Welcome Speech

Dr. Edgar Löffler
CEO IBt Bebig, Berlin, Germany

Dear brachytherapy friends,

I am very pleased and excited to welcome you to the international HDR brachytherapy meeting, organized by IBt Bebig, in Pattaya, Thailand. The main motivation for coming together in Asia is the health care situation and low income in developing countries. Worldwide, the burden of cancer is set to increase, driven primarily by the growth and ageing of the global population. More than 70% of all cancer deaths occur in low and middle income countries. While in high income countries, 50-60% of all cancer patients receive radiotherapy as part of their treatment, in low income countries, significantly fewer patients have access to radiation therapy. It is time that will have to rethink our view for these countries. In the near future, degenerative deceases such as diabetics or cancer will play more important role than infectious deceases. Therefore, we have to prepare ourselves that much more patients will have access to an adequate cancer treatment. We assume that radiotherapy will play a key role in the future in cancer care in the low and middle income countries. Within radiotherapy by nature brachytherapy allows a tailored radiation dose to be delivered very precisely to the target area, while minimizing unwanted exposure of the surrounding healthy tissues and organs. As a pressure on healthcare resources intensifies, the treatment has to become more and more cost efficient. With brachytherapy the treatment can be performed in less time and as outpatient-based treatment. These are effective ways to reduce costs and provide more efficient use of resources. Additionally, brachytherapy involves lower overall infrastructure costs than newer forms of radiotherapy, such as IMRT or proton therapy, and provides the opportunity to maximize already existing resources in a radiotherapy department. Therefore, the role of brachytherapy will increase in these low income and developing countries. The first use of brachytherapy goes more than 100 years back. Compared to the beginning of brachytherapy, the treatment today is very sophisticated. It utilizes a combination of state-of-the-art imaging, computer-based planning and treatment delivery technologies. This way an optimal radiotherapy can be achieved. We all know, brachytherapy has pushed innovations in radiotherapy. Advanced computerized treatment planning and image-guided delivery systems increased efficiencies. It improves the outcome, not neglecting the patient acceptance. The advantage of brachytherapy is definitely the overall short treatment time. Patients can complete treatment in days rather than weeks that are required for external radiotherapy. This increases patients compliance. Brachytherapy is used for many indications. It is the standard treatment for cervical, prostate, breast, skin, and head and neck cancers. It is generally well tolerated with a good toxicity profile for many of its applications, largely due to its tissue sparing approach. The occurrences of adverse events are similar or even less frequent. In prostate cancer, for example, the use of brachytherapy results in lower longer term side effects. As you may know, IBt Bebig is one of worldwide brachytherapy market leaders. It is a company that offers full brachytherapy portfolio with LDR and HDR sources and treatment devices. As company we are fully committed to brachytherapy. For the upcoming days I wish you a successful meeting with a lot of knowledge exchange for wide spreading modern brachytherapy.

New aspects of Brachytherapy

Alfredo Polo, MD, PhD
Brachytherapy and Intraoperative Radiotherapy Unit,
Radiation Oncology Department, Ramon y Cajal University Hospital,
Madrid, Spain
e-mail: alfredo.polo@mac.com

Brachytherapy can be considered as the ultimate conformal therapy in the armamentarium of radiation therapy techniques. It implements sophisticated tools for applicator placement, dose optimization and delivery, but its inherent physical characteristics (internal sources, rapid fall-off of the dose and gradient generation at the edge of target volumes) causes brachytherapy to become self-optimized by nature, achieving a high degree of conformation with low integral doses to the rest of the anatomy. Brachytherapy has a prominent role within oncological therapeutics. It can be used either as an exclusive treatment or in combination with external beam radiotherapy, for radical treatments with curative intent, combined with surgery (preoperatively, intraoperatively or postoperatively) or in a palliative setting. Different technological approaches are possible, resulting in different modalities of brachytherapy: low dose rate brachytherapy release dose continuously (seeds, iridium wires). Remotely afterloaded brachytherapy presents three alternatives: either fractionated high dose rate, pulsed dose rate or low dose rate are possible, depending on the activity of the source used in the afterloading machine. Radiation therapy can exploit the properties of the tissues in interaction to improve the therapeutic ratio. Brachytherapy has special conditions depending on the technological solution used, as every modality creates a different dose-rate condition, and the mechanisms involved at the molecular level are possibly different. The knowledge of the tissue kinetics parameters can lead to optimized brachytherapy treatments with more antitumoral effect without the excess of the normal tissue toxicity. Promising trials are being envisaged. In the last 40 years, a considerable effort was made to understand the relationships between delivered dose, dose rate and irradiated volume. By the late 70s it became clear that low dose rate brachytherapy was an optimal treatment in a variety of tumours, including head and neck and breast (Pierquin,

Radiother Oncol 2001; 58: 7-9). This created the basis for the clinical radiobiology, applied to optimize treatments with radiotherapy. Brachytherapy has played a major role during the last 20 years in the treatment of cancer. It has been used, combined with external beam radiotherapy in the treatment of gynecologic malignancies with good results. Prostate brachytherapy has opened a new era in organ and function conservation and became the most prominent example of highly conformal therapies. The use of brachytherapy in breast cancer has contributed to the change of paradigm in breast conserving therapies for early stage low risk breast cancer. Finally, the use of intraoperative brachytherapy approaches will contribute in the following years to the more radical surgical results. Modern brachytherapy relies on the paradigm built around the triad dose-volume-fraction. Small doses per fraction (or small dose rate) to doses in the range of 65 to 70 Gy are used, for tumor cures depending on the extent of the disease, but with local toxicity kept low. Volume was related to dose and later, with the advent of CT-based dose planning a more detailed knowledge of this relationship was possible. However, this knowledge was only partial due to the poor resolution of CT for target volume delineation, when applicators are in place and the lack of temporal information of organ motion, very important in brachytherapy due the marked gradients involved in dose delivery. On the other hand, clinical results with different dose rates (or doses per fraction) and modeling studies set the basis for the knowledge of the basic rules for tissue response to ionizing radiation. However, in the last five years, technological advances in radiology and nuclear medicine gave us more understanding of the topography and metabolism of tumors, and a new dimension to optimize radiation therapy, including brachytherapy.

For precise dose deposition novel imaging techniques are also needed. In the new paradigm (dose-guided brachytherapy), imaging is used to know the exact coordinates of the tumor cells, and to guide applicator insertion to the correct position. To map cancer cells, a number of new image modalities have been developed in the past several years: PET, MRI-MRS and power doppler US imaging are among them. All those image modalities give twofold information: morphological in one side and metabolical in the other. Combining these two different aspects are possible to define areas where it is likely that tumor burden is present, or certain hypoxic areas, or areas of repopulation or intrinsic radiosensitivity load. Those areas are supposed to be liable to be boosted by high-precision modalities. In this setting, brachytherapy will offer the intrinsic advantages already mentioned. The rapid fall-off of the dose would serve to precisely sculpt dose around these sub-volumes. This process is known as dose-painting, as we can paint the different dose levels we want to achieve within the target volume. Correlation studies with pathologic specimens are needed to check the spatial and temporal stability. Imaging is also required for precise deposition of the prescribed dose. Beyond CT-based 3D planning and US needle guidance for prostate implantation there is a brand new field of "dose guidance" in which brachytherapist could see in real time the relationship between the planned dose, the applicator and the anatomical volumes of interest. Different tools can be used (CT, MRI, US), every one adapted to different clinical situations. Ultrasound is very suitable in the circumstances where brachytherapy is performed. It can be intraoperative, it is fast, providing no radiation exposure to the staff, it is not expensive and allows direct visualization of the applicator and the intended dose overlayed together with anatomical and functional information. The new paradigm in brachytherapy relies on the new image modalities for tumor mapping and dose guidance, where brachytherapy would obtain a clear advantage from this modalities that could translate in better treatments, more conformal to the target volume, more dose-intense, and less toxic to the surrounding tissues.

