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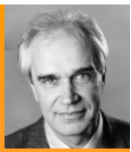

ESTIMATION OF THE EFFECTIVE DOSE TO THE PERSONNEL IN DIAGNOSTIC RADIOLOGY FROM UNDER-APRON AND OVER-APRON MEASUREMENTS

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1. UNDERESTIMATION OF THE EFFECTIVE DOSE

In diagnostic radiology where the personnel usually wears lead aprons the individual monitoring of external exposure [personal dose equivalent $H_p(10)$] is frequently performed based on personal dosimeters worn on the body below the lead apron. Because this location normally represents the most protected area of the body the effective dose is underestimated in most cases.

2. NEW CONCEPTS

A simple solution would be a measurement in front of the apron, but in this way the effective dose would be considerably overestimated. Therefore a general approach with single dosimeter measurements assumes an algorithm with the reading either divided by (over-apron case) or multiplied (under-apron case) with a certain correction factor. The combination of one dosimeter worn below the apron and another one above the apron allows to determine the effective dose more accurately. In this "double dosimetry" concept the resulting effective dose can be validly estimated by a linear combination of both measurements.

3. ALGORITHMS FOR DIFFERENT CASES

Coefficients for the one-dosimeter and two-dosimeter situations are derived using organ dose conversion coefficients according to ICRP 103 [1]. The recent recommendations of the ICRP 103 emphasize the contribution of the head and neck region to the effective dose E.

For <u>single dosimeter readings</u> (apron 0.5 mm Pb, with {without} thyroid protection):

$E = 2.0\ \{3.0\} \times H_{p,c,u}$ Dosimeter in the anterior thoracic region ($H_{p,c,u}$) (chest underneath the protective apron)

$E = H_{p,n,o}/11.3\ \{7.0\}$ Dosimeter on the front area ($H_{p,n,o}$) of the neck over of the protective garment

For <u>double dosimetry</u>:

$E = 0.84\ H_{p,c,u}(10) + 0.051\ H_{p,n,o}(10)$ with thyroid protection
$E = 0.79\ H_{p,c,u}(10) + 0.100\ H_{p,n,o}(10)$ without thyroid protection

4. SUMMARY

In a radiological department for one year over-apron personal dosimetry was performed instead of the under-apron measurement as usual in Germany. The effective dose of the personnel was determined with the correction factors derived. The over-apron dosimetry provides a better measure of effective dose (Tab. 1) and further advantages (Tab. 2).

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Fig.1: Estimation the effective dose E from single dosimeter measurements assumes an algorithm with the reading either divided by (over-apron case) or multiplied (under-apron case) with a certain correction factor.

"under apron" (2009)			"over apron" (2010)		
Dose E [mSv]	Number	Per-cent	Dose E [mSv]	Number	Per-cent
E = 0	29	91 %	E = 0	19	54 %
0 < E ≤ 0,2	3	9 %	0 < E ≤ 0.2	13	37 %
0.2 < E ≤ 0.4		0	0.2 < E ≤ 0.4	1	3 %
0.4 < E ≤ 0.6		0	0.4 < E ≤ 0.6	1	3 %
1 < E ≤ 2		0	1 < E ≤ 2	1	3 %

Tab 1: Eff. dose E based on different methods of measurement

Problem	Dosimeter under apron	Dosimeter over apron
Estimation of the eye dose and the dose for the head-neck region is possible	-	+
Measures for optimizing the radiation protection shows dose reduction	-	+
Differentiation of workplaces by the dosimeter readings as expected > zero	-	+
Possibility to check the use of the dosimeters	-	+
Underestimation of the effective dose	x	
Overestimation of the effective dose		x

Tab. 2: Comparison of different methods of personal dosimetry

LITERATUR

[1] von Boetticher H, Lachmund J, Hoffmann W. An analytic approach to double dosimetry algorithms in occupational dosimetry using energy dependent organ dose conversion coefficients. Health Physics 99 (2010) 800-805

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