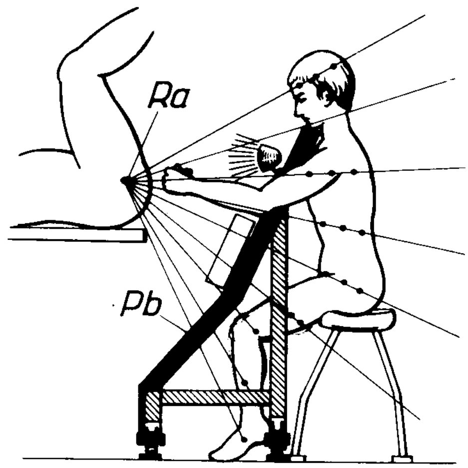

Figure 2 Physicial protecting lead-shield with projecting lines necessary for the calculation of integral doses

4. CONCLUSIONS

4.1 It can be stated that the gynaecological radioprotection equipment fitted to Mutscheller-tolerance-dose valid 40 years ago can be developed further on, even meeting the present maximum permissible dose values and requirement. Equipments we developed are mounted in any national gynaecological radium department.

4.2 In order to lower the workers' radiation loading to a significantly less maximum permissible dose value, expressed by recent literature data as very desirable, it is advisable to effect a regular turn in most of the exposed working spheres.

4.3 It was established that a physician in the third period is exposed to ten-times less cardiac region dose than in the first period, nevertheless, his integral dose becomes only three-times lower. In case of the assistent the cardiac range dose becomes 50-times lower depending on the fact that her dosimeter and most part of her body get into the shadow of the lead-shield, however, her integral dose lowers to its half only, while, on the other hand the integral dose lowering at the surgeon's assistant is double under five-times cardiac region dose lowering.

4.4 The same dose, therefore, shown by a dosimeter belonging to the same person may involve integral doses of various orders of magnitude that possible significantly influence the biological damage. For this reason, we suggest that in some cases when personal dosimeter data approach the maximum permissible values, e.g. reach the half of it, the evaluable integral dose value, when concluding things to be done that is at the real estimation of the effective damage, should be taken into consideration. It is very probably that the idea of the integral dose is not the only proper one for the judgement of the biological damage, however, the information it renders is, by all means, more rich than that of given by the personal dosimeter. Their interdependence involves further, closer investigation.