

Evaluation of Radiation Safety Reports for Brachytherapy Equipments in Korea

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Introduction

Radiation safety report for brachytherapy unit is a crucial requirement when installing or remodeling brachytherapy facility. Radiation safety reports have been referenced from regulating bodies such as National Council on Radiation Protection and Measurements (NCRP), International Commission on Radiological Protection (ICRP) and Nuclear Regulatory Commission (NRC). NCRP report 49 published in 1988 suggests broad-beam tenth value layer (TVL), half value layer (HVL) and exposure rate constant data for several radioisotopes including Iridium-192.

In Korea, Korea Institute of Nuclear Safety (KINS) oversees safety related matter regarding radiation safety reports with reference to guideline provided by the Ministry of Education, Science and Technology. However, there needs to be a more appropriate reference that reflects current radiation treatment clinical situation in Korea.

This paper evaluated current status of brachytherapy equipments and radiation safety reports accepted at the time of installation and remodelling for requirement of appropriate guideline that reflects current clinical situation in radiation oncology departments across Korea.

Materials and Method

38 radiation safety reports were analyzed to collect information including brachytherapy unit manufacturer, year of report publication, drafter information, half-value-layer (HVL) as well as exposure rate constant and treatment time used for workload calculation. Manufacture company was counted and percentage was obtained for each company. Radiation safety report publication year data was sorted for each year. Drafter information was categorized into "included" or "not included". "Included" category was further divided into drafter's affiliated institution. HVL information and exposure rate constant value were counted according to its value. Lastly, treatment time was counted in range of 100 mins.

Results and Discussion

Total of 38 radiation safety reports for 39 brachytherapy units currently (2010) being operated across Korea were evaluated. The installation of brachytherapy unit was increasing until 2001 but began to decrease thereafter. As seen from figure 1., Nucletron (63.2%), Varian (13.2%), MDS Nordion (10.5%), Bebig (5.3%), Buchler (5.3%) and Shimadzu (2.6%) supplied brachytherapy units at the time of report completion (merging of Elekta and Nucletron in 2011, Varian and MDS Nordion in 2002).

18 reports (47.4%) comply with international and national regulations which mandates inclusion of personal information and qualification of the person

who prepared the report. 11 (61.1%) out of 18 reports mentioned above were processed by the institution itself while seven (38.9%) were completed by

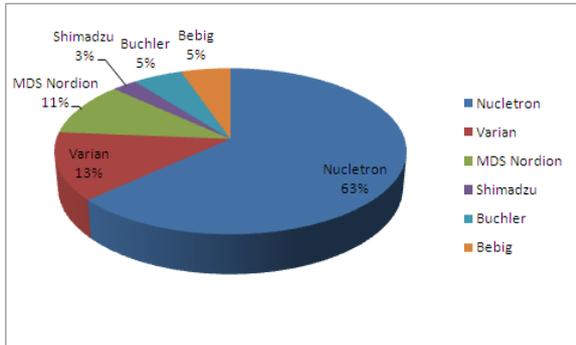


Fig. 1. Brachytherapy unit manufacturers

outsourcing companies. As represented in figure 2, with the introduction of outsourcing companies reports completed by agencies (18.4%; 1980-2009) began to increase from 6.7% (1990-1999) to 33.3% (2000-2009) and currently (2011) there are 13 outsourcing agencies available.

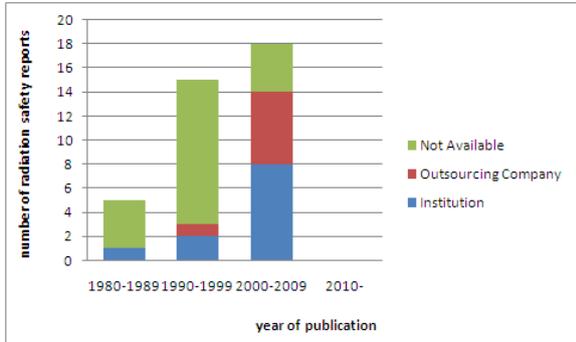


Fig. 2. Graphical representation of drafter affiliation

Out of 36 brachytherapy units that used Iridium-192 sources, 97.2% of sources had activity of 10 Ci at the time to treatment. Exposure rate constant used in workload calculation for Iridium-192 sources were in the range between 0.469 - 0.592 R · m²/Ci · hr and 0.480 R · m²/Ci · hr was most frequently used (44.7%). Many reports (28.9%) assumed treatment time as 40 hours/week which is used for linear accelerators. From those that calculated treatment time, 100-200 min/week and 600-700 min/week (15.8% each) were most frequently observed.

Concrete thickness of 4.1 cm (23.7%) and 4.3 cm (28.9%) suggested by NCRP report 49 as well as lead thickness of 0.6 cm (47.3%) also referenced from NCRP report 49 was most frequently used HVL for Iridium-192 sources.

Conclusion

It was found that majority of units (63.2%) were being supplied by Nucletron. Significant amount of reports (47.4%) complied with the regulation and included personal information of the person who completed the report. Out of those that with drafter information 18.4% were completed by outsourcing agencies. There were no huge variation in the use of HVL values for concrete and lead (4.3 cm and 0.6 cm, respectively), as well as exposure rate constant values were used for Iridium-192 sources (range: 0.469 - 0.592 R · m²/Ci · hr, mode: 0.480 R · m²/Ci · hr). However, 28.9% of reports assumed treatment time as 40 hours/week which is an over-estimation for brachytherapy equipments.

In terms of shielding calculation, HVL values used were in agreement with values suggested by NCRP and exposure rate constant values used for workload calculation showed little variation. However, there was wide variation for treatment time per week.

Even though installation of brachytherapy unit has been decreasing since 2001, radiation facility shielding is still critical issue in terms of safety. Additionally, with the introduction of outsourcing agencies, more centers are relying on these agencies who are not in a position to reflect actual clinical situations.

Hence, the result from this study shows that there needs to be a guideline for radiation safety report completion that reflects current clinical situation of radiation oncology departments in Korea.

Reference

1. National Council on Radiation Protection and Measurement, "Structural Shielding Design and Evaluation for Medical Use of X Rays and Gamma Rays of Energies Up to 10 MeV", NCRP Report No.49, (1976)