Taking the classic concepts of dose-rate and volume effect, modern brachytherapy moves to personalized treatments, using predictive assays and detailed functional information of the tumor to model response of the individual patient to the treatment given. As we already mentioned above, functional imaging gives a picture of the tumour biology, allowing dose delivery to be much more adapted to the actual tumour. Dose prescription are individualized, with different dose levels to the whole target volume and the different sub-volumes, including the dominant lesion or the more radio-resistant hypoxic regions. Predictive assays are very useful tools to model the behavior of different tumours based on their individual genetic profiling. Microarray technology has been exploited for its predictive ability in disease development, clinical outcome and prognosis-based treatment. Microarrays have been used to discriminate which patients treated with brachytherapy for head and neck tumours would need prophylactic neck dissection as a part of their treatment (Watanabe *et al.*, *Radiother Oncol* 2008; 87: 237-42). However, the predictive assays for local relapse after surgery or radiation therapy are lacking, personalization of the local treatments (different dose levels to good and poor responders application, addition of bio-modulators or other local strategies) is required. Targeted brachytherapy is a new integrative paradigm, where the goal is to improve therapeutic ratio through the integration of detailed information of the tumour coordinates and genetic profiling as well as the precise delivery of the prescribed dose using image guidance. Some of the modules described above are already available. Dose guidance is accessible in some commercial systems. Technology for intraoperative functional imaging is already available (US Power Doppler, and Elastrography). Other modules are under development or still experimental. The work in progress is promising. The whole paradigm could become a reality in the next five years.

Commissioning, QA and HDR brachytherapy treatments of cervical cancers: using the first Co-60 BEBIG Multisource unit in Bangladesh

Sadiqur Rahman Malik, MD

Delta Medical College and Hospital, Dhaka, Bangladesh
e-mail: smalik51@hotmail.com; smalik2008@gmail.com

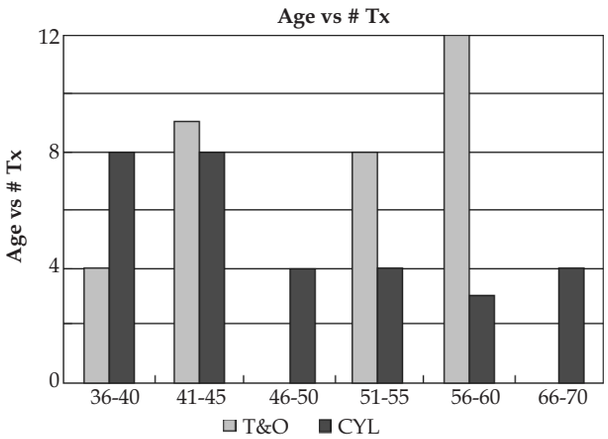

Fig. 1. No. of treatments at Delta Hospital Ltd (December 10 to Mid February 11), using BEBIG 60Co Multisource with the Fletcher Unit & Cylinder (Total Tx = 64)

High Dose Rate brachytherapy (HDR) is an important modality of cancer therapy where the dose is delivered at short distances locally to the tumor with rapid dose fall-off in the surrounding normal tissues. The MultiSource Co-60 remote after-loader is the first of its kind in Dhaka. All methods and analysis applicable to the Quality Assurance (QA) and Commissioning of Co-60 have been investigated and finally the delivery of high dose have been systematically analyzed, measured and documented before treating a patient. Studies and safety requirements of this HDR remote after-loader are carried out as reported in Task Groups. Acceptance and the QA are imperative to justify functionality and dependability in delivering a treatment. The absorbed dose (Gy) to a point P at a distance of '*r*' centimeters from a source of known Reference Air Kerma Rate, RAKR, is by equation (1):

$$\text{Dose P} = \text{RAKR} \times \{r^{ref}/r\} \times F \times t \times \frac{[\mu/\rho]^{water}}{[\mu/\rho]^{air}}$$

Where:
RAKR is the reference air kerma rate traceable to a national standard;

$$\frac{[\mu/\rho]^{water}}{[\mu/\rho]^{air}}$$

is the ratio of the mean mass energy absorption coefficients at about 1.11 for water and air; $\{r^{ref}/r\}$ is the ratio of reference to some distance for dose calculation; F is the combined attenuation and scatter factor; t – is the time of exposure. The general formalism for the D (r,Θ) a cylindrically symmetric source are examined in TG-43 viz. Air Kerma Strength (S_k), the dose-rate constant (Λ), the geometry factor (G (r, Θ)), the radial dose function (g (r)) and the anisotropy function (F (r, Θ)) which includes the photon attenuation and scatter at any polar angle.

Source Strength measurement is done by:

$$S = R \times CF_{cal} \times CF_{ion} \times CF_{T:P} \quad (2)$$

$$RAKR = R \times CF_{cal} \times CF_{T:P} \times CFapp \times CFsat \quad (3)$$

S = in mGy/h at 1 m or Ci or GBq, R = Amps, leakage-corrected electrometer reading, CF_{cal} = Chamber calibration factor, CF_{ion} = Correction for ion recombination, $CF_{T:P}$ = air mass correction, CFapp = applicator correction, CF sat = saturation correction factor. An uncertainty of 2.5% in RAKR measurement is quoted by PTB (2009).

The QA and Commissioning required measurements and emergency tests to verify the functional limits of parameters for acceptance of the HDR afterloader. Some acceptable limits are: 1) deviation between specified and measured source strength: ± 3%; 2) positional accuracy and uniformity: ± 1 mm; 3) temporal accuracy (i.e. timer error & linearity and end error): ± 1% or 30 sec; 4) treatment planning system (digitizer & localization software): ± 3% or 1 mm; 5) distance from line to the first dwell position and all other: 5 mm and 10 mm (± 1 mm).

Following the acceptance of the Co-60 Multisource HDR unit, the Delta Hospital has completed about 31 cylinder and 38 tandem & ovoid (Fletcher Suit & Manchester applicators) treatments since December 2010. CT scans were done before HDRplus planning, where a good reproducibility (± 2%) has been documented in repeating the plan for the same set up and the patient.

