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Editorial

Telecommunication has made giant strides in last couple of decades in terms of technological advancement and also in the practical use of these innovations. Medicine and health sector is not untouched by these revolutions. Telemedicine is one of these marvels which have come to their ubiquitous presence in large number of hospitals, medical centers and research institutions. Medical Physics being technology oriented specialty, we are in a unique position to harness the potential of telemedicine capability to enhance our boundary-less real-time interaction, exchange of data and ideas, discussion on treatment plan, dosimetry process, techniques and methods and educational confabulations. Through this communication it is to propose an informal network of medical physicists on telemedicine link in the country.

Now-a-days many hospitals and medical colleges have either procured telemedicine facilities or are in process of doing so. Telemedicine facility requires a video conferencing equipment and connectivity link like anyone of Telephone line, ISDN (Integrated Services Digital Network), Broadband or VSAT (Very Small Aperture Terminal Network). Computer or server, scanner or digitizer, bigger screen or display and a place for conference may be other requirements. Telephone line providing 64 Kbps bandwidth is a narrow link and it is not very suitable for smooth video conference. ISDN which is like the combination of two or more telephone lines provides 128 or 384 Kbps bandwidth. VSAT is a satellite link and may be provided by Indian Space Research Organisation. Generally 384 Kbps bandwidth is considered acceptable for telemedicine connectivity. A telemedicine center can be linked to another telemedicine center if both have the same connectivity. That is why a telemedicine facility may have more than one link. For VSAT there may be different configuration for different telemedicine centers and it may not be possible to connect two centers with VSAT connectivity if their configurations are different.

Keeping all these issues in mind readers are invited to share their views in "Letter to the Editor" column about the way telemedicine link may be used for medical physics networking. It is also suggested to send their connectivity specifications so that a list of participants of this network may be prepared.

Pratik Kumar

DIRECT PRODUCTION OF ^{99m}Tc USING MEDICAL CYCLOTRON – POTENTIAL FOR ALLEVIATING CHALLENGES IN RADIOISOTOPE SUPPLY

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A few years of current decade have been increasingly challenging for the speciality of Nuclear Medicine due to unpredictable supply of radioisotopes particularly generator produced Tc-99m. Conventional method of production involves the neutron flux in nuclear reactors inducing fission of enriched ^{235}U resulting into production of a variety of radioisotopes including ^{99}Mo (T ½ = 67 hours). The subsequent purification involves series of steps and finally ^{99}Mo is absorbed on Al_2O_3 to provide a ^{99}Mo / ^{99m}Tc generator. ^{99m}Tc is eluted from this generator as sterile solution of pertechnetate ($^{99m}TcO_4^-$). Globally a large number of ^{99m}Tc- labelled radiopharmaceuticals are used in diagnostic nuclear medicine ranging from about 70 K – 80 K. About 70 % of the global requirement of ^{99m}Tc-generator is met out by National Research Universal Reactor, Canada and High Flux Reactor, Netherland. Until recently the alternative resources of Tc-^{99m} were hardly explored and no serious efforts have been made due to abundant availability of ^{99m}Tc from reactor produced ^{99}Mo / ^{99m}Tc-generators. However due to frequent interruptions in ^{99}Mo supply caused by aging reactors and increased cost of their maintenance, the search for alternative sources of production of ^{99m}Tc has been intensified.

Out of very few options available, the direct production of ^{99m}Tc by bombardment of enriched ^{100}Mo by energetic protons has received active consideration. It attracts a widespread interest because of easy accessibility of enriched ^{100}Mo (more than 99.5 %) at an affordable cost in metal or oxide form from a number of suppliers. The technique to produce ^{99m}Tc in large quantities using (p, 2n) reaction in a cyclotron was demonstrated several decades ago but was not practically utilized by any centre due to prompt and easy availability of reactor produced ^{99}Mo. It has also been now established that, cyclotron produced ^{99m}Tc is well suited for in-vivo imaging with GMP grade ^{99m}Tc labelled radiopharmaceuticals. In the Indian scenario where most of the metro cities are crowned with relatively larger number of nuclear medicine centres, such a decentralized chain of medium energy cyclotrons can be effectively utilized for regular production of GMP grade ^{99m}Tc in large quantities and may effectively complement or even replace the traditional supply of reactor produced ^{99}Mo for generator produced ^{99m}Tc. Such an approach would also tend to optimize the use of medium energy cyclotrons currently available in almost all metro cities of the country. In the scenario where old and aging reactors plagued with excessive maintenance cost, the cyclotron produced ^{99m}Tc may offer low cost technology well suited for cost effective and uninterrupted supply of ^{99m}Tc on a regional basis and can also facilitate faster growth of diagnostic nuclear medicine facilities in the country.

