Journal of
Nuclear Medicine & Radiation Therapy

Tai et al., J Nucl Med Radiat Ther 2017, 8:2
DOI: 10.4172/2155-9619.1000330

Research Article Open Access

The results of a TLD Therapy Dosimetry Quality Assurance Program for Dong Nai General Hospital, Vietnam (Period 2013-2017)

Duong Thanh Tai[1,2*], **and Truong Thiet Dung**[1]

[1]*Department of Radiation Oncology, Dong Nai General Hospital, Bien Hoa, Vietnam*

[2]*Faculty of Physics & Engineering physics, University of Science, Ho Chi Minh, Vietnam*

***Corresponding author:** Duong Thanh Tai, Department of Radiation Oncology, Dong Nai General Hospital, 810000 Bien Hoa, Vietnam, Tel: +84945569139; E-mail: thanhtai_phys@yahoo.com

Received date: February 20, 2016; **Accepted date:** March 13, 2017; **Published date:** March 17, 2017

Abstract

The objective of this study is to perform a thermo luminescent dosimetry (TLD) postal dose audit provided the International Atomic Energy Agency (IAEA) for a linear accelerator in Dong Nai General Hospital. The TLD were irradiated with an absorbed dose to water of 2 Gy for 6 MV and 15 MV photon beams generated by a linear accelerator (LINAC) (Siemens Medical Solutions, Concord, CA). The percentage deviation relative to IAEA measured dose was 0.4% and 3.4% for 6 MV and 16 MV, respectively. Agreement within ± 5% between the users stated dose and the IAEA measured dose is considered satisfactory. The results showed that all photon beams are within the IAEA's acceptance limit of ± 5%. As a conclusion, the beam output of Siemens Primus is accuracy in delivery of absorbed dose within ± 5%.

Keywords: Linear accelerator (LINAC); TLD postal dose audit

Introduction

Radiation therapy is one of most commonly used for treatment cancer to deliver as high doses to the tumor while sparing the surrounding healthy tissue and organs. Therefore, it is important to have high accuracy in the dose delivered of LINAC. Dong Nai General Hospital was equipped with a LINAC for this purpose since 2009. Quality assurance (QA) of the beam outputs is recommended for safe use of linear accelerators for radiotherapy. The International Atomic Energy Agency (IAEA) and the World Health Organization (WHO) operate the IAEA/WHO TLD postal dose audit program [1]. The purpose of the program is to verify the beam calibration in radiotherapy centers and to improve the accuracy and consistency of clinical dosimetry in radiotherapy hospitals worldwide. The TLD audit is cost free to participants. It can be checked the calibration of clinical external beams therapy such as Co-60 and megavoltage beams from accelerators. It is not designed for small beams used in radiosurgery, electron beams, brachytherapy or orthovoltage X-ray beams, or stereotactic radiosurgery equipment, a Gamma-knife, X-ray knife, Cyber-knife, or similar. The advantages of TLD are small, reasonably tissue equivalent and not attached to measuring equipment with cables or wires. In Vietnam, this program in collaboration with the Institute of Atomic Energy Vietnam has been conducted in most of the radiation facility in the country. Recently, Dong Nai General Hospital have participated this program since 2013. The irradiated TLDs should arrive at the IAEA laboratory not later than 6 weeks after irradiation; otherwise the hospitals will have to wait for their results due to queues for the TLD reader arising from irregular return of TLDs. This work show technical note and result of a TLD Therapy Dosimetry Quality Assurance Program for Dong Nai General Hospital, Vietnam (period 2013-2017). The TLD results are sent to the Dong nai Hospital within 8 weeks of receiving the irradiated TLDs at the IAEA, depending on the queue for the TLD reader. Our hospital receives individual result certificates for each beam checked with TLDs. If the results within a 5% limit are considered acceptable, the next TLD audit will be recommended after two years later. Otherwise, if the results outside the 5% acceptance limit are provided with a second, the repeat irradiation TLD is immediately required. If the second TLD result is still not acceptable, an expert will visit to resolve the problem, and the next TLD audit is recommended for one year later. After getting the bad result, a hospitals participating in the IAEA/WHO TLD postal dose audits should have to revised their dosimetry procedures and upgrade their instrumentation to prevent radiological accidents.

