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Short Communication

Low I-131 Radiation Dose Factors for the Thyroid Caused by Use of Wrong Thyroid Mass Values

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The age dependent radioiodine dose factors for the thyroid recently published by Kaul and Roedler (1980) seem to support the view that the radioecological pasture-cow-milk pathway of I-131 is commonly overestimated in the official recommendations (BMI 1979), for these would imply to nearly double the maximum mid – European dose factor (from 8.4 to 16 rad/μCi ingested) and to shift the corresponding age to the time of maximum milk consumption (from 3 to less than 1 year old).

The opposite is true, however, as Kaul and Roedler have used an apparently wrong age curve of the thyroid, yielding mass values far too high even for their region of reference (Saarland, West-Germany). As the dose factor is reciprocal to the thyroid mass (see eq. (3) in their paper), any change in the mass can easily be expressed in terms of the resultant dose factor.

This is done in the first three columns of Table 1. The calculated average values of the masses of healthy thyroids from well documented observations (in the case of Raulier-Fabry and Hammer (1965) the values were deduced for radiation protection purposes) are shown for different ages and sexes (note: the age classifications do not fit exactly into the scheme). The corresponding dose factors are given in parenthesis [all other dosimetric inputs were left as in Kaul and Roedler (1980)].

While the two sources of the first two columns, which are referred to by ICRP (1975), consider various regions in mid Europe, the third one concentrates on the Saarland.

In the last column, the comparison is given for the set of the mass values and dose factors put forward by Kaul and Roedler. (Note: the mass values except for the adult had to be obtained by recalculation, as they were not given explicitly in that paper).

As to the maximum dose factor, neither the reduction nor the shift in age mentioned above are supported by the other sources. Moreover, even the commended values 16 rad/μCi for the infant, 1,9 rad/μCi for the adult (BMI 1979) appear fairly low. According to the evidence given they should be raised by about 50% if they are at least intended to cover the average at every age.

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Table 1. Thyroid mass values as observed (mean values) or proposed for radiation protection calculations by different authors. Figures in parantheses are the corresponding dose factors for 1-131 if the metabolic data from Kaul and Roedler (1980) is used

Age (years)	Sex	Roessle and Roulet, 1932		Raulier-Fabry and Hammer, 1965		Fischer, 1980		Kaul and Roedler, 1980	
		mass (g)	Dose(rad/μCi)	(g)	(rad/μCi)	(g)	(rad/μCi)	(g)	(rad/μCi)
0	m	2.9	(16)	2	(20)	2.9	(14)	7.6	(5.2)
	f	2.8	(17)			3.2	(13)		
1/2	m			1	(47)	2.6	(18)	6.8	(6.9)
	f					3.1	(15)		
1	m	3.1	(15)	2	(24)	4.0	(12)	5.8	(8.2)
	f	2.2	(22)			3.1	(15)		
3								5.8	(8.4)
5	m	6.1	(8)	4.9	(10)	4.7	(10)	7.6	(6.4)
	f	4.4	(11)			5.6	(8.7)		
10	m	8.4	(6.3)	8.7	(6)	6.2	(8.6)	26	(2.0)
	f	7.8	(6.7)			11.0	(4.8)		
15	m	12.5	(4.3)	13.3	(4.1)	20.6	(2.6)	39	(1.4)
	f	11.5	(4.7)			17.7	(3.1)		
Adult (different ages)	m	22–32	(2.5–1.9)	16–20	(3.7–3.0)	24–33	(2.5–1.8)	43	(1.4)
	f	21–32	(2.9–1.9)			19–31	(3.2–1.9)		

In view of the conflicting mass values, the scientific basis of the choice made by Kaul and Roedler would be important. But to my surprise I could not find such basis: these authors have taken, according to the reference given, an age curve named „Saarland" given by Glöbel (1978), who in his unpublished work refers only to the M. D. thesis of Hellstern (1978), which however, besides the average adult mass, 43 g, does not contain any information specific to that curve. Asking the authors of these three papers yielded no better result up to time this letter was written.

A final remark: as the size and the function of the thyroid vary greatly even within a small region for persons in the same age groups (see Hellstern 1978, e.g.) a serious dosimetric discussion should deal with frequency distributions and normal ranges instead of arithmetic averages only (see Dunning and Schwarz 1981, e.g.). Due to the considerable scattering of the input parameters, which seem to be only weakly correlated for individuals (work in progress), a normal range covering 95% of the dose factors of the exposed persons would turn out to be quite broad, with an upper limit several times higher than the average values discussed above.

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