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THERMOLUMINESCENCE: BASIC THEORY

Shaila Bahl, Medical Physics Unit, IRCH, AIIMS, New Delhi

The phenomenon of Thermoluminescence (TL) has been mentioned in alchemist texts as early as 1602 and its first scientific report was provided by Robert Boyle in an address to the Royal Society of London in 1663 describing it as 'glimmering light' which he observed from heating diamond in the dark. Scientific studies on the TL of minerals and other solid states started in the 1st quarter of the 20th century leading to the establishment of TL as an important method to study energy storage in thermally stabilized trap states.

Luminescence is the phenomenon in which a substance absorbs energy in some form or the other and reemits a fraction of it as visible or near visible radiation. Thermoluminescence is the thermally stimulated release of stored energy in the form of visible electromagnetic radiation [1]. TL studies provide vital information about the mechanism of trap generation, nature of the traps, trap modification and so on [2]. The TL technique is used in many fields like radiation dosimetry, archaeology, geology, forensic science and quality control industry. Generally, in these experiments, a sample is excited by gamma or X-rays or other irradiating sources and then heated at a constant rate while the luminescence intensity is monitored. For the thermoluminescence measurements the requirement are to heat the sample linearly and take precise readings of its light output continuously. The result such as glow peak temperature, activation energy and thermoluminescence plot should be available within a limited time period of measurements. The instrument consists of a temperature sensor with linear heating system, a light intensity measurement system and a microcontroller. It automatically acquires the relevant data from the system (sample temperature and intensity of the light) and, at the same time, controls the heating process. The acquired data is transmitted to PC for further processing.

Basic mechanism

Thermoluminescence is the thermally stimulated emission of light from an insulator or a semiconductor following the previous absorption of energy from ionizing radiation. The thermoluminescence process can be understood in terms of the band structure model of insulators. In a pure insulator there are two relevant energy bands: (i) an almost completely filled valence band and (ii) an almost empty conduction band. The two energy bands are separated by a forbidden gap, which means that between these two bands there are no electronic energy levels. Transitions of electrons between the valence band and the conduction band are allowed and they produce "free" electrons in the conduction band and "free" holes in the valence band. The energy difference between the two bands is denoted by the band-gap energy Eg (Figure 1).

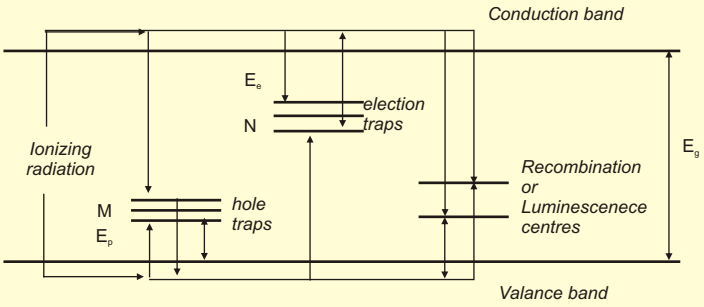

Figure 1. *Energy-level presentation of the thermoluminescence process, showing the filling process of the electron and hole traps and the mechanism, which is responsible for thermally activated luminescence (TL). N= the total concentration of electron traps with energy Ee, M=the total concentration of hole traps with energy Ep.*

Imperfections in the crystal, associated with impurities and/or lattice defects may create new localized energy levels in the forbidden band gap. The positions of the energy levels depend on the nature of the imperfections/defects and the host lattice. Some of these defects are capable to trap an electron or a hole. Therefore the centers are referred to as electron or hole traps and after trapping an electron or hole the new defects are called trapped electron or trapped hole centers, respectively. The most simple trapped electron center is the F-center, which is an anion vacancy in the crystal lattice after it has trapped an electron. The name 'F-center' is derived from the German word 'Farbe' , which means color. When the concentration of F-centers is sufficient, the crystal absorbs sufficient light in a limited frequency range and as a result, the crystal is colored. To maintain electroneutrality of the crystal, for each trapped electron a hole is produced, which might be trapped at a hole trap and thus creating a trapped hole.