Implications of these studies are described in detail in this paper, where equipments and guidelines of measurement parameters are enunciated. Treatment plans, as per protocol, are evaluated viz. Contouring structures from CT Images, prescription points for dose delivery, optimization, isodose evaluation, DVH, dwell times and a 3-D dose reconstructed images, etc. followed by a final verification after delivering the treatment at the console. The average bladder dose remained within 38-53% while the rectum dose evaluated to be < 27% of the prescription dose (Rx).

Figure 1 presents the differential between age groups and modality of treatment procedure:

Key words: cervical cancer, Co-60, HDR brachytherapy, MultiSource.

Brachytherapy of prostate cancer: first experience with Co-60

Alexey Molokov, MD, D.A. Shutov, MD

Department of Medical Physics, Regional Clinical Oncology Center, Khabarovsk, Russia

e-mail: aleksejmol@rambler.ru

Purpose: In the Russian Federation prostate cancer takes the 4th place (6.1%) in the structure of oncological diseases after malignant neoplasms of lungs, stomach and skin, and it takes the 1st place among onco-urological pathology. In 2009, the number of 733 patients with prostate cancer in the Khabarovsk Region were registered. For the first time in 2009 there have been revealed 165 cases, among which 58 patients with I-II stage (35.1%), 47 with III Stage (28.5%), 60 cases with IV stage (36.4%). Therapeutic approach choice for prostate cancer treatment has always been a challenge. Traditional treatment mode for localized forms of prostate cancer is radical prostatectomy. However, it is a major, complex and traumatic operation. Its application is limited due to high risk of complications like heavy bleeding, erectile dysfunction, urinary incontinence, etc. For years, external beam radiation therapy (teletherapy) has served an alternative to surgical treatment. The method is rather effective, although due to usage of high-dose irradiation (74-76 Gy) in radical programs a high percentage of radiation complications (radiation ulcers, hemorrhagic proctitis and cystitis) has been observed, and their relief represents a long-term complicated task. Thus, prostate cancer is a great medical and social problem. New approaches to the treatment and mitigation of complications are constantly being looked for. One of such methods is represented by brachytherapy. Brachytherapy (from the Greek *«brachios»* – near, close to) deals with the delivery of radiation therapy directly into the tumor center. One of the main advantages of this method is the local dose distribution from one source and the ability to implement sources directly into the tumor, allowing to minimize errors due to patient positioning and internal organ motions. In 2005, the Regional Clinical Oncology Center had set up two MultiSource® with Co-60 sources. This equipment was exclusively used for the treatment of gynecological tumors. In November 2009, the HDR irradiation equipment for prostate was acquired. Specialists received specific training at various bases during the process of new technology introduction. More than ten ultrasound researches of prostate were conducted and two transperineal prostate biopsies were performed under transrectal ultrasound (TRUS) control. The first patient was treated on 15th of April 2010.

Material and methods: We performed treatment of 10 patients with prostate cancer T2N0M0 during the period from April to December 2010. The average patient's age was 67 years (ranged 66-74 years). Adenocarcinoma of the prostate, Gleason score 2-7 has been morphologically diagnosed for all the patients. Prostate volume constituted 30-42 cm^3 during the examination according to the TRUS data prior to brachytherapy. PSA values prior to treatment ranged from 1.68 to 26.4 ng/ml. The following irradiation conditions were provided during treatment - the first step was prostate brachytherapy (10 Gy, 2 fractions in 14 days), followed by radiotherapy interval up to 3 weeks and the second stage included teletherapy in the region of prostate and regional lymph nodes 44-46 Gy.

Results: While performing the RT in this mode the critical organs (urethra, rectum, and bladder) received radiation exposure within acceptable levels. No complications were detected in all the patients treated during case follow-up period after prostate brachytherapy. Prostate volume decrease was observed by an average of 30% in 1-2 months after treatment during check examinations according to the TRUS. Dynamics of the PSA level was not monitored due to short terms of observation.

Conclusions: For patients with localized prostate cancer, as well as for patients with locally advanced disease (with a favorable prognosis) organ-saving alternative to surgery is a combined radiotherapy (CRT), one component of which represented by brachytherapy. This technique allows to achieve good results while minimizing radiation complications and absence of post-operative complications. Brachytherapy is an advanced, high-tech, effective and sparing method of radical radiotherapy of prostate cancer for patients of the favorable prognostic group.

Key words: prostate cancer, HDR brachytherapy, Co-60, MultiSource.

The history of brachytherapy in Russia: comparison of Co-60 vs. Ir-192 sources

Irina Bocharova, PhD

Moscow Research Oncological Institute n.a. P.A.Hertsen, Moscow, Russia

e-mail: bocharova@msm-medical.ru

Purpose: Brachytherapy is known as the first historical method of radiotherapy. At the beginning of its development it was used only as a manual applications of liquid solutions of nuclides. Only in the middle of 50s specialized machines for automatic afterloading have been designed. The first types of the machines were those with pneumatically driven pellets of Cs-137. The main advantage of this nuclide was its long half-life time of about 30 years resulting in long periods between source replacements. However, due to the same reason, it was impossible to provide

high source activity within small pellets. As a result, those machines can be defined as those of low dose rate (less than 2 Gy/hr.). Patients had to spend 1-3 days with the applicators inserted in order to obtain the full therapeutic dose of 24 Gy. Later on, brachytherapy machines of medium and high dose rate were designed, as soon as various treatments methods as well as radiobiological models and calculation methods had been developed. This allowed to deliver irradiation in many fractions, so that it simulates low dose rate mode with its prolonged treatment time. These machines used one or several sources moving from one treatment position to another after previously calculated program. The first similar device in Russia – AGAT-VU – used sources of Co-60. The AGAT-VU was oriented mostly on gynecological cancers. It had 3 channels and 3 sources. The source size was quite big: the outer dimensions were 1.5 x 10 mm. The reactor technologies of that time allowed to reach activities of no more than 1 Ci. Thus, minimal applicator diameter could not be reduced to less than 3 mm, and treatment time was quite long. At the same time in Europe, afterloading machines with Ir-192 were developed. Due to very short half-life time (74 days), Ir-192 allows to obtain very small sources with much higher activity. Therefore, the list of possible applications for Ir-192 is much wider. Currently, a standard afterloading Ir-192 source is considered as that of approximately 1 mm diameter x 5 mm, with the nominal activity of 10 Ci at the delivery time. But lower half-life time leads to frequent source replacements (each 3-4 months). We will try to analyze the results of treatment more than 4000 patients treated with brachytherapy machines with Co-60 and Ir-192. Comparing results of local control and acute and long-terms complications bring us to the conclusion that there is no clinical difference in treatment with these two sources.

Material and methods: In our Institute, from 1986 to 2006 we have worked with Russian machine AGAT-VU; since 1997 till now – GammaMed-12i and since 2009 – Multisource HDR are used. AGAT-VU was applied in gynecological cancers (more than 2000 patients), as well as in rectum (more than 300 cases), esophagus (84 patients), trachea and main bronchi (43 cases). With GammaMed-12i we added interstitial methods (more than 150 patients), nasopharyngeal zone (15), bronchus of 3rd-4th level (32), superficial skin irradiation (67 cases). The Multisource HDR was used to treat gynecological tumors (more than 100 patients), rectum (23), esophagus (12) and superficial tumors (11 cases).

