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Central Europe User Meeting

Modern brachytherapy:

Role in multidisciplinary cancer treatment

13-15 October 2011,
Bratislava, Slovakia

Programme and abstracts

Central European Users Meeting
2nd Announcement

Modern Brachytherapy:

Role in Multidisciplinarycancer treatment

13 - 15 October 2011 - Bratislava - Slovakia

For more information, registration and abstract submission, please visit our website at **www.nucletron.com/** bratislava2011

Nucletron
Improving patient care

Introduction

Modern cancer management requires an increasingly multidisciplinary and often multimodality approach. Radiotherapy plays a key role, and the technological advances and clinical outcomes achieved with modern brachytherapy confirm its place in effective cancer management. The forthcoming Central Europe User Meeting, to be held in Bratislava, Slovakia 13-15 October 2011, will provide an opportunity to review and discuss the needs and solutions in the successful implementation of new brachytherapy techniques in the radiotherapy department.

Nucletron is proud to partner with health care providers in Central Europe, and to support the active and growing brachytherapy community in the region. Our aim is to suport your goals in bringing optimal solutions for the treatment of cancer patients. The theme of the meeting is “Gaining deeper understanding of the current state-of-the-art, while preparing for the future”. With this in mind, the program will focus on the latest insights and strategies, and includes a look at other indications and stakeholders in cancer patient care. The program will also feature a review of opportunities to build awareness of brachytherapy and how Nucletron can support you in laying the foundations for the further growth of brachytherapy in the region. We join the Scientific Committee in looking forward to seeing you in Bratislava.

Scientific Committee

Chairpersons
E. Boljesikova, MD, PhD.
P. Dubinsky, MD, PhD.
P. Lukacko, MD
Members
J. Kausitz, MD, PhD.
T. Salek, MD, PhD.
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P. Matula, PhD.
J. Finek MD, PhD.
D.Feltl MD, PhD.
C. Polgar, MD, PhD.
J. Skowronek, MD, PhD.

Scientific Topics and Themes

- Moving from 2D to Image Guided brachytherapy, with focus on gynecological cancer
- Breast brachytherapy: Boost and Accelerated Partial Breast Irradiation (APBI)
- Prostate cancer: radiotherapy versus prostatectomy
- User experiences in other therapeutic areas

Programme overview

Thursday 13th October 2011

SESSION: INTRO AND GYN
CHAIR: P. LUKACKO, MD

10:00-12:45	Registration
12:45-13:00	Welcome by Nucletron *P. Kingma, VP Sales and Service, Nucletron*
13:00-13:20	Opening and Welcome to Bratislava *E. Boljeskova, MD, PhD, P. Dubinsky, MD, PhD, P. Lukacko, MD*
13:20-13:55	Brachytherapy in gynecological cancer; the when, why, and who differentiators *Prof. R. Pötter, MD, PhD, Vienna, Austria*
13:55-14:30	Moving from 2D to 3D brachytherapy in gynecological tumors *P. Petrič, MD, Ljubljana, Slovenia*
14:30-15:00	Coffee break
15:00-15:30	Radiobiological evaluation in the complex treatment of gynaecological tumors based on 3D-planning and timing *P. Matula, PhD, Kosice, Slovakia*
15:30-16:00	OncentraBrachy 4.0: updates on Applicator library & Applicator model ling *E. Sewsingh, Nucletron*
16:00-16:15	User experience 1: Lung treatment *J. Skowronek, MD, PhD, Ass. Prof., Poznan, Poland*
16:15-16:30	User experience 2: The use of para-cervical anaesthesia in brachytherapy *P. Petrič, MD, Ljubljana, Slovenia*
16:30-16:45	Proffered paper 1: Retrospective analysis of 303 stage II and III cervical cancer patients treated with external beam radiotherapy and HDR brachytherapy *P. Dubinsky, MD, PhD, Kosice, Slovakia*
16:45-17:00	Closing remarks *P. Lukacko, MD, Bratislava, Slovakia*