Another class of imperfections is associated with impurities, e.g. transition ions, which are quite often the reason why certain materials e.g. minerals show a characteristic color. The color is due to absorption bands caused by electronic transitions between energy levels in the band gap. The energy levels in the band gap depend, as mentioned above, on the nature of the imperfection, lattice defect or impurity and can, in principle, be located at any energy position varying from just below the bottom of the conduction band to just above the top of the valence band. Optical transitions between energy levels located in the forbidden band gap may occur if they are allowed according to existing selection rules, which depend on the symmetry properties of the ground and excited state, but also transitions between the energy levels in the gap and empty more or less localized electronic levels in the conduction band are possible. Obviously, the later transition results in empty electron traps in the band gap. Eventually, the electrons may escape from the centers associated with these energy levels and could return later at these locations by re-trapping. This description leads us to the definition of electron traps, which are localized defects in the crystal where electrons (conduction electrons or electrons from other centers) can be trapped. Accordingly, these centers can be filled or empty. This general description can be applied as an example to very simple centers, like the F-center in alkali halides. In this most simple example, the filled trap corresponds with the F-center, while the empty trap is an anion vacancy.

An analogous discussion can be given for hole-type centers. As mentioned above the valence band is filled almost completely, which implies that free holes exist in this band. Similar to the description for electronic levels in the band gap and the trapping and detrapping processes it is possible to consider centers with energy levels in the forbidden band gap, which are capable of trapping free holes, which are available in the valence band. Like the trapped electrons, trapped holes can be released thermally or optically. After releasing the trapped hole a hole trap is left. A variety of defects belonging to the above-mentioned two classes of centers, which are associated with energy levels in the forbidden band gap, are also produced during exposure to ionizing radiation. Well-known examples of radiation-induced defect centers are the F-center (the proto-type electron center, which has been described above) and a variety of V-centers. V-centers form a group of defects, which absorb light in the violet part of the optical spectrum. This property is the reason why these centers are called V-centers. An important property of V-centers is that they have trapped a hole, which is produced simultaneously with the electron. The most simple V-center is the V_k-center in alkali halides, which is referred to as a "self-trapped hole". It consists of a hole trapped at two neighboring chloride ions at regular lattice positions in the NaCl crystal (figure 2). The hole therefore belongs predominantly to two neighboring Cl^- ions. After the hole is trapped, the chloride ions of the resulting Cl^{2-} molecule are displaced considerably from their original lattice positions (figure 2). This implies that the V_k-center is in fact a Cl^{2-} center.

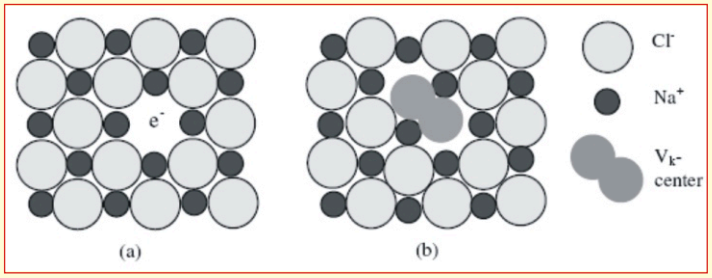

Figure 2. *Two dimensional representation of a NaCl crystal showing the F-center(a), and the V_k-center (b) in NaCl. The F-center is the proto-type of trapped electron centers and the V_k center is the most simple trapped hole center*

Due to ionizing radiation electrons are transferred from the valence band to the conduction band, which leads to the presence of significant concentrations of free electrons (in the conduction band) and free holes (in the valence band). In ionic materials, quite often the primary radiolytic reactions resulting from interactions between radiation and the crystal take place at anions (e.g. the Cl^- or O^{2-} ions in case of chlorides or oxides, respectively). Due to these processes excitations with binding energies slightly smaller than the forbidden band gap take place. These excitations are called excitons. Usually, the subsequent de-excitation processes are sufficiently energetic and effective to induce atomic/ionic displacements in the crystal lattice, which leads to the formation of radiation damage, i.e. radiation induced defects.

