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Cross-Calibration of Diode Detector in 192Ir Source for High-Dose Rate Brachytherapy

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Introduction: High dose rate (HDR) brachytherapy system that used in clinical aspects are normally containing the ^{192}Ir-source. On each occasion, a new ^{192}Ir-source is installation, the institution has to do the source calibration for quality assurance (QA) program which the ion-chambers (IC) are the standard detector for source calibration. Meanwhile, the diode dosimeters can provide the higher sensitivity and smaller size than IC. However, the diode detectors are unusual send to the standard laboratory for air-kerma calibration factor.

Purpose: To cross-calibration diode detector with ion-chamber for calculate the air-kerma calibration factor of the diode.

Methods: Connected the 0.6 cc ion-chamber (type 30001) with build-up cap to the electrometer then setup at the center between 2 needle plastic applicator. Linked the applicators with transfer tubes and the tubes to channel 4-5 of HDR machine. Applied voltage of electrometer at +300 volts, determine the dwell position and using dwell time 300 secs per reading. Recorded and repeated the measurement 2 time. Disconnected the IC and replaced the IC position with the rectal diode detector (T9112). Changed the applied voltage to zero then repeated the procedure as done with IC. Calculated the reference air-kerma rate (RAKR) of ion-chamber. Subsequently, the diode air-kerma calibration factor was calculated.

Results: The calculated reference air-kerma rate from IC is 9.1561 mGy/h. Meanwhile, the air-kerma rate from the source certification is 9.1054 mGy/h at measurement duration. The percent different was around 0.56%. The ratio of accumulated charge between IC and diode was 1:3.99. The calculated for diode air-kerma calibration was 13.63 mGy/nC.

Discussion & Conclusion: The percent different of air-kerma rate between ion-chamber and certification was approximately 0.56% that indicate the good agreement (± 2% criteria). The accumulated charge from diode showed higher value than IC due to the better sensitivity of the diode detector. So, the diode air-kerma calibration factor was lesser than IC.

Keywords: Cross calibration / Diode detector / High dose rate brachytherapy

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