Results: The comparison of clinical results did not show significant differences in local tumor control, nor in complication frequency. Early reactions with Ir-192 were slightly higher almost in all cases; that happened due to high source activity. The similarity of results for Co-60 and Ir-192 seems to origin from the fact that the dose distribution for both sources are quite similar. At the distances of several centimeters, the dose important for brachytherapy depends mostly on the geometrical factors of $1/r^2$, where the radiation absorption is negligible. In recent years, new technologies have been developed, allowing to produce Co-60 sources of the same size (1 x 5 mm) with nominal activity of up to 2.2 Ci. Taking into account that Co-60 has much higher gamma equivalent than Ir-192, it is comparable to almost 6 Ci of Ir-192, and the activity of Co-60 decreases slower at many times. At the moment of replacement of Ir-192 after 3-4 months, its activity is as low as 2-3 Ci (equivalent to 0.5-0.6 Ci of Co-60). The replacement of Co-60 is determined by its mechanical wear and tear, so it can work up to 5 years or more, loosing just one half of its nominal activity. Nevertheless, at the moment of source replacement, the effective activity of Co-60 is several times higher than that of Ir-192. In addition, the energy spectrum of Co-60 is significantly simpler than Ir-192. Thus, the dose calculations for Co-60 are easier, faster and more precise.

Conclusions: Using of Co-60 for HDR brachytherapy seems more preferable than Ir-192. On the one hand, Co-60 gives more clinical opportunities, on the other hand it significantly reduces the maintenance costs. We can predict that in the nearest future the Co-60 afterloaders will exclude Ir-192 from the clinical practice.

Key words: HDR brachytherapy, gynecological cancer, superficial brachytherapy, Co-60, Ir-192.

Experiences with HDRplus treatment planning

Mikio Nemoto, MD, Takako Mori, MD,
Masanori Nakazawa, MD

Department of Radiology, Jichi Medical University Hospital,
Shimotsuke-shi, Tochigi-ken, Japan
e-mail: nmtmk@jichi.ac.jp

Purpose: The Co-60 MultiSource System was introduced to our institution in September 2006. We present several cases treated with this system, and discuss some points to be corrected.

Case presentation and results: 1) Intraoral mold brachytherapy to hard palate cancer (Asian, female, 87 years) with previous history of radiotherapy to the same site. Surgical operation was not accepted, and mold brachytherapy for recurrent tumor was chosen. Applicator-Mold and the paired lower mold stabilized the treatment reproducibility. As multiple channel connectors were confusing to be identified, numbering of each applicator was necessary. 2) Interstitial irradiation to tongue cancer (Asian, female, 81 years). Patient refused the brachytherapy through submental route under general anesthesia. We selected to insert applicators through oral route. After local anesthesia, inserted applicator was fixed with held caps. As the hole size was too-tight, we could not use fixation ball Rasin that made spacer well suppressed to the movement of the applicator. 3) Standard intracavitary irradiation to cervical cancer. It was very efficient, because of the data of the applicator as its real shape in the software.

Separated ovoid was easy to be inserted and assembled in the vagina. Problems were as follows: 3.1) spacing ovoid ends could not be reproduced in each fraction; 3.2) built-in screw of ovoid caps becomes worn with repeated use; 3.3) applicator fixation special clamp to the base plate had a little difficulty when vaginal position was not fitted in obese patients; 3.4) cluster function which utilizes the previous dwell point and time, did not register separately the position of the applicator, the source position, dwell time, and set of the control point.

Conclusions: Mold treatment was successful with this system. Junctional end-mark on the needle applicator, if numbered additionally, would be helpful. Brachytherapy for tongue cancer was feasible through oral route, however held cap holder should have been changed so the application of this method. We would like the current holder to have a handle with an acute angle made. Intracavitary brachytherapy with HDRplus was standardized at our institution. Several improvements of the tools would be ideal, i.e. ovoid spacing marker, built-in screw, screwdriver, applicator fixed device, and cluster function.

Key words: hard palate cancer, mold treatment, HDR brachytherapy, Co-60.

Brachytherapy with MultiSource® – for a higher standard in HDR brachytherapy

Kentaro Mazur, Antonius Spiller

IBt Bebig, Berlin, Germany
e-mail: Kentaro.mazur@ibt-bebig.eu and Antonius.spiller@ibt-bebig.eu

MultiSource® by IBt Bebig is a genuine HDR afterloader which has become even superior in 2011. Amongst new features like the 40 Channel Support, which enables to conduct complex implants with up to 40 channels, or the Channel Coding, an additional safety feature that reduces human errors to a minimum, the MultiSource® provides state of the art proven HDR features like the Integrated In-Vivo Dosimetry System or the Integrated Calibration System. Furthermore, IBt Bebig enables the MultiSource® customers to choose between a proven and reliable Ir-192 source or a particularly cost-effective miniaturized Co-60 source which is exclusively manufactured by IBt Bebig. High standard HDR brachytherapy cannot be conducted without the necessary accessories. With an eye on actual worldwide cancer statistics and permanent contact to the physicists and clients, IBt Bebig continuously expands its applicator portfolio for different body sites according to the patient's requirements. Among others, a new breast template with fixation buttons was introduced and an outlook on upcoming applicators (most notably a full ring applicator) was presented.

Finally, a short outlook about the new HDRplus™ 3.0 treatment planning system has been given. In addition to proven basics from HDRplus™ 2.6.4 like the DICOM RT functionality or the Real 3D contouring, a new and innovative features have been implemented. The Automatic Image Fusion enables users to synchronize CT and MR images within 30 minutes in order to achieve optimal visual results from both imaging technologies. The automatic Applicator Reconstruction identifies implanted breast needles and visualizes them in 3D in order to simplify treatment planning. HDRplus™ is exclusively available with an optional prostate module only for the MultiSource® by IBt Bebig, a leader in brachytherapy.

Key words: brachytherapy, MultiSource, Co-60, HDRplus.

HDR Brachytherapy in Breast Cancer. Experience of Le Littoral Cancer Centre

Prof. Redouane Samlali, MD

Department of Brachytherapy, Casablanca Clinic, Casablanca, Morocco
e-mail: samlali.r@menara.ma

Purpose: We will present technical aspects of HDR brachytherapy of breast cancer especially within the framework of a conservative strategy. Also, we will talk about some non-classical indications providing a specific monitoring.

Material and methods: In a private Le Littoral Cancer Center, the Department of Brachytherapy started its activity in July 2010. We chose HDR brachytherapy with the Co-60 source because of the reduced treatment time and the ambulatory treatment in contrary to the LDR brachytherapy requiring 2 days of hospitalization on average. Furthermore, the use of a Co-60 source with a half life of 5 years makes the treatment more accessible. HDR sources with Ir-192 have only a half life of 74 days, which is very expensive and limits the practicability of this treatment in Morocco. In our clinic, the MultiSource System is installed in the room of the external radiotherapy treatment. When implementing the HDR treatment option we have been impressed by the quality of 3D Treatment Planning System HDRplus delivery. Until today we have treated 37 breast cancer patients with Co-60 HDR brachytherapy.