From the point of view of TL , exposure to ionizing radiation has two important consequences:

I. radiation induced defects (both electron and hole traps) are created and;

II. free electrons and holes are created in the conduction band and the valence band, respectively.

As long as the concentration of radiation-induced defects is small, the number of defects usually increases with increasing radiation dose. Ultimately, for very high doses, one might expect that the concentration of the radiation-induced defects saturates. i.e., with increasing dose the concentration of radiation-induced defects reaches a maximum value. The continuous production of

free electrons and holes as a result of the exposure to ionizing radiation is essential for the production of sufficiently stable defects, which produce TL. Due to the high mobility, free electrons and holes can migrate in the crystal until they are trapped by impurities, luminescent centers and other imperfections in the crystal. During irradiation the electrons and holes are (re-)distributed continuously over the available electron and hole traps. A necessary condition for a mineral to be a suitable luminescent material for TL dating is that the relevant traps are deep, i.e. not easily emptied. This implies that the energy of the trapped electron should be located sufficiently far from the bottom of the conduction band. Similarly, the energy of the trapped hole should be located sufficiently far from the top of the valence band. A trap is characterized by the energy E that a trapped electron (or hole) must acquire from lattice vibrations to escape to the conduction band (or valence band). Electrons in the conduction band can move freely in the crystal. Holes, which were removed from hole traps are free to move in the crystal, when they are excited to energy levels in the valence band. There is a characteristic temperature at which the thermal vibrations of the crystal lattice are sufficient to cause the release of trapped electrons. Some of the released electrons reach luminescence centers, which are filled with holes, and light is emitted in the recombination process. A similar reasoning holds for the case of luminescence produced by recombination of free holes at the electronic recombination centers. Figure 1 shows the schematic representation of the thermoluminescence process in an insulating crystal with forbidden gap width Eg.

Applications

Thermoluminescence finds favour in diverse scientific disciplines such as archaeology, geology, medicine, solid-state physics, biology and organic chemistry, to name just some of the mainstream areas of study.

Radiation dosimetry

The increased use of thermoluminescence became evident in the late 1940s and early 1950s. Although a quantification of the thermoluminescence mechanism was necessary in order to calculate the trapping parameters, several other applications of the phenomenon were beginning to emerge at this time. The prime motivators of this emergence of thermoluminescence as a practical research tool in several different fields of application were Farrington Daniels and his research group at the University of Wisconsin, USA, during the 1950s. The absorption of radiation increases the level of thermoluminescence observed from a specimen by filling the localized energy levels with trapped electrons. The absorption of heat from the environment, on the other hand, tends to reduce the numbers of trapped electrons by thermally releasing them. Thus, the intensity of thermoluminescence from a specimen is the result of a competition between trap tilling by radiation and trap emptying by thermal excitation. At a given temperature of irradiation, many materials display an intensity of thermoluminescence which is proportional (or nearly so) to the amount of radiation absorbed, and this led Daniels and colleagues to propose that thermoluminescence may be used as a means of radiation dosimetry. The first proper application of thermoluminescence to dosimetry was in 1953 when LiF was used to measure radiation following an atomic weapon test. LiF was found by Daniels to be a particularly good material for use in radiation dosimetry because of its high sensitivity and small pellets.

Defects in solids

Our understanding of the nature of crystal defects has been increasing over the past 50 years or more owing to the development of refined experimental techniques. Defect concentrations, enthalpies and energies of formation and activation and other relevant parameters are generally determined from studies of ion movement, such as ionic conductivity, diffusion, defect reactions, etc. This type of measurement has been supplemented by many other techniques including optical absorption, electron spin resonance, X-ray diffraction, photoconductivity, optical scattering, impurity decoration and many more, all of which can serve for comparison with the other 'dynamic' methods. In principle, experiments on thermoluminescence can be expected to yield useful information on the properties of the various types of defect present within an insulator or semiconductor.

Geology

The occurrence of natural thermoluminescence from rocks has long been known and several early observations have already been made. For example, Fluorite and Calcite too were known to be good thermoluminescent phosphors. The natural glow from Calcite was discovered accidentally by parties of prospectors in Ontario searching for radioactive minerals. When placed on a hot camp stove at night the calcite was observed to glow brightly. It would be a mistake, however, to think that fluorite and calcite were somehow unique among minerals. It was found that out of over 3000 natural minerals studied (mostly granites and limestones), approximately 75% were found to exhibit natural thermoluminescence of such an intensity that it was easily measured. The remaining 25% were also thought to emit thermoluminescence, but of lower intensity, and the sensitivity of the measuring apparatus at that time was not high enough to detect it. Some of the recorded natural thermoluminescence was bright enough to be 'sufficient for reading a newspaper'.