Materials and Methods

Treatment machines and equipments

Measurements have been performed on the Siemens Primus LINAC (Siemens Medical Solutions, Concord, CA). The beam qualities of photons, D20/D10 are 0.57 and 0.642 for 6 MV and 15 MV respectively.

Dose 1 dosimeter, Ionization chamber FC 65-P, Blue phantom (IBA Dosimetry, Germany) and plastic phantom.

TLD samples have provides by IAEA. The TL material currently used is LiF: Mg, Ti, type TLD-700. The TL powder is annealed before it is used for dose measurements in order to optimize the LiF characteristics, and to achieve better stability of powder sensitivity and lower fading.

Setting up TLD capsules [2]

- Assemble the TLD holder
- Place the holder in a water tank on the treatment table
- Set a 10 cm × 10 cm field size
- Align the holder tube with the central axis of the beam

Citation: Tai DT, Dung TT (2017) The results of a TLD Therapy Dosimetry Quality Assurance Program for Dong Nai General Hospital, Vietnam (Period 2013-2017). J Nucl Med Radiat Ther 8: 330. doi:10.4172/2155-9619.1000330

- Filling the water tank exactly to the level of the top of the holder (Figure 1)

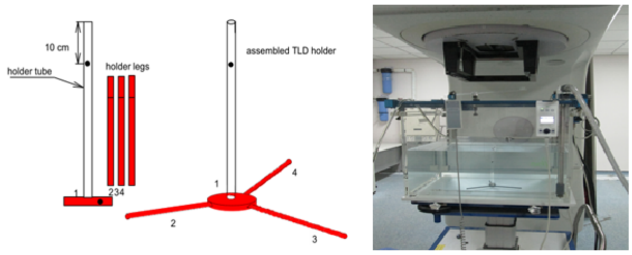

Figure 1: TLD holder and Siemens Primus LINAC.

Calculation of time/monitor setting

For example of 15 MV photons, we have used the blue water phantom (IBA). We record the value of absorbed dose in water at depth=10 cm, SSD=100 cm, field size 10 cm × 10 cm with LINAC delivered of 200 MU. The result was 1.573 Gy. To receive 2 Gy at this depth, we must set the Monitor Unit as 254.5 MU [3].

Irradiation of TLD capsules

The TLD capsules were irradiated at 10 cm depth in water using a field 10 × 10 cm^2 at a distance 100 cm with SSD fixed source skin distance (Figure 2).

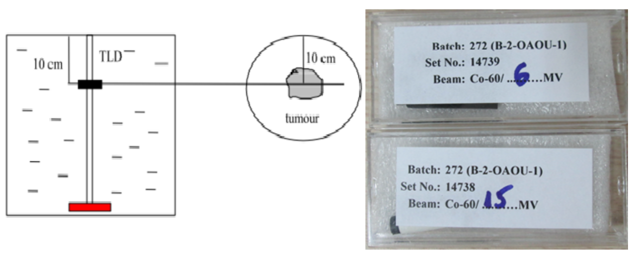

Figure 2: Position of TLD capsules.

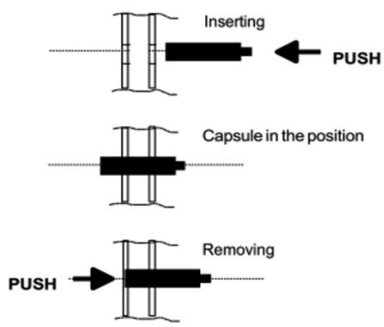

Figure 3: Inserting and removing the TLD capsule.