Technical aspects of boost in breast cancer: The first step of brachytherapy is the tracking of the target volume

to be treated. Sometimes ultrasonography is used to visualize post surgical cavity with a sterile felt-tip pen that allows the placement of hollow needles by following the drawn points. We place the hollow needles by covering all the volume to be treated and by respecting the main rule of brachytherapy which means parallelism and equidistance. Through the hollow needles the flexible implants are introduced. X-ray markers are applied to identify the different channels in the 3D visualization.

Treatment plan: When the implantation is finished, a CT Scan images are taken and the paths of the flexible catheters are identified. A 3D reconstruction is supported by the treatment planning system HDRplus. The radiotherapist accomplishes the contouring. It is necessary to keep away at least 1 cm from skin, and to identify critical organs chest wall and lung. These precautions improve the tolerance. The software allows displaying the target volume and the path of flexible catheter as well as the critical organs especially skin, lung and chest wall. The treatment planning system calculates the ideal 3D dosimetry: on the one hand good distribution of the dose around flexible catheters in the target volume; on the other hand, sparing of the critical organs. Via dose volume histogram the software enables the radiotherapist to check the dose in critical organs. Once the plan is validated the flexible catheters are connected to the MultiSource®.

Intra-operative brachytherapy boost: In more than 20 years, we have performed intra-operative brachytherapy by LDR with Iridium-192. At the present, we perform a boost by intra-operative HDR brachytherapy with the MultiSource®. The treatment is realized at the time of the surgery. This allows better determination of the target volume.

***Doses in Co-60 HDR brachytherapy*:** we used a boost dose: 2 fractions of 5 Gy with interval of 6 hours; for the APBI we applied a total dose of 34 Gy in 10 fractions twice daily.

Results: Skin complications have dominated in our series. This can be explained by the fact that sometimes the range of 1 cm from skin was not respected. These complications have never exceeded the stage of grade 2 for radiodermatitis and are regressing without a sequel. Hence, when we respect the rules of brachytherapy, we can achieve good aesthetic results.

Conclusions: The first results show that HDR brachytherapy is a realisable therapeutic option in breast cancer treatment. HDR with a Co-60 source is economically accessible; the further follow up of patients is very important.

Key words: HDR brachytherapy, breast cancer, Co-60, boost.

HDR-brachytherapy for internal mammary lymph nodes in breast cancer patients

Prof. Alexander Petrovsky, MD, Vartan Gevorkyan, MD, Mikhail Nechushkin, MD

Russian Cancer Research Center, Moscow, Russia
e-mail: alexpetrovsky@hotmail.com

Purpose: It is well known that mediastinum, lungs, heart, spinal cord are the unwishful targets in distant radiation therapy at the parasternal zone in breast cancer patients. Different treatment-related morbidity has been observed. That was the reason for the modern radiation therapy application at this zone. It has been shown that internal mammary artery is the optimal natural pathway for the radiation sources which leads to symmetrical irradiation of internal mammary lymph nodes. Our goal was to identify the efficacy of breast cancer treatment depending on the parasternal brachytherapy using Co-60 or Cf-252 sources in comparison with Microselectron-HDR Ir-192 afterloading and to analyze long-term results in each group.

Material and methods: 868 patients with central and medial location of the tumor underwent parasternal brachytherapy. In 575 women (66.2%) Co-60 was used, in 194 (22.4%) Cf-252 was used, and 99 patients (11.4%) had afterloading Microselectron-HDR irradiation with Ir-192. Medium age was 48.2 (± 15.8) years in the first group, 50.8 (± 12.6) years in the second group, and 49.7 (± 9.8) years in the third group. I stage had 98 patients (11.3%), IIA – 388 (44.7%), IIB – 202 (23.3%), IIIA – 121 (13.9%), IIIB – 59 (6.8). All women with T3 and T4 (62 – 19.8%) were treated with a standard preoperative chemotherapy. Manual installation of Co-60 or Cf-252 sources was performed for the time necessary for the prescribed dose to be achieved. The isodose at the specification point was 80 Gy, while at 2 cm from the medial field edge total dose was at least 36 Gy. A total dose of 45 Gy in three 15 Gy fractions was delivered to the internal mammary lymph nodes using Ir-192 afterloading. No significant complications associated with brachytherapy were registered.

Results: With a median follow-up of 118 months no significant difference in 15-years disease-free and overall survival was detected in all brachytherapy techniques.

Conclusions: The Microselectron-HDR Ir-192 afterloading technique is consider to be preferable to manual Co-60 and Cf-252 radiation source installation due to decreased medical staff irradiation. It has become apparent that distant radiation therapy is a cause of significant morbidity, especially among long-term survivors. If the internal mammary nodes are to be treated we suggest using afterloading brachytherapy technique.

Key words: HDR brachytherapy, breast cancer, Co-60, Cf-252.

Radiochemotherapy for cervical cancer with cisplatin

Alexander P. Seryakov, MD, PhD, Prof., K. Lyadov, MD, PhD, Prof., Ch. Salchak, MD, PhD

Oncology Department, Medical and Rehabilitation Centre, Moscow, Russia

e-mail: alseryakov@yandex.ru

Purpose: to improve the results of combined radiotherapy in patients with common forms of cervical cancer by applying cisplatin.

Material and methods: 160 patients with IIB-IIIB stages of cervical cancer were divided into 2 groups: study group – 60 patients who underwent radiochemotherapy with cisplatin and a historical control group – 100 patients who received only combined radiotherapy. The age of the patients ranged from 40 to 59 years old. The examination of patients included: general and gynecological status, morphological characteristics, ultrasound, CT and other investigations that allowed us to determine linear dimensions and volume of the primary tumor and extraorganal spreading of the tumor. The indication for radiochemotherapy was low differentiation of the tumor or its "aggressive" morphological type (adenosquamous carcinoma, adenocarcinoma), extensive local distribution of tumor process, infiltrative-ulcerative or endophytic forms of tumor growth and relatively young age. Combined radiotherapy on radical program was carried out for all patients. External radiotherapy as a component of the combined radiotherapy was conducted using gamma apparatus "ROKUS AM" and "THERATRON". The internal radiotherapy was carried out on the modern computerized HDR afterloader MultiSource® for brachytherapy. Cisplatin was administered once a week during 5-6 weeks, i/v by 40 mg/m^2, up to a total dose of 360-490 mg.

Results: Analysis of general reactions on the scale of the toxicity of CTC has not revealed statistically valid distinction based on their frequency and severity for the study and the control groups. The integration of cisplatin into the combined radiotherapy did not require any corrections of administrated dose and pauses in the treatment. The technology of treatment showed a high efficiency of the method with minimum number of radiation reactions and complications. The study group full tumor regression was observed in 40% of patients, and in the control – in 20%. Proportion of survivors while assessing the one-year and three-year survival rate is higher in the study group ($p < 0.05$).