Clinical

Traditionally, dosimetry in diagnostic radiology [3] has been mainly restricted to personnel dosimetry and local investigations, but also it has a broader application for instance by checking the quality of the used irradiation beams. According to the national and international guidelines, e.g. EU directives, the absorbed doses to the patients, exposed to radiation from diagnostic radiology, have to be determined [4]. Therefore, *in vivo* measurements on patients undergoing radiological examinations or nuclear medicine studies are performed. Also, as in therapy, anatomical phantoms are useful for absorbed dose measurements in diagnostics. In clinical practice, the main detectors used for dosimetry are ionisation chambers and semiconductors. Ionisation chambers are commonly used for phantom measurements because of their accuracy and practicality [5,6], but for *in-vivo* measurements they are not frequently used because of the high voltage applied and the cables attached to the chamber. Semiconductor diodes are routinely used for absorbed dose measurements of clinical studies. These measurements make use of the advantages of semiconductors, such as ease of handling and the dose determination in real time [7,8,9,10]. Thermoluminescent (TL) dosimeters are widely used for radiation detection in the fields of environmental, industrial and personnel applications, just to mention a few. The theory of TL dosimetry, and the abilities of different TL materials for use in several applications, have been summarized in a variety of books [11,12,13,14,15,16,17]. The main advantages of TL dosimeters are [18]: i) wide useful dose range, ii) small physical size, iii) reusability and therefore, iv)

economy, v) no need for high voltage or cables, i.e. stand alone character, and vi) tissue equivalence (LiF) for most radiation types. These make TL detectors a useful tool for clinical dosimetry; since its first use for *in vivo* dosimetry during radiotherapy [19], the use of TL detectors has become an important technique for clinical dosimetry [13,14,15,20,21,22]. TL detectors can be, and commonly are, used for the absorbed dose measurements performed with the aim to investigate cases where dose prediction is difficult and not as part of a routine verification procedure. Among these cases are, for example, new radiotherapies which have been developed for patient treatment during the past decades. Absorbed dose determination in these radiotherapies, e.g. radioimmunotherapy and boron neutron capture therapy, is more complicated compared with the external radiotherapy [23,24,25,26]. High uncertainties may be present in the dose determination due to patient anatomy, i.e. geometry, inaccurate irradiation source definition or the radiation quality, among other things.

Age determination

Once the relationship between thermoluminescence intensity and absorbed radiation dose had been established it was only a short step to the use of thermoluminescence as a means of age determination. This application of thermoluminescence also suggested the premise that the natural thermoluminescence from rocks is directly related to the radioactivity from uranium, thorium and potassium present within the material. This radioactivity results in the accumulation of a so-called 'geological' dose. If the rate of irradiation from the radioactive minerals is established, and if the rate of thermal release of the thermoluminescence during the rock's irradiation can be shown to be negligible, then the length of time over which the rock has been irradiated (i.e., its' geological age') can be determined from:

Age = absorbed dose/dose rate.

In addition to these major innovations, thermoluminescence dating has benefited from many valuable improvements in technique which have helped to overcome a plague of complexities (e.g., difficulties in dose rate evaluation, the problems of 'spurious' luminescence - i.e., not due to radiation and of athermal fading). The result is that thermoluminescence dating is now establishing itself among archaeologists as a respectable method of age determination.

Outlook and Conclusions

Most uses of thermoluminescence come under one of the applications mentioned so far, namely, dosimetry, age determination, geology or solid-state defect structure analysis. However, in recent years several novel and, at first sight, unlikely applications have been described in the literature. In biology the technique is finding increasing usage. More recently thermoluminescence from DNA-base analogues has been observed. These materials act as tumor inhibitors by a mechanism of radical conversion and it is hoped that thermoluminescence will help us to understand the charge transfer processes involved. With ion chambers and film, TLD is one of the three most important detectors in clinical dosimetry. While some already well established materials such as LiF:Mg,Cu,P (27,28,29) have still to be widely implemented into medical practice, old materials can still be optimized (96) and new TLD materials have the potential to broaden the application base of TLD even further. Automatic glow curve analysis provides additional information and a powerful quality assurance tool that could reduce the number of 'spurious' readings, which are often of concern for clinical dosimetry. All this will help to develop a variety of new applications and establishing TLD as the dosimeter of choice for many additional applications in medicine. The technique has also been used to identify the dust particles responsible for lung disease in miners and the volcanic soil responsible for non-filarial elephantiasis. A full list of applications of thermoluminescence would also include the use of suitable phosphors for image storage devices, a test for fire damage in building materials, a quality control tool for ceramics and an aid in forensic science. It is to be noted that there have been attempts to identify the cause of ball lightning by examining the thermoluminescence from bricks close to where the phenomenon occurred. Even without these minor applications thermoluminescence has proved itself to be a technique of immense versatility. Its accelerated usage over the last 30 years reflects that the technique has come a long way since Boyle's observations on the 'glimmering light' from diamond.

