nm/ LETTERS TO THE EDITOR

NUCLEAR MEDICINE TRAINING IN MEDICAL SCHOOLS

At the Washington meeting of the Society of Nuclear Medicine in July 1970 the subcommittee on Medical Student Education in Nuclear Medicine reviewed a questionnaire which had been sent to the heads of medical-school nuclear medicine divisions. It was determined that the teaching time of the schools devoted to nuclear medicine varied widely (Table 1). Some schools utilized block times of lectures and clinical instruction, while others taught through electives and integrated courses. A few schools had no organized teaching in either core curriculum or electives. The committee concluded that with the present trend towards a smaller core curriculum system with more electives, the chiefs of service would achieve optimal results through the development of strong elective programs and the increase of participation in integrated programs.

The committee also discussed and evaluated the advantages of teaching aids such as narrated slide sets, movies, and video tapes. The consensus was that these teaching aids could prove to be very useful in bringing nuclear medicine to medical students. It was proposed that the schools already experienced in the production of such teaching aids join in a group effort to make a series of slide sets and video tapes. A more detailed report will be presented at the 1971 meeting of the Society.

TABLE 1. NUCLEAR MEDICINE TEACHING IN MEDICAL SCHOOLS

Schools reporting	49	
Lectures and electives	25	(50%)
Lectures alone	7	(14%)
Electives alone	11	(22%)

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EXPOSURE RATE AT THE SURFACE OF SYRINGES CONTAINING RADIOACTIVE MATERIAL

The article "The question of radiation exposure to the hand from handling ^{99m}Tc" by C. M. Neil in the *Journal of Nuclear Medicine* (*1*) has called attention to the acute problem of the radiation safety in medical radioisotope laboratories. A knowledge of the exposure at the surface of syringes containing radioactive solutions lets one assess the probable magnitude of dose to the fingers of persons handling the syringes. In addition to the value of the exposure rate at the surface of a hypodermic syringe found by Neil, McEwan (*2*) determined this parameter experimentally for the 10-ml syringe containing radioactive materials in 3–5-ml volumes of the solution.

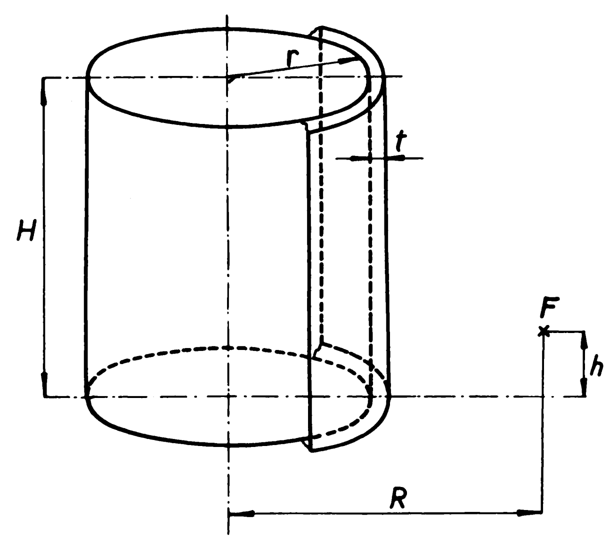

FIG. 1. Illustration showing meaning of symbols in calculation of exposure rate.

The aim of this letter is to show that the surface exposure rate can easily be determined theoretically for any syringe and any radionuclide considered. Of course the calculation based on the assumption of a point source, such as that made by Neil, should be entirely avoided because the result may be quite misleading.

The volume of the syringe in which the radioactive solution is uniformly distributed has the form of a right cylinder (Fig. 1). If the specific activity of the solution is A_s mCi/cm^3, the exposure rate at a point of interest F outside the cylinder can be calculated from the expression (*3*)

$$P = 2A_s \Gamma r \, [G_1(k, p, \mu r) + G_1'(k', p, \mu r)] \quad R/hr \qquad (1)$$

where Γ is the specific gamma-ray constant for the radionuclide (R/mCi/hr at 1 cm), k is h/r, k′ is (H − h)/r, p is R/r, and μ is the linear attenuation coefficient of gamma rays in water. G_1 is a complex function tabulated by Gusev et al (*4*) for a range of values of parameters k, p, and μr. The maximum exposure rate occurring for h = H/2 can be obtained by using the value of G_1 for the cylinder of half height and multiplying by two. Then Eq. 1 simplifies to

$$P = 4A_s \Gamma r G_1 (k, p, \mu r) \quad R/hr \qquad (2)$$

in which k = H/2r.