Conclusions: The integration of cisplatin into the combined radiotherapy is a good safe option: we noted no additional toxicity as compared with combined radiotherapy alone and better 3-year survival. All this factors allows to consider this technique quite effective both in terms of patients treatment and in terms of quality of life and medical and social rehabilitation of this serious cases.

Key words: radiochemotherapy, brachytherapy, cisplatin, cervical cancer.

Nursing Care for uterine cancer patients utilizing the MultiSource® HDR system

Takako Mori, certified radiation therapy nurse in Japan

Department of Radiology, Jichi Medical University Hospital, Shimotsuke-shi, Tochigi-ken, Japan

e-mail: t.mori@jichi.ac.jp

The purpose of this presentation is to review the role of radiotherapy specific certified nurse and to share information regarding the nurses capability of completing the treatment using the MultiSource® HDR system. Subjects to be reviewed in detail are: 1) outline the status of brachytherapy at our institution; 2) overview of the treatment process; 3) symptoms associated with intracavitary brachytherapy; 4) nursing care during treatment. Overview of the treatment process, as in point 2, includes following nurse's special role, i.e.: 1) orientation; 2) schedule coordination with external radiation; 3) patient premedication before entering the treatment room. Nursing care during intracavitary radiotherapy, as in point 4 has four important tasks such as: 1) to ease anxiety of patients; 2) to assist safe and secure treatment; 3) to manage adverse effects; 4) to improve the quality of medical team.

In conclusion: 1) uterine cancer requires a multidisciplinary approach, thereby specialized nursing care is strongly recommended; 2) intracavitary brachytherapy, without general anesthesia develops critical symptoms such as pain and anxiety, G-I or genitourinary symptoms, etc.; 3) radiation therapy nurses should understand the overall course of treatments, and offer appropriate care with specialized knowledge and full experience.

Key words: uterine cancer, nursing care, intracavitary radiotherapy, MultiSource.

Quality standards for seed implantation

Frank Kahmann, MD

Gemeinschaftspraxis Drs. Henkel & Kahmann, Berlin, Germany
e-mail: Dr.Kahmann@t-online.de

There is a multitude of options for the treatment of localized prostate tumors. The most common are radical prostatectomy, external beam radiation and seed brachytherapy. There are currently no prospective randomized trials comparing these options. In order to remain accepted as an equal treatment option, a stringent quality control is necessary to achieve and maintain constant results. Quality control for prostate brachytherapy consists of three steps: 1) preoperative; 2) intraoperative; 3) postoperative. The first and probably the most important step is the right indication: PSA < 10, Gleason < 7a, clinical stage T1-T2b. If the indication is correct the results are shown to be excellent with tumor specific 10 year survival of 98% (Grimm *et al*. 1998). Nowadays, the data with a follow up of 15 years and more support these figures. Intraoperative quality starts with an interdisciplinary professional OR team. A minimum number of 60 treatments has been established as a learning curve and an annual flow of 30 patients is needed to maintain the quality. The third step is the postoperative quality control with a CT based post plan to recalculate the doses given to the prostate and the organs at risk. For iodine implants this should be done 4-6 weeks after the implant. Dose parameters such as V100, V150, D90 and other should be calculated. Those dose parameters correlate with the survival of the patient (D90) as well as the toxicity (V150). The post plan dosimetry is the only way to control the quality of the implants and predict the outcome for the survival and the toxicity experienced by the patient. This enables us to continuously work on our implant technique. Even after performing more than 2000 implants we are still improving the technique. We could show that improvements in dose planning permited us to use less seeds per prostate volume and at the same time achieve a higher V100 and a lower V150. We could also show that those improvements in dose delivery were not only an academic interest, but also resulted in lower side effects such as less nycturia reduction of frequency and obstructive symptoms as well as impotency. In conclusion, quality control for prostate brachytherapy is imperative. Only centers with a high number of patients (> 30 patients) can achieve constant results. These results however are necessary for brachytherapy to remain accepted as a primary treatment option for the localized prostate tumor.

Key words: prostate cancer, I-125, seeds, Quality Standards.

Prostate Seed Treatment with IsoCord®-Seeds from IBt-Bebig

Janusz Skowronek, MD, PhD, Ass. Prof.

Brachytherapy Department, Greater Poland Cancer Centre, Poznań, Poland
e-mail: janusz.skowronek@wco.pl

Prostate cancer (CaP) is the most common malignancy in men in many countries (US, Netherland, Japan, Spain etc.). The present treatment options include radical prostatectomy, external beam radiation therapy (EBRT), temporary and permanent brachytherapy, hormonal therapy, and watchful waiting. The proportion of patients treated by permanent brachytherapy is rapidly increasing, because brachytherapy offers several practical and theoretical advantages over EBRT in selected patients. Firstly, due to the physics of radiation emanation from the implanted radioisotope, there is a dose escalation within the prostate, with rapid dose fall in surrounding normal tissues. Target motion, set-up variation, and localization errors from day-to-day are not of major concern as they are with EBRT. Brachytherapy is a simple, outpatient procedure that avoids hospitalization and allows an early recovery of the patient as well as rapid return to normal activity. With widespread patient education of the availability of the treatment options, its advantages have become more apparent to the general public. It was estimated that of 190 000 patients diagnosed in US with localized prostate cancer in 1996, only 8000 (4.2%) were treated using brachytherapy, but in 2006 about half of patients were treated by brachytherapy. The advantages of low-dose-rate brachytherapy are good quality of life after treatment, high survival rates and short, one-time hospitalization. All this requires accurate dose distributions planning. In this presentation the usefulness and superiority of IsoCord® stranded seeds used in prostate brachytherapy are analyzed. Differences in CaP treatment methods in alternate countries are presented. It seems that similar tendencies in CaP incidence observed in highly developed countries are expected in Eastern Europe and Asia. One of the main difficulties in growing use of seeds are high costs (lack of reimbursement in some countries) and small number of trained radiotherapists. Greater Poland Cancer Centre experience in using IsoCord® stranded seeds is presented with analysis of clinical data and treatment plans. 57 patients (ranged 50-82 years) were treated since 2008 in median age of 63.8 years. In LDR-BT monotherapy prescribed dose was 145 Gy. Results confirm practical usefulness of IsoCord® stranded seeds.

Key words: prostate cancer, stranded seeds, IsoCord®, LDR brachytherapy.

The role of LDR and HDR brachytherapy in the management of early and intermediate stage prostate cancer

Jean Michel Hannoun-Levi MD, PhD, Prof.

