RADIATION SAFETY PRACTICE IN BPKM CANCER HOSPITAL, NEPAL

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Background: After the discovery of X-rays by Wilhelm Conrad Roentgen in 1895 and during the year following the discovery of X rays, Henri Becquerel and Marie Curie discovered and studied the radioactivity and set the stage for the development of new tools for both diagnosis and therapy.[1]. Initially X-rays were used for diagnostic such as e.g. taking photographs of joint and fracture of bones and later radiation is used for therapeutic propose. The first patient cured by radiation therapy was reported in 1899 [2]. The first use of brachytherapy with insertion of needle done in 1910 and in 1951, first patients in world was reated with cobalt -60 gamma rays in canada [1]. It is useful for diagnosis propose as well as treatment of cancer. since the use of radiation is increased in many advance technologies day by day but abuse and improper handling of radiation cause cancer and fatal damage. So, radiation protection and safety is very important where radiation is in use.

Objectives: The objective of this work was to evaluate all the safety procedures toward the radiation protection for workers in the radiation oncology department, BPKM Cancer Hospital, Nepal. And to survey of radiation level in treatment machines and to let know the workers about the radiation level in the working areas and places.

Materials and Methods: Radiation survey was performed at the doors, console areas, and heads of the treatment machines at different positions and different distances from heads. The survey is done using Aloka survey meter. For Elite-100 cobalt (Co-60) machine, leakage radiation is surveyed around the machine at the distance of 5 cm and 100 cm from the surface of machine as show in fig. 1. The radiation level is measured at door, control console room during the treatment of patient.

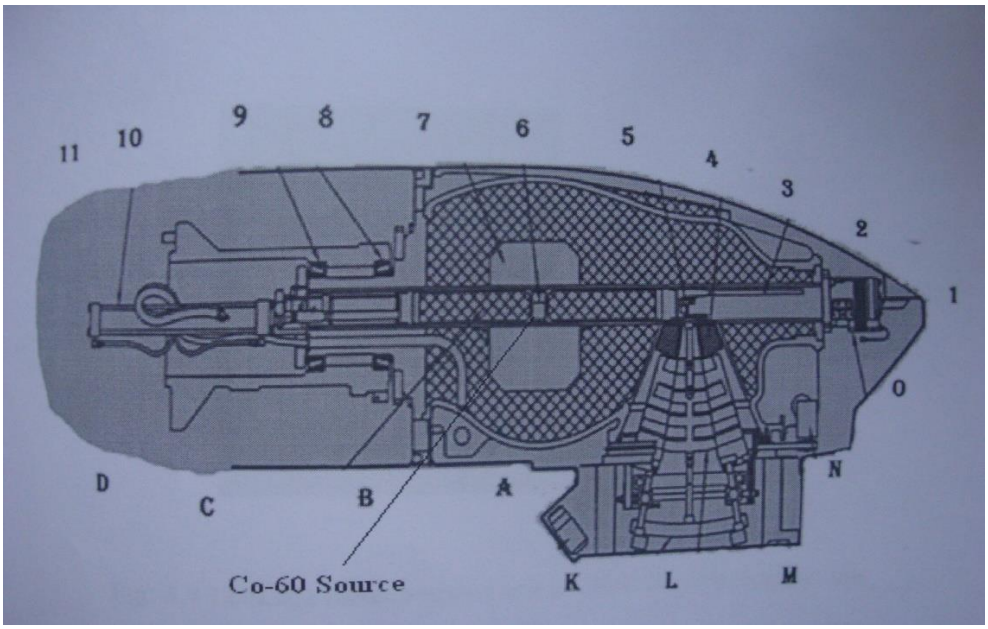


Fig.1: Radiation level measurement site on head of Co-60 [3]

Similarly, in high dose rate (HDR) Brachytherapy unit, radiation leakage from radiation isotope Iridium-192 (Ir-192) was measured during source at safe position at 5 cm and one meter from the machine at different sides as soon in fig. 2. The radiation level is also measured at door and console area. The radiation level is measured at door, control console; patients waiting area during 20 MV beam on at different gentry angles.

For personal dose monitoring TLD have been using since last ten years. Every three month one can get the report of TLD badges and cumulative dose of one year and five years. The collected data of all survey and five years TLD dose report is analyzed.

Fig.2 HDR brachytherapy machine

Fig.3 Red line for public/visitor unnecessary prohibited area

Results and Discussions:

The present activity of cobalt-60 source is around 3100 Curie.

Table 1:-The radiation level at upper part of head during the source at safe position.