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MOVERS AND SHAKERS

Dr Kamlesh Passi, Chief Medical Physicist, Deptt. of Radiotherapy, M.D.Oswal Cancer Hospital, Ludhiana and President, AMPI-NC has been awarded Ph.D. by University of Mumbai in Feb 2011. The title of her thesis was " Dosimetric And Radiobiological Study Of EBRT and HDRICB For Carcinoma Of Uterine Cervix". Congratulations !!!

Know our Medical Physicist

Dr.R.N.L. Srivastava, Professor Medical Physics and Radiological Safety Officer, J.K. Cancer Institute, G.S.V.M. Medical College, Kanpur-2008 (U.P.) obtained his M.Sc. (Physics) from Pt. Deen Dayal Upadhyai University, Gorakhpur (formerly known as Gorakhpur University), U.P. in 1970 and one year post-graduate diploma (Dip.Rp.) in Radiological and hospital Physics from D.R.P., B.A.R.C. Mumbai in the year 1971. He was awarded Ph.D. (Biomedical Physics) in 1983 from Baba Bheem Rao Ambedkar University, Agra (formerly known as Agra University, Agra) on the basis of thesis entitled "Hepatobiliary Scintigraphy and Temporal Analysis using Radionuclide Hepatocholecystography and evaluation of its clinical role".

He joined as Physicist-cum Lecturer in S.N. Medical College, Agra on 22nd September 1972, was promoted and transferred as Associate Professor Medical Physics to J.K. Cancer Institute, Kanpur in 1992 and was elevated to designation of Professor in the year 2005 and is still working there.

Dr. Srivastava has 39 years of teaching and research experience in radiation medicine, radiotherapy and radio-diagnosis. He has published 37 scientific papers in national and international journals and contributed a chapter "Associated Risk in Interventional Procedures and dose Reduction Methodologies" in the ICRPP2K2 proceedings entitled "Radiological Protection of Patients in Medical Application of Ionizing Radiation" published by SGPGI Lucknow in 2002. He participated in several scientific national and international meetings organized in India.

He is life member of AMPI, IARP and Society of Nuclear Medicine of India. He has been past president of UP-Delhi Chapter of AMPI and chief editor of medical physics bulletin published periodically by UP-Delhi Chapter of AMPI. He is also national assessor and project referee of DST, Govt. of India, New Delhi. He is also a Technical Expert (Equipments), Govt. of U.P. and external examiner of Ph.D., M.Sc. (Medical Physics) and B.Sc. for several Indian universities. He is involved in installation and commissioning of Radiation Generating Equipments Viz, LINAC, Telecobalt units, Remote A/L Brachytherapy unit, Digital X-ray unit and MRI system,

MOVERS AND SHAKERS

Dr. Arun Chougule, Professor, Medical Physics Unit, SMS Medical College, Jaipur has been awarded with ' Satkar Vibhuti" award for contribution to scientific and social work. The award was given by Shri Vilas Rao Deshmukh, Cabinet Minister, govt. of India in a function in Delhi. Congratulations !!!

LETTER TO THE EDITOR

Radhakrishnan B, Assistant Professor of Radiation Physics, Government Medical College, Mulankunnathukavu, Trichur-680 596, Kerala. rkdiprp@yahoo.com

Government Medical College Hospital at Trichur in, Kerala has one telecobalt unit [Make: Best Theratronics, Canada, (formerly known as MDS Nordian) model: Elite-80] which was installed here in the year 2004. We also have a HDR remote afterloading brachytherapy, 3D and 2D planning systems, immobilization devices, manual afterloading intracavitory brachytherapy and manual interstitial needles and tubes. Majority of the patients who are treated in this centre belong to poor category and for those patients the services are rendered absolutely free. In the last week of March 2010 the telecobalt unit went out of order. The authorised agency in India have tried to attend the repairs and finally stated that its control unit (comprising a processor cabinet, Interface module and two PCB) has been damaged and the whole spare part will cost Rs. 45 lakhs (100,000 US dollars) and this will have a warranty of only 3 months period. They have submitted a quotation for this amount and asked the institution to approve their quotation so as to make the unit functional. The amount quoted and the warranty was definitely not acceptable to us. The Head of the Department of Radiotherapy gave a report to the authorities suggesting some procedures which may take another 10 years in a Government set up to revive the functioning of the unit. The machine was shut down. In the mean time the HOD got transferred to another institution and the new HOD who was posted here also proceeded on leave without taking charge. The machine was out of order for 45 days and all the patients were referred to nearby Government set-ups.

I, being the Chief Medical Physicist, was feeling very much hurt by seeing the plight of poor patient by keeping the machine idle while there were no scarcity for other infrastructure. The charge of the department was handed over to a Radiation Oncologist who was much junior to me in service. I decided to write a mail to the owner of M/s. Best Theratronics Ltd, Canada stating the present condition and passed on all the quotes received from their local agency. The owner, being an Indian, understood the prevailing conditions and directed M/s. BTL to send the spares to our site directly. The spares were sent to us without collecting a single pie from us and even the custom duty was paid by the BTL.

Once such a development has taken place, the local agency voluntarily came to our institution to fix the spares from their stock unconditionally. After getting concurrence from M/s. BTL, Canada we allowed the local agency to fix their spares temporarily. The machine became functional on 13th May 2010 and the treatment resumed on the same day.

There are following lessons that can be derived from the above story:

1. Monopoly of local agency always leads to escalation of the cost of the spares.
2. A Medical Physicist need not be a human calculator sitting inside the treatment planning room and he should come forward in dealing with tricky issues concerning the department so as to gain the confidence of the administrators.
3. There is a necessity of a Radiation Physics department in all the institutions who can manage the services offered by the equipments to the patients independently. The Radiation Oncologists can dedicate more time in the treatment and clinical activities because the above incidence is a sample that a Medical Physicist can also think and care about the patients and not only the contours, CT slices or treatment charts to do treatment planning. Are we not justified in demanding an independent Department of Radiation Physics in all medical institutions?

OBITUARY

Dr. A.K. Srivastava, Physicist cum RSO, Dept of Radiology, UCMS & GTB Hospital, Delhi-110095

Late Dr. K.K. Manocha

Dr. Krishan Kumar Manocha, Ex. Professor of Radiation Physics, Dept of Radiotherapy, Pt. B.D. Sharma PGIMS, Rohtak, passed away in Rohtak on 3rd August 2010, following a long history of tachycardia and hernia.

He was born on 5th May 1946 and graduated from Punjab University. He was a Gold medalist. He did his M.Sc. in Physics from Punjab University. He had joined PGIMS in 1972 and completed his Ph.D. in 1979. His thesis topic was "Analytic studies of Radiation Doses". Prof. Manocha had joined initially as a Physicist but rose to become Professor after honorable court of Haryana passed an order in which he was designated as a Teacher in Radiation Physics. He retired from his services in the year 2006.He had published twenty five papers in national and international journals.

His life has been full of medial miracles. He had history of first successful treatment of brain hemorrhage in 1986 followed by severe heart attacks in 1987, 2000, 2004, 2009.

Dr. Manocha is survived by his wife Mrs. Kamlesh Kumar Manocha, and three daughters Mrs Namita Sharma, Mrs. Sunita Girdhar, Mrs. Supriya Rajat Gautam.

We have lost a kind hearted, very gentle, well behaved and very helpful person. His demise has created a vacuum which cannot be filled. We prey to almighty to rest the departed soul in peace and give strength to dear ones' to bear the loss.

MOVERS AND SHAKERS

Dr Lalit M Aggarwal has ben appointed as Associate Professor, Radiological Physics in the Dept of Radiotherapy & Radiation Medicine, Institute of Medical Sciences, Banaras Hindu University, Varanasi. Earlier he was working as Radiological Safety Officer in the same department . Congratulations !!!

MOVERS AND SHAKERS

Dr Anuj K. Tyagi, Associate Professor of Medical Physics, Deptt. of Radiotherapy, S.N. Medical College, Agra & Secretary, AMPI-NC has been awarded Ph.D. by Dr. B.R.A. University, Agra in Nov. 2010. The title of his thesis was "Calibration And Dose Distribution of High Dose Rate Brachytherapy Source". Congratulations !!!