Antoine Lacassagne Cancer Center, Nice France
e-mail : Jean-Michel.HANNOUN-LEVI@nice.fnclcc.fr

Brachytherapy for prostate cancer (PC) was used for the first time with radium sources in 1910 and 1911 in the US and in France, respectively. The techniques continued to improve rapidly during the last century. Currently, permanent (Iodine 125, Palladium 103) or temporary (Iridium 192) implants can be proposed for the treatment of low or intermediate/high risk PC, respectively. Whatever the indication and the technique, let us not forget the fundamentals of brachytherapy i.e. the "3S system": **S**mart dose, **S**mall volume and **S**hort time. Furthermore, PC represents a specific entity for brachytherapy due to the presence of an organ at risk (the urethra) inside the target volume. Low-dose rate (LDR) brachytherapy is proposed to the patients with a low-risk PC (stage ≤ T2A, PSA < 10 ng/ml, G ≤ 6) and good urinary function (IPSS score < 12, residual urine volume < 50 ml and urinary outflow Qmax > 15 ml/s). Regarding efficacy, LDR brachytherapy provides excellent biochemical control ranged between 85% and 90% at 10 years. Most urinary symptoms resolve within 12 months after prostate implant, and significant long-term urinary toxicity remains very low. In terms of rectal toxicity, in most patients the changes are minimal and slowly resolve with time. The 7-year actuarial rate of potency preservation is ranged between 50% to 60%. A recent phase III randomized trial analyzing urinary and sexual outcomes after radical prostatectomy versus iodine implant reported better results after brachytherapy in terms of erection ability (p = 0.007) and quality of erections (p = 0.002). High-dose rate (HDR) brachytherapy is mainly used as a boost for intermediate and high-risk PC. It is well known that dose escalation is significantly correlated with a better biochemical control. However, the rate of G2-3 GU and GI toxicity is significantly higher after high doses delivered through a 3D external beam radiation therapy (EBRT). Intensity modulated 3D EBRT can reduce GU and GI side effects, but security margins are always warranted in order to properly cover the CTV due to the prostate motion. Using HDR brachytherapy, the prostate AP-PA motion (rectum distension) appears less important, because the needles move with the prostate itself, but catheter craniocaudal displacement must be corrected before each fraction. Two randomized trials comparing EBRT vs. EBRT plus brachytherapy boost (LDR or HDR) concluded the superiority of brachytherapy boost in terms of biochemical control. Interstitial brachytherapy (LDR or HDR) for PC remains an efficient and precise technique to increase the dose delivered to the prostate without delivering a prohibited dose to the organ at risk. In order to promote this technique, it remains crucial to teach it and to obtain an appropriated reimbursement.

Key words: prostate cancer, HDR brachytherapy, I-125, LDR brachytherapy.

Ru-106 Plaque brachytherapy: indications and outcome in ocular tumors

Vijay Anand P. Reddy, MD, Santosh G. Honavar, MD, Surbhi Joshi, MD, Mohd Javed Ali, MD, Milind N. Naik, MD, Padma Ganesan, MD

Ocular Oncology Service, LV Prasad Eye Institute, Hyderabad, India
e-mail: vijayapredddy@hotmail.com

Aim: To evaluate Ruthenium 106 (Ru-106) plaque brachytherapy in the management of intraocular and adnexal tumors.

Material and methods: A retrospective review of the medical records of 118 eyes of 118 patients at the LV Prasad Eye Institute (January 2001 – December 2010) identified a spectrum of ocular tumors managed with Ru-106 plaque brachytherapy. We analyzed the patient demographics, tumor characteristics, radiation parameters, and the outcome. Tumor recurrence and eye salvage were the main outcome measures.

Results: The tumors included uveal melanoma (38), ocular surface squamous neoplasia (25), choroidal hemangioma (35), retinoblastoma (18) and choroidal metastasis (2).

Uveal melanoma: The mean patient age was 47.1 (range 17-76) years. There were 23 male patients. Plaque brachytherapy was the primary treatment in 97.3% patients. The mean tumor diameter was 12.1 (7-21) mm and mean height was 5.3 (3-8) mm. A notch plaque was used in 76%. The mean tumor apex dose was 96.4 (range, 67.3-151.9) Gy and mean duration for treatment was 117 (45.7-261.9) hours. We analyzed results of patients who had completed 1 year of follow up (n = 32). Tumor regression and eye salvage was achieved in 82%, and 71.4% with useful residual vision (> 20/200). Complications included scleral necrosis (6.2%), vitreous hemorrhage (6.2%), radiation retinopathy (3.1%), cataract (3.1%), and retinal detachment (3.1%).

Ocular surface squamous neoplasia: The mean patient age was 48.2 (range, 33-71) years. There were 14 male patients. Plaque brachytherapy was used to manage resid-

ual (excision base involvement on histopathology) or recurrent OSSN. The mean tumor diameter was 9.8 (5-15) mm, and mean height was 2.3 (1.5-3) mm. A round plaque was used in all cases. The mean tumor apex dose was 56.1 (range, 48.9-67.4) Gy and mean duration for treatment was 22.3 hrs. We analyzed results of patients who had completed 1 year of follow up (n = 20). Tumor regression rate was 84.2%, eye salvage was achieved in 78%, and 63.2% with useful residual vision (> 20/200). One patient each had scleral necrosis and corneal epithelial defect.

Choroidal hemangioma: The mean patient age was 32.1 (range, 9-70) years. There were 20 male patients. Plaque brachytherapy was used as primary treatment in patients with choroidal hemangioma with diffuse subretinal fluid. The mean tumor diameter was 9.4 (8-18) mm, and mean height was 5 (3.6-9) mm. A notch plaque was used in 91.4%. The mean tumor apex dose was 35.6 (range 24.9-60.2) Gy and mean duration for treatment was 48.2 (16-97.4) hrs. We analyzed results of patients who had completed 1 year of follow up (n = 21). Tumor regression rate was 95.2%, eye salvage was achieved in all and 57.9% with an improvement of visual acuity (> 2 Snellen lines).

Key words: Ru-106, ocular tumors, plaque brachytherapy.

Surface Brachytherapy of skin with individual applicators

Andrey Chernichenko, MD, PhD, Prof., Anna Boiko, MD, Irina Mescheryakova, MD, Vyacheslav Gerasimov, MD

Moscow Research Oncological Institute n.a. Hertsen Moscow, Russia
e-mail: chernandr@mail.ru

Purpose: Implementation of Quality of Life (QL) program in brachytherapy via using individually developed surface applicators.

Material and method: Brachytherapy (contact X-Ray therapy) is a trend in radiation therapy, that experience another stage of its development on the basis of modern radiotherapy techniques. Brachytherapy is used usually in combination with teletherapy or as a boost for dose escalation in focus. Now, it is possible to conduct brachytherapy using spatio-temporal optimization, as close as possible to the principles of conformity. In our country there is no cumulative experience of treating patients with the help of brachytherapy.There are no standards to determine the normalization point, such as point A and B in the treatment of gynecologic cancer. The National Oncology Project, which was launched in 2009, include modern brachytherapy devices in the list of mandatory equipment of radiotherapy departments. Thus, the development and putting in practice intracavitary, intrastitial and surface irradiation are actual. Surface brachytherapy with the use of individual applicators is of particular interest especially for large tumors of face skin usually with a different depth of invasion (fronto-temporal region of the transition to the superciliary arch, scalp, including the destruction of bone structures and the defeat of the dura mater, back the nose, nasolabial triangle).The presence of critical organs close to the field and anatomic features of the tumor does not allow the traditional methods of radiotherapy. In Moscow Research Oncological Institute n.a. Hertsen, a new technique of surface brachytherapy was developed with the help of individual applicator, permitting placement of the radioactive source closely to the tumor for optimal reproducibility during the course. This could be achieved because each of applicators is made individually on the base on CT scans. The applicators are produced at the laser stereolithography facility. The applicators are made from a photopolymerizable composition based on acrylic oligomer. This material meets the sanitary and technical requirements for such products and does not accumulate radiation, is not toxic for topical use and can be a subject for cold sterilization.

Results: This technology allows radiation therapy of patients with malignant tumors of the skin (including face, scalp) of a large area, with different depth of tumor invasion, as well as the anatomical and topographical location of the tumor. The result of it is the improvement of the QL, avoidances of mutilating operations and, in some clinical situations, it can be considered as an alternative to surgical treatment. Our subsequent developments have led to individual applicator for the treatment of surface cancer, taking into account the size of the tumor and organ. Along with this, the individual applicator ensures reproducible irradiation conditions from session to session.

Conclusion: Current actual development and implementation methodologies brachytherapy with the aim of a radical treatment in patients previously recognized incurable and palliative treatment to ensure the QL for patients. Such individual approach to brachytherapy allows to increase indications of radical radiotherapy as an alternative to damage surgical treatment and sometimes as the only possiblity of special tumor treatment.

Key words: surface brachytherapy, skin cancer, Quality of Life.

HDR brachytherapy at University College Hospital, Ibadan, Nigeria

A. A. Adenipekun, MD, Ass. Prof.,
Theresa Elumelu-Kupoluyi, MD
University College Hospital, Ibadan, Nigeria

Introduction: In 2008, the Ibadan University College Hospital (UCH) became the first centre in Nigeria/West Africa to acquire a High Dose Rate Brachytherapy facility – the GyneSource from Eckert & Ziegler BEBIG GmbH, Germany. This was in the context of an International Atomic Energy Agency (IAEA) project. The 5-channel GyneSource was supplied with the treatment planning system HDRbasic, as well as Co-60 source. The activity of the source at time of installation was 74.75 GBq. The IAEA also acquired a C-arm mobile X-ray machine for imaging. The installation was completed on 2nd August, 2008.

Quality control and treatment accessory: The quality control (QC) equipment for source calibration and daily QC measurement were delivered by IBt Bebig. The applicators were supplied together with the afterloader. For gynaecological patients, the ring applicators (30^0, 45^0 and 60^0) and vaginal cylinders were used.

Number of cases treated: Between August 2008 and January 2011, the following patients were treated with the IBt Bebig GyneSource brachytherapy system: 154 patients with cervical cancer (3 sessions per patient), 15 patients with vaginal cancer, 1 patient with oesophageal cancer and 2 patients with cancer of the anus. The patients with oesophageal or anal cancer were all male. Our usual dose per fraction ranged from 5-8 Gy.

Incidence of failure: When the system was initially installed we experienced some problems related to the local power supply which had not been allowed for the project planning. All these problems were solved, either by IBt Bebig, or by our technician, who had been trained by IBt Bebig to handle minor faults.

Advantages of HDR: The use of the IBt Bebig HDR afterloader in our centre has increased our ability to apply curative doses of radiation to patients with the early stages of cervical cancer. The treatment was performed on an outpatient basis. As there was no admission to hospital, there was less financial burden on the patients. As the treatment time is short, it allows accessibility to more patients. Additionally we are achieving better disease control with HDR in comparison to EBRT and chemotherapy.

Challenges: The afterloader was acquired without the in vivo bladder and rectal dosimetry system. In practice we have found that the absence of rectal and bladder probes makes it difficult for us to determine the dose distribution to these critical organs during treatment. We are therefore compelled to perform estimations. It has also become clear that a single set of applicators (ring and cylinder) is not sufficient, as they must be sterilised before reuse. The C-arm X-ray machine provided does not include electronic image storage devices, so that the patients images are printed on photographic paper.

Key words: HDR brachytherapy, Co-60, gynaecological brachytherapy.

HDR Brachytherapy using Co-60 in cervical cancer. Initial experience from the United Kingdom

Yoodhvir Singh Nagar, MD, Orla Hayman, MD,
Antony Palmer, MD
Department of Oncology, Queen Alexandra Hospital, Portsmouth, United Kingdom
e-mail: yoodhvirsingh.nagar@porthosp.nhs.uk

Introduction: The standard treatment for locally advanced unresectable cervical cancers is external beam radiotherapy (EBRT) + concurrent weekly cisplatin chemotherapy followed by intracavitary brachytherapy. In 2008, the Royal College of Radiology conducted a survey of gynecological brachytherapy services in the United Kingdom. The survey reported that only 52% centers use HDR Brachytherapy equipment and all have Ir-192 source. The most common (74% centers) brachytherapy planning technique remains the Orthogonal Films technique and 26% centers use CT/MRI information for planning brachytherapy. Still, the most common practice of dose prescription remains the Manchester point-A system. In our center we have used HDR brachytherapy since 1996 using Ir-192 source. However, we have replaced the Ir-192 with Co-60 source since June 2010. We present our very early and limited experience using the Co-60 HDR brachytherapy.

Methods: The treatment protocol for locally advanced cervical cancers at our center is EBRT to a dose of 50.4 Gy/28 fractions along with weekly cisplatin ($40mg/m^2$) x 5 cycles followed by HDR brachytherapy to a total dose of 17 Gy/2 fractions. For EBRT we use CT information and virtual simulation with appropriate shielding. For brachytherapy we initially used orthogonal films for planning until October 2010 since then we have started to practice Image guided brachytherapy (IGBT) using CT scans and outline the Intermediate Risk Clinical Target Volume (IR-CTV) and the High Risk Clinical Target Volume (HR-CTV) as defined by the GEC-ESTRO guidelines. However, we still prescribe the dose currently to the Manchester point-A. We did a retrospective analysis of 11 patients of cervical cancer who received the intracavitary brachyther-

apy with Co-60 source. The early results of response rates and acute toxicity were recorded for analysis.

Results: Since June 2010 to January 2011 we have treated 11 patients of cervical cancer using Co-60 source (5 with orthogonal planning, 6 with CT based IGBT). Four patients had Stage IIB, Stage III – 5, and Stage IV – 2 patients. Complete response following all treatment was seen in 9/11 patients with one patient showing partial response. One patient developed distant metastasis to the supraclavicular lymph nodes. All patients tolerated the treatment well with only grade 1-2 reactions except one patient who suffered a grade 3 diarrhea. The follow-up is not long enough yet to define long-term complications of using Co-60 source for brachytherapy.

Conclusions: Using the Co-60 HDR brachytherapy did not show any significant difference in response rates and toxicity when compared to the Ir-192 source. However, our experience is very limited and we will need further long-term follow-up to better define the advantages or disadvantages of using the Co-60 source HDR brachytherapy. Nevertheless, it would appear that there would be significant cost savings since source replacements would be needed every 4-5 years compared to Ir-192 every 3-4 months. Equipment down time and physics support time could also be potentially reduced by 40% by Co-60 source versus Ir-192 source.

Key words: cervical cancer, HDR Brachytherapy, Co-60, Ir-192.