Friday 14th October 2011

SESSION: BREAST
CHAIR: E. BOLJESKOVA, MD, PHD

9:00-09:30	Radiotherapy options in breast-conserving therapy *C. Polgar, MD, PhD, Budapest, Hungary*
9:30-10:15	Multicatheter Accelerated Partial Breast Irradiation (APBI) *C. Polgar, MD, PhD, Budapest, Hungary*
10:15-10:45	Coffee break
10:45-11:15	Clinical comparison of boost modalities in breast cancer: brachytherapy vs. external beam *V. Strnad, MD, PhD, Erlangen, Germany*
11:15-11:45	New insights to image based 3D PTV definition and planning *T. Major, MD, PhD, Budapest, Hungary*
11:45-12:00	Proffered paper 2: Is the improvement of dose distribution possible for single or multi-lumen interstitial breast balloon used for accelerated partial breast irradiation using IPSA optimisation algorithm? *G. Bieleda, MSc, Poznan, Poland*
12:00-12:15	Proffered paper 3: Whole scalp surface HDR brachytherapy – 2D and 3D reconstruction method: 2 cases report *M. Jasenčak, MD, Kosice, Slovakia*
12:15-13:15	Lunch

SESSION: PROSTATE
CHAIR: P. DUBINSKY, MD, PHD

13:15-14:00	Treatment options in localized and locally advanced prostate cancer: Urologist´s and Radiation Oncologist´s perspectives *Prof. J. Breza, MD, PhD, Bratislava, Slovakia & P. Dubinsky, MD, PhD, Kosice, Slovakia*
14:00-14:30	Clincial evidence for HDR and LDR (seeds) brachytherapy in early and intermediate prostate cancer *R. Galalae, MD, PhD, Herne, Germany*
14:30-15:00	Three years experience with permanent low-dose rate brachytherapy in localised prostate cancer *B. Obsitnik, MD, PhD & L. Bezak, MD, Bratislava, Slovakia*
15:00-15:30	Coffee break
15:30-16:00	Treatment planning and dosimetry in prostate LDR brachytherapy *G. Goldner, MD, PhD, Vienna, Austria*
16:00-16:30	Nucletron presentation Oncentra Prostate *P. Segers, Nucletron*
16:30-16:45	Proffered paper 4: Salvage HDR brachytherapy for local recurrences of prostate cancer: preliminary results *M. Gawkowska-Suwińska, MD, Gliwice, Poland*
16:45-17:00	Proffered paper 5: Volume assessment of the dose in the ICRU rectal and bladder points for the cervical cancer brachytherapy *M. Szlag, MD, Gliwice, Poland*
17:00-17:15	User experience 3: Head and neck treatment *V. Strnad, MD, PhD, Erlangen, Germany*
17:15-17:30	User experience 4: Pediatric brachytherapy *Prof. R. Pötter, MD, PhD, Vienna, Austria*
17:30-17:45	Closing remarks *P. Dubinsky, MD, PhD, Kosice, Slovakia*

Saturday 15th October 2011

SESSION: AFTERLOADING, VELOCITY, AND PLENARY DISCUSSIONS
CHAIR: E. BOLJESKOVA, MD, PHD, P. DUBINSKY, MD, PHD, P. LUKACKO, MD, P. MATULA, PHD

9:00-10:30	Plenary discussion: increasing brachytherapy awareness *J. Skowronek, MD, PhD, Poznan, Poland*
10:30-11:00	Coffee break
11:00-11:30	Safety and Quality in remote afterloading *E. van't Hooft, Nucletron*
11:30-12:00	Oncentra External Beam 4.0 *J. Pijpelink, Nucletron*
12:00-12:15	Closing remarks & Selection next location *E. Boljeskova, MD, PhD, P. Dubinsky, MD, PhD, P. Lukacko, MD*
12:15-14:00	Lunch & Departure

From Editor:
The authors are responsible for the content and linguistic accuracy of abstracts.

