Darbo vietos ir personalo apšvitos stebėjimas ir vertinimas radioembolizacijos su Ho-166 metu

Workplace and personnel exposure monitoring and evaluation during radioembolization with Ho-166

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The recent developments in radionuclide treatment have created a need to achieve the highest quality standards in the field of radiation protection. New radionuclides are currently being introduced in diagnostic and therapeutic procedures. Radioembolization with holmium-166 microspheres is a new treatment method used for clinical purposes. It`s a minimally invasive procedure in which radioactive microspheres are delivered directly to liver tumors via an interventional radiological procedure. This study investigated occupational exposure levels under working conditions with Ho-166.

Ho-166 microspheres are made of poly-L-lactic acid (PLLA), which contain the isotope Ho-166. During the microspheres production process, Ho-165 is incorporated in the PLLA matrix and during nuclear activation in a nuclear reactor part of the Ho-165 is activated to Ho-166. Ho-166 emits high-energy beta particles (1773.9 keV; yield 50.5% and 1854.5 keV; yield 48.2%) and gamma rays (80.57 keV; yield 6.6% and 1379.4 keV; yield 0.9%), and have a half-life of 26.8 h. The diameter of the microspheres are in the range of 15-60 µm, with a density of 1.4 g/cm^3. These are administered through a catheter to a hepatic artery. The paramagnetic properties of holmium allow to localize it using MRI scan, however, SPECT/CT is mostly used to acquire clinical images [1]. The standard treatment procedure consists in different steps: peri-procedural imaging performed by high-speed multislice CT or angiography, activity calculation and treatment planning with a scout dose (about 150 MBq), treatment procedure (about 10 GBq) and treatment evaluation process (post-treatment imaging) [2].

To measure radiation exposure, dose rate and patient dose rate, i.e. measurements ensuring that the patient could be discharged from the hospital, the ATOMTEX AT1121 ambient dosemeter was used. To determine the contamination, NuviaTech Healthcare CoMo 170 contamination monitor was used. The radiation exposure data for medical staff was measured with the Thermo ScientificEPD TruDose dosemeters. The readings of the activity meter Veenstra VDC-405, used for checking of activity (<5% deviation), were verified by the secondary standard chamber Capintec CRC-15R, No. 158488 (Center for Physical Sciences and Technology). To evaluate the doses in different locations (Fig. 1) for monitoring the working area exposure during one procedure, NaCl pellets read by optically stimulated luminescence, OSL, (made at Skane University Hospital, Malmö, Sweden) were used. The linear detection range is from about 10 µGy to >1 Gy. For readout procedure, the Risø TL/OSL reader (DTU Nutech, Denmark) was used. NaCl pellets were positioned at different locations (Fig. 1) for monitoring the exposure in the working area during one procedure.

Table 1. Working area monitoring results.

No.	Dosimeter position	Estimated doses (mGy)
1	Ho-166 transportation table (No. 1)	0.05
2	Ho-166 transportation table (No. 2)	0.07
3	Ho-166 transportation table (No. 3)	0.07
4	Ho-166 transportation table (No. 4)	0.05
5	Ho-166 transportation table (No. 5)	0.06
6	Waist level under the lead vest/skirt (interventional radiologist)	0.06
7	TV stand, 50-70 cm from the patient (No. 7)	0.08
8	Near the patient's, 1.5 meters (No. 8)	0.05
9	Right side, next to the patient, 5-10 cm (No. 9)	0.18
10	Left side, next to the patient, 5-10 cm (No. 10)	0.88

Immediately after the administration of the therapeutic dose, the dose rate at one meter from the right side of the patient was up to 80 µSv/h, during the discharge process was up to 32 µSv/h at 1 meter after 18 hours.

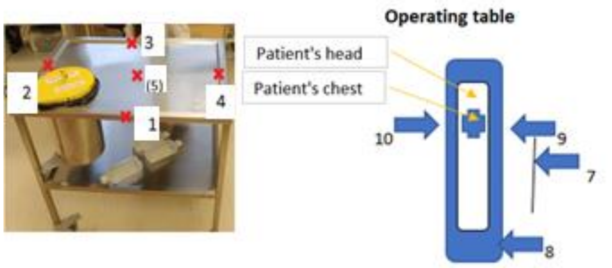

Fig. 1. Positions of NaCl pellets on the transportation table (right side) and on the operating table (left side).

Keywords: nuclear medicine, radioembolization, occupational exposure, radiation protection.

References

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