The dependence of the maximum exposure rate as calculated from Eq. 2 for one syringe on the distance from it is given in Fig. 2 along with the results of experimental verification. The theoretical results agree satisfactorily with experimental ones obtained using ionization chambers and thermoluminescent and film dosimeters. It is seen that a very thin film dosimeter attached to the syringe gives a higher value of the surface exposure rate than the 3.8-mm-thick LiF capsules.

By extrapolating and interpolating values of G_1 given by Gusev et al (*4*), it can be shown that at the surface of the cylinder the function G_1 is relatively insensitive to the syringe volume, length-to-radius ratio H/r, and energy of gamma rays. For syringes ranging in volume from 1 to 20 cm^3 with H/r ranging from 6.5 to 8 and for energies higher than 100 keV we found $G_1 = 1.55 \pm 0.06$. Putting this value of G_1 in Eq. 2 leads to

$$P = 103.5 \, A_s \Gamma r \quad mR/min. \qquad (3)$$

If A denotes the total activity in the syringe, the volume of the syringe is $V = \pi r^2 H$, and one obtains

$$P = 33 \frac{1}{Hr} A\Gamma \quad mR/min. \qquad (4)$$

It follows from this expression that for the activity given for a radionuclide in question, the maximum surface exposure rate decreases linearly with the increasing syringe diameter and its length. Using Eq. 1 it can be shown that the exposure rate on the end of the syringe is 60–70% of the maximum exposure rate as calculated from Eq. 2. The error involved in calculating the maximum surface exposure rate from Eqs. 3 or 4 instead of Eq. 2 is less than ±5%.

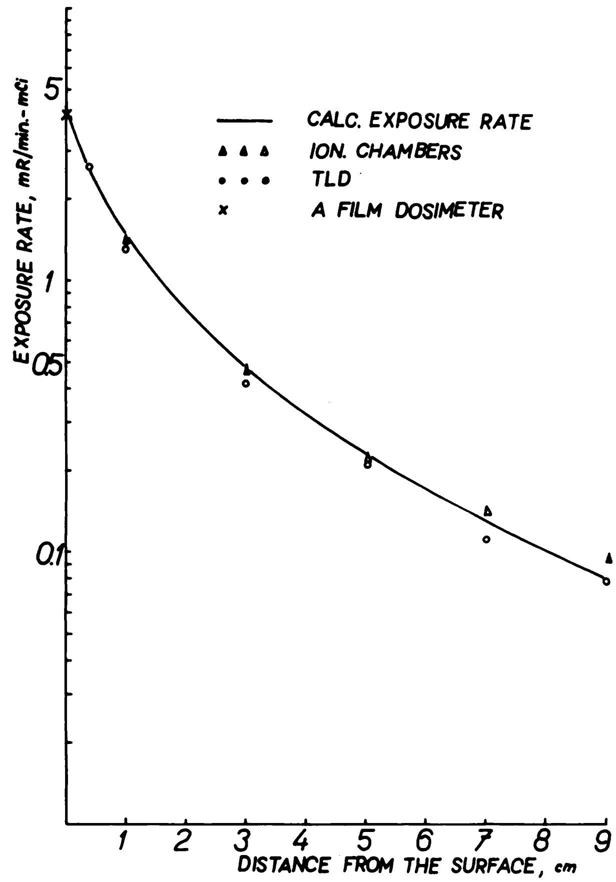

FIG. 2. Dependence of exposure rate on distance from surface of syringe containing 10 ml of ^{99m}Tc solution (r = 0.79 cm).

The use of equations presented will be illustrated by the following example. The maximum surface exposure rate is to be calculated for a 10-ml glass syringe containing 10 mCi ^{99m}Tc (the inner diameter of the syringe is 0.79 cm). Substituting Γ = 0.56 R cm/mCi-hr, A_s = 1 mCi/ml, and r = 0.79 cm in Eq. 3, one obtains P = 46 mR/min, i.e. 4.6 mR/mCi-min. The precise Eq. 2 yields 4.4 mR/mCi-min. If 10 mCi ^{99m}Tc is contained in a 2-ml syringe (r = 0.44 cm), the surface exposure rate increases to ∼130 mR/min.

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