- The capsule of TLD-100 powder is placed at 10 cm depth, field size of 10 cm × 10 cm at axis and 100 cm Source-Axis Distance (SAD).
- Before irradiation recheck whether the alignment, field size, water level and distance are correct (Figure 3) [4].
- Insert the capsule into the upper hole of the holder
- Irradiate the TLD capsule with the time or the number of monitor units
- Remove the capsule from the holder and repeat

Error analysis:

$$Percentage\ deviation = \frac{\text{(User stated dose - IAEA mean measured dose)}}{\text{IAEA mean measured dose}} x\ 100\%$$

Results

A relative deviation with positive sign indicates that the user estimates higher dose than what is measured; a patient would therefore receive higher dose than calculation. Results for the TLD audit are shown in Table 1.

Beam	User stated dose (Gy)	SSDL measured dose (Gy)	IAEA mean dose [Gy]	% deviation relative to SSDL measured dose
6 MV	2	2.02	1.99	0.4
	2	1.97		
15 MV	2	1.92	1.94	3.4
	2	1.95		

Table 1: Results for the TLD audit for 6 MV and 15 MV.

Discussion

A main aspirational goal of this work was to report the result of A TLD audit for Dong Nai General Hospital and to share a technical note with other center oncology which would implement TLD audit in the future because TLD audit for dosimetry in radiotherapy has proved to be effective in assuring the quality of dose determination in radiotherapy.

Several authors [1,5-8] have reported a perspective of dosimetry practices at hospitals in developing countries and results. Their study aimed checks the accuracy output factor of radiotherapy beams with a TLD in reference conditions given by IAEA. Some participants did not report regarding the dosimetry protocol used and their dose calculation procedures and did not include step by step procedure. There are several protocols as the German DIN-6800, the IAEA TRS-398, and the AAPM TG51. Our study used the IAEA TRS-398. The purpose of the current study was to perform the step by step of measurement TLD in water phantom by using the IAEA TRS-398 protocol.

It is interesting to note that the agreement between the Dong Nai hospital dose and the IAEA measured for 6 MV and 15 MV photon beams are within ± 5%, this result is considered satisfactory. The percentage deviation relative for 15 MV was higher than 6 MV. The IAEA/WHO TLD postal program for radiation therapy beams at Dong Nai hospital has been strengthened with new procedures to improve the overall efficiency of the treatment. During recent years, we attended and got the good results.

Our study has only expressed one of the many aspects needed to be considered related to the output beam properties. However, the results of this research support using LINAC in treatment radiation oncology in Dong Nai hospital.

Conclusions

Radiotherapy treatment Planning can be inaccurate because of problems in beam output of LINAC which directly affected treatment outcome in clinical. So it is reasonable and prudent to make accuracy beam quality of LINAC. Our result of TLD audit shows that LINAC in Dong Nai hospital is accurate for treatment delivery.

References

1. Izewska J, Andreo P, Vatnitsky S, Shortt KR (2003) The IAEA/WHO TLD postal dose quality audits for radiotherapy: a perspective of dosimetry practices at hospitals in developing countries. Radiother Oncol 69: 91-97.
2. International Atomic Energy Agency (2013) IAEA/WHO TLD POSTAL DOSE QUALITY AUDIT for Co-60 and Megavoltage X-ray Beams, Instruction sheet.
3. Abdullah N, Kadni T, Deraman SS (2016) Intercomparison programme of absorbed dose for megavoltage x-ray teletherapy units in Malaysia, Jurnal Sains Nuklear Malaysia 28: 11-19.
4. Iewska J, Andreo P (2000) The IAEA/WHO postal programme for radiotherapy hospital. Radiother Oncol 54: 65-72.
5. International Atomic Energy Agency (1987) Absorbed dose determination in photon and electron beams. An international code of practice. Technical Reports Series 277.
6. International Atomic Energy Agency (2007) Dosimetry in Diagnostic Radiology: An International Code of Practice. Technical Reports Series 457.
7. International Atomic Energy Agency (2000) Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry Based on Standards of Absorbed Dose to Water. Technical Reports Series 398.
8. Izewska J, Godfrey A, Bera P (2010) 40 years of the IAEA/WHO TLD postal audits for radiotherapy. SSDL Newsletter 58: 17-23.