Thursday 13th
Oral presentations

Moving from 2D to 3D brachytherapy in gynecological tumors

Petrič P, MD, MSc
Institute of Oncology, Ljubljana, Slovenia

Purpose: The most widely used method of cervix cancer brachytherapy (BT) treatment planning is nowadays still based on dose specification and prescription at point A, defined on two orthogonal pelvic radiographs with the applicator in place. In endometrial cancer BT, various systems (My-point, S-point, A-line) have been used for dose specification in the context of X-ray based 2D BT [Gerbaulet A, ed. GEC ESTRO Handbook of brachytherapy]. Accordingly, the most commonly utilized approach to reporting the dose to the organs at risk (OAR) is based on the system of points, defined in the International Commission on Radiation Units and Measurements (ICRU) Report 38. Due to the lack of visual information on the relationships between the BT applicator and the pathoanatomical structures, the ability for clinically meaningful dose adaptation in 2D BT is limited. In patients with residual tumour at time of BT, that extends beyond the reach of the standard isodose distribution, parts of the tumor are not covered with the prescribed dose, leading to cold spots that predispose to treatment failure. Similarly, the definition of point-related dose constraints for the OAR is also controversial (steep dose gradient, dose inhomogeneity, and non-contiguous high-dose regions over the irradiated volume). Nevertheless, numerous published results support correlation between the dose at point A and probability of local control [Gerbaulet A, ed. GEC ESTRO Handbook of brachytherapy]. Similar correlations have been consistently reported for the ICRU point dose (rate) and probability of late complications for bladder and rectum [Perez, IJROBP 1999, Barillot, IJROBP 2000]. However, the doses to other OAR (including the sigmoid colon, small bowel, etc.) have not been reported systematically in the conventional radiography-based studies. It seems more appropriate to correlate the tissue effects of radiation with doses, absorbed in tissue volumes, rather than at certain points. Implementation of 3D imaging into BT planning allows for delineation of the target volume and organs at risk (OAR), and asessment of the correlations between the dose-volume parameters and the effects of irradiation in the tissues. In addition, together with utilization of the treatment planning systems and remote afterloaders, this approach permits an individualized adaptation of the dose distribution, applying high doses to target volume while respecting organs at risk (OAR) dose constraints. Understanding the size and topography of the tumor, OAR and their relations to the applicator is a precondition for the success of 3D image guided BT. Small inconsistencies in definition of these structures may result in significant uncertainties of optimized dose distribution, compromising the treatment outcome, recording and reporting. One of the most important sources of uncertainties in contouring of the target volume and the OAR is the choice of imaging modality.

Sectional imaging modalities in 3D gynaecological BT: Ultrasound (US) allows for an accurate evaluation of local tumor spread. When compared with computed tomography (CT), it is characterized by a superior depiction of intracervical, intrauterine, parametrial and vaginal tumor infiltration and eventual involvement of the bladder and rectal wall. It is relatively inexpensive, portable, and more readily available than CT or magnetic resonance imaging (MRI). US is therefore an attractive imaging modality in the field of gynecological BT planning. However, while US-guidance has been proven helpful in achieving good position of the intrauterine tandem [Granai CO, Gynecol Oncol 1984, Mayr NA, Brachytherapy 2005, Sahinler I, IJROBP 2004, Davidson MT, Brachytherapy 2008] and is a promising method in interstitial gynaecological BT [Stock RG. IJROBP 1997, Weitmann HD. Strahl und Onkol 2006], adaptations of the US devices and development of an US-based target concept may be needed before it can be fully exploited in gynaecological BT. As far as CT and MRI are concerned, variations in tissue characteristics that influence MR signal are more pronounced than differences in the X-ray attenuation coefficients. MRI therefore exhibits superior soft tissue depiction quality than CT, which is further enhanced by its capability of multiplanar imaging. In the 1990's, early experience with MRI in BT planning demonstrated its superiority to CT for evaluation of tumor extent, topography and relations to the applicator [Schoeppel, IJROBP 1992, Tardivon, Radiographics 1996, Pötter, Selectr Brachyther J 1991]. A systematic analysis of potential of MRI in cervix cancer IGABT demonstrated, that it enables accurate definition of the regions of interest. [Dimopoulos, IJROBP 2006]. While CT is adequate for OAR delinieation, its value in target contouring is limited [Viswanathan, IJROBP 2007]. MRI has been recommended for GTV, CTV and OAR contouring and can be considered current gold standard in cervix cancer IGABT [Haie Meder, Radiother Oncol 2005, Pötter, Radiother Oncol 2006]. While 18F-fluorodeoxyglucose positron emission tomography - based contouring of metabolically active target volume has been used in image guided cervix cancer BT planning with encouraging results [Malyapa, IJROBP 2002, Mutic, IJROBP 2002], it currently remains an experimental approach due to a lack of clinical data.

Conclusions: 3D image based adaptive gynaecological BT enables individualized optimization of the dose distribution in the tissues, resulting in encouraging clinical results when compared to conventional x-ray based methods

[Pötter R, Radiother Oncol 2007, Haie-Meder C, Radiother Oncol 2007, De Brabandere M, Radiother Oncol 2008, Haie Meder C, Radiother Oncol 2010, Pelloski CE, IJROBP 2005, Petric P, Radiother Oncol (abstract) 2011, Janssen HLK, Radiother Oncol 2011]. This approach allows for a meaningful and reproducible assessment of the dose volume histogram parameters and their correlation with clinical outcome. MRI can be considered the gold standard imaging modality in this field [Pötter R, Radiother Oncol 2006, Haie-Meder C, Radiother Oncol 2007, Hellebust T, Radiother Oncol 2010, Dimopoulos JCAD, Radiother Oncol 2011].

Key words: brachytherapy, gynaecological tumours, 3D imaging.

Radiobiological evaluation of effects in the complex treatment of gynaecological tumours based on 3D planning and timing

Matula P, Koncik J, Dubinsky P

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Purpose: To review the radiobiological factors affecting clinical outputs in the the complex treatment of gynaecologic tumours; comparing biologically effective dose (BED/EQD_2); predicting the local control (TCP) and of normal tissue complication probability (NTCP) for chosen treatment schedules (LDR, PDR and HDR) based on DVH parameters and overall treatment time.

Material and methods: In lines with Recommendations of GYN GEC ESTRO 2006 and guidelines of EMBRACE study, the values EQD_2, TCP and NTCP based on DVH (from axial MR/CT images for selected treatment schedules) have been analyzed using radiobiological modeling. The treatment schedules were used from the work Lang *et al*. (2006, Radioth. and Oncol. 78). The external therapy (EBRT, EQD_2 = 45 Gy) has been supplied by brachytherapy with different treatment schedules: A. HDR 4F/7Gy/ to point A (prescribed dose on HR CTV D90); B: PDR 1F/35Gy/48 hours to point A; C: LDR 15 Gy on 60Gy reference volume isodose. EQD_2, TCP and NTCP have been calculated using own program BioGray-Plus. For elimination of differences in physical distribution during radiobiological analysis the same and re-normalized DVH was used according to applied/prescribed dose /fraction(s).

Results: Calculated values of total doses (TD) in 3 arms (HDR, PDR and LDR) were: 85 Gy, 80 and 86 respectively. EQD_2 and TCP (for clinical stage IIB) are the same: 85 Gy_{10} and 91.3% respectively. The expected differences are manifested in values of EQD_2 and NTCP because of different dose rate and timing. EQD_2 (to reference volume 2cc of OaR) for bladder in the arms A, B and C were 84, 85 and 68 Gy_3 respectively. The corresponding NTCP were 2.8, 3.1 and 0% respectively. EQD_2 for rectum were 74, 75 a 62 Gy_3 respectively. NTCP in all arms were 0%. EQD_2 for sigmoid were 71, 75 and 62 Gy_2 respectively. The corresponding NTCP were 7.1, 11.2 and 4.5% respectively. Increasing NTCP correlated with higher values of EQD_2 in HDR brachytherapy and also in PDR depending on described dose and treatment parameters.

Conclusions: Calculated EQD_2 and predicted values of TCP a NTCP for selected (mostly applied) treatment schedules of cervical tumours are comparable and reflect worthfull clinical experience of their designers. The issue of this contribution is offering a comprehensive tool for radiotherapists and physicists to creating flexible dosimetrical and radiobiological reports tailored to Recommendation GYN GEC ESTRO. Using BioGray (workshop version is free) we can document the individual radiobiological reports of treatment history and assess impacts of differences in DVH statistics, prolongation of treatment etc.

Key words: intracavitary 3D brachytherapy, cervix, radiobiological models, TCP, NTCP.

HDR endobronchial brachytherapy (HDR-BT) in the management of lung cancer – indications, techniques, results

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Purpose: Lung cancer is the leading cause of cancer death with five-year survival rates reaching only 10-12% during the last 20 years. The lung cancer failure rate remains unacceptably high, despite major advances over the past 40 years in the field of surgery, radiotherapy and chemotherapy. In general, upon diagnosis 25-30% of the NSCLC patients present with tumors confined to the lung (stage I or II) and only 40-50% of them can be resected for cure, 30% have locally advanced disease (stage III), the remaining 40-45% have distant metastases (stage IV). Local recurrences after external beam radiotherapy (EBRT) occur in 60-70% of patients, and are responsible for 60% of the mortality due to respiratory failure, obstructive pneumonia and sepsis. One of the most distressing symptoms for lung cancer patients is airway obstruction. Lack of improvement in treatment results of lung cancer leads to searching for new methods. Removal of endobronchial obstruction leads to quick improvement of clinical status and Quality of Life (QoL). Brachytherapy is one of the most efficient methods in overcoming difficulties in breathing that is caused by endobronchial obstruction in palliative