MPC for Short Lived Radiopharmaceuticals

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Cyclotron-produced radiopharmaceuticals used in nuclear medicine are mainly short half-lived nuclides. They are often classified as unknown nuclides because of the deficiency of the description with regard to their values in Tables of ICRP Publication 2. As a result, legal control values for the desirable short lived radiopharmaceuticals, such as ^{11}C (half-life: 20 min.), ^{123}I (half-life: 13.3 hr.) etc, are too strict. According to ICRP publication 2, maximum permissible concetnration has been calculated for the short-lived nuclides which are to be produced by NIRS cyclotron. Instead of the absorption coefficient for the soft tissue, has been used the absorption coefficient for water by calculation from the effective energy E. Equations (1) and (2) have been applied when the critical portion of the gastrointestinal (GI) tract is upper large intestine, ULI (or lower large intestine, LLI) and small intestine, SI.

For LLI, ULI: $(MPC)_a =$

$$\frac{8.2\times10^{-10}mR}{(1-f_1)f_a\tau Ee^{-\lambda_0 t}}\mu Ci/cm^3 \quad \text{.....(1)}$$

For SI: $(MPC)_a =$

$$\frac{8.2\times10^{-10}mR}{f_a\tau Ee^{-\lambda_0 t}}\mu Ci/cm^3 \quad \text{.....(2)}$$

in which $(1-f_1)$ in equation (1) is a correction factor for the uptake in SI and it is not included in formula of ICRP. Results by these calculations are shown as follows. (nuclide: critical organ: $(MPC)_a$: $(MPC)_w$, in which A(B) represents $A\times10^{-B}$ $\mu Ci/cm^3$.

^{11}C: total body: 6(7): 4(2), ^{13}N: totla body: 5(7): 7(1), ^{15}O: total body: 4(7) 3(0), ^{43}K: LLI: 1(7): –, total body: –: 7(3), ^{52}Fe: ULI: 3(8): 1(5), ^{67}Ga: LLI: 1(6): 5(3), ^{123}I: thyroid: 3(7): 2(3), ^{111}In: LLI: 3(7): 1(3), ^{157}Dy: LLI: 1(6): 7(3), ^{169}Yb: lung: 7(8): –, LLI: –: 1(3).

The Sensitivity of the Limulus Test and Inhibitory Factors in the Radiopharmaceuticals

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The basic sensitivity of the Limulus test and the ihibitory factors in the radiopharmaceuticals were examined. Twenty-one radiopharmaceuticals commonly used were examined by Limulus lysate (Pre-gel; Teikoku hormone). Inorder to detedt the inhibitory factors, several doses of E. coli endotoxin were added to the radiopharmaceuticals before Limulus test and the results were compared with the control study using saline solution of endotoxin. When the pH of the reaction solution

lay out of a suitable range (6.0–7.5), pH was adjusted by Tris-HCl buffer before the reaction.

The sensitivity of the Limulus test using Pre-gel was found to be 10^{-3} μg/ml of E. coli endotoxin. This is about ten times higher than those of rabbit testing adopted by J. P. for E. coli endotoxin. Limulus test could be applied with its sensitivity and without inhibitory reactions on $^{99m}TcO_4^-$, ^{99m}Tc-albumin, ^{99m}Tc-MZZ, ^{99m}Tc-tin-colloid, ^{131}I-hippran, $Na^{131}I$, $Na_2{}^{51}CrO_4$, ^{67}Ga-citrate and ^{57}Co-bleomycin as they were commercially supplied. ^{111}In-DTPA, ^{99m}Tc-phytate, ^{99m}Tc-pyrophosphate, ^{99m}Tc-DTPA, ^{131}I-PVP, $^{59}FeCl_3$, Na-phosphate (^{32}P), ^{198}Au-colloid and ^{75}Se-selenomethionine needed to be adjusted their pHs to avoid inhibition. Benzyl alcohol in the radiopharmaceutical showed inhibitory effect at the concentration more than 1%. Commonly used ^{169}Yb-DTPA was found tobe evaluated by this test with the sensitivity of 2.5×10^{-3} μg/ml due to addition of little amount of benzyl alcohol. ^{131}I-BSP and ^{169}I-rose bengal showed intence inhigition on the gelation reaction. Contaminations of endotoxin were detected in nine radiopharmaceuticals.