Position (As shown fig.1)	1	2	3	4	5	6	7	8	9	10	11
Distance from maximum leakage(cm)	76	65	51	35	20	0	20	35	51	65	86
Meter reading at 5cm (μSv/h)	2	1	0.5	0.5	4	22	6.5	5.5	6.5	5	2.5
Meter reading at 100 cm (μSv/h)	0.5	1	1.5	2	2	2	1.5	1.5	1	1	0.5

The average reading at 5cm and 100 cm is 5.09 μSv/h and 1.32 cm μSv/h respectively.

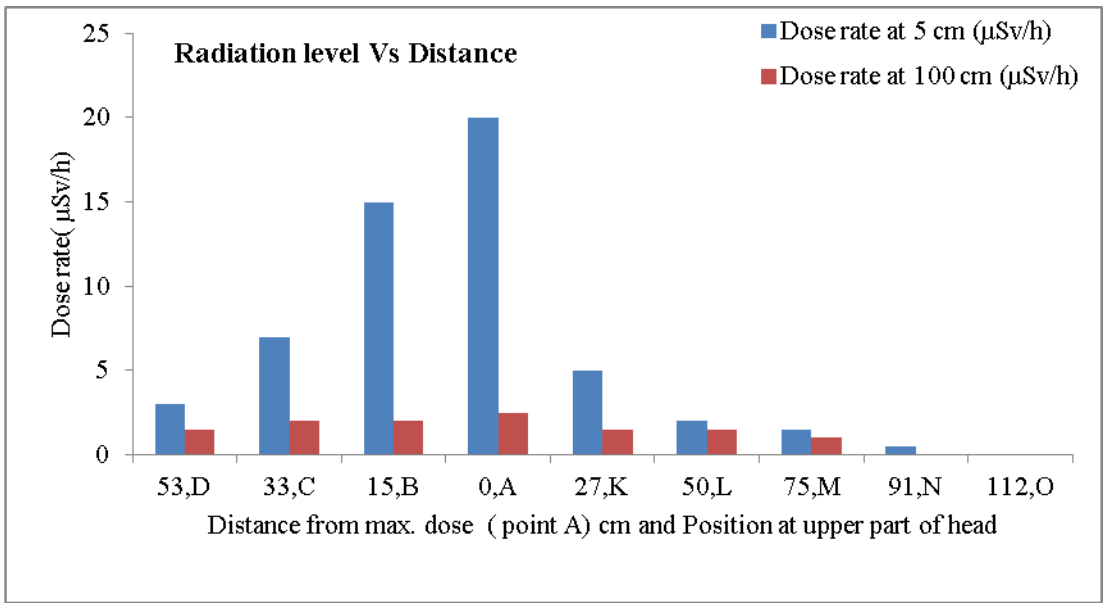
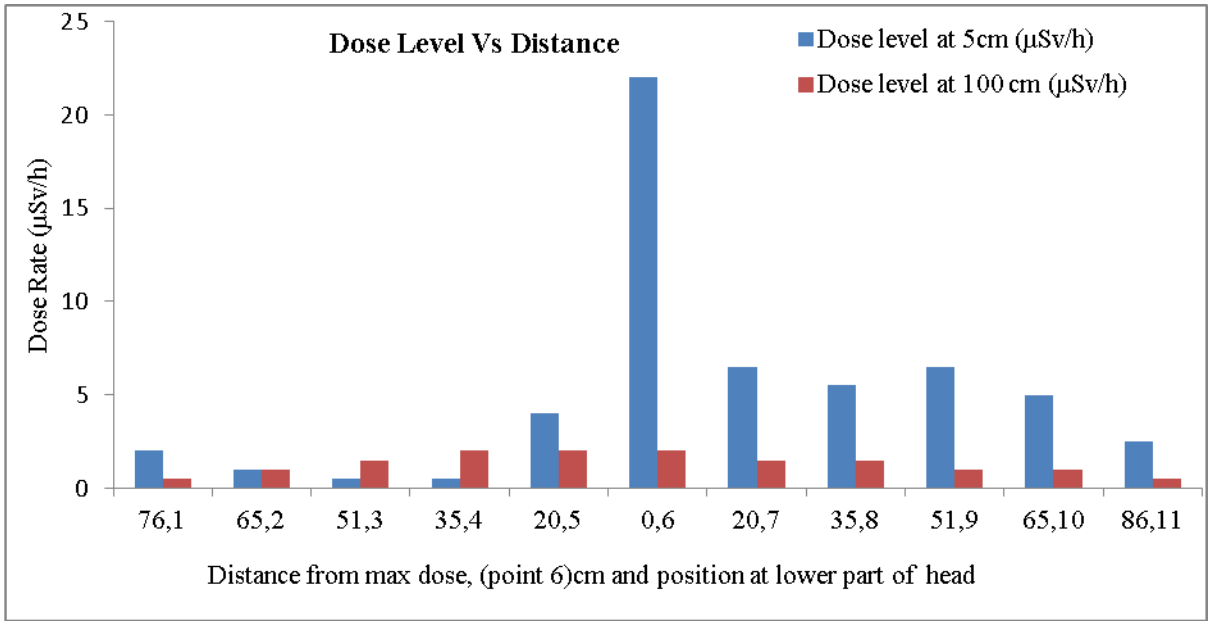


Table 2:- Radiation level at lower part of head during source at safe position.

Survey position (as shown fig)	D	C	B	A	K	L	M	N	O
Distance from maximum leakage(cm)	53	33	15	0	27	50	75	91	112
Meter reading at 5cm (µSv/h)	3	7	15	20	5	2	1.5	0.5	0
Meter reading at 100 cm (µSv/h)	1.5	2	2	2.5	1.5	1.5	1	0	0

Average reading at 5 cm and 100 cm is 6.0 µSv/h and 1.33 µSv/h respectively.



From table 1 and 2 , it can be seen that the average leakage radiation level at different points of upper and lower part of head are less than 0.02mSv/h at one meter from the head during the source in part mode. It is high at the nearest point form source point A and point 6 in figure 1 and decreased with distance as usual. Thus it can be concluded that the head of cobalt machine is properly shielded. Considering average dose rate at one meter cm is distance from head is of the machine is as 1.33 μSv/h and no of patients treated by a RTT is 15 in a day taking average 3 minutes per patient setting time than in a year working average 265 days, the dose rate per year found 0.26mSv/year. At 5 cm distance considering average dose rate as 6μSv/h, the total dose rate per year is 1.19mSv/year. This value is less than the maximum permissible dose 20mSv/year [4] for a radiation worker. The hand pendent is kept at a distance of one meter from the head so the radiation workers are safe from high exposure. The radiation level at the door, outside the treatment room and control console room is found in back ground level during the treatment.

Table 3:- The meter reading at 5cm and 10 cm from the surface of machine at different points during source at park mode.

Position	A	B	C
Dose rate at 5 cm (μSv/h)	.5	4.5	3
Dose rate at 100 cm μSv/h	0	1	0

The maximum radiation dose is found at point B which is closer to source container. The workers normal position is near one meter away from machine where dose rate is 1 μSv/h. The average patients treated per day is 4 and average time elapse by worker is 1 minute for a patients. For 300 working days, annual dose rate is 0.02mSv/year. This is within annual dose rate. There is o.5 μSv/h dose at bottom of the door and back ground level at upper part.

When survey is performed in linear accelerator for 6MV X-rays, the radiation level at door and control console room is background level. Immediately after the exposure of 6MV there is not presence of radiation in the treatment room. In case of 20 MV beam at Gantry angle zeor, dose rate at bottom of door is 6 μSv/h and console room is zero. But for Gentry angle 90 or 270, radiation level increased by 20 % at door and noted 15 μSv/h in front of console area at foot level. Although 20 MV X-rays is used only at gentry angle Zero and 4-5 patients are treated per day.

The dose report of individuals' TLD badge is obtained within a month after the three months of its uses. The cumulative dose of TLD for a year and five year is also provided by TLD reading centers out side the country. Table 4 show the five year TLD badge reports from 2006 to 2010.

Table 4:- Five year TLD badge reports

Year	2006	2007	2008	2009	2010
Average	0.010	0.996	0.024	0.040	0.013
Standard deviation	0.042	6.098	0.119	0.142	0.044

In annual reports, it is found that TLD badge is dose of one staff is very high than annual dose limit. That was happened due to the misplacement of TLD badges in the cobalt room. The average annual dose is 0.210mSv which less than annual dose limits 20mSv/year [4]

Conclusion: The survey of teletherapy cobalt unit at different position and distance shows that the radiation level in the treatment room is within occupational annual dose limit. Similarly, the dose level at door, control console of teletherapy machines is background level and brachetherapy room is also in safe limit. The annual TLD badges reports shows that average annual dose, 0.210mSv is very less that 20mSv/year. The radiation safety practices for radiation protection are satisfactory and the radiation workers of the departments are found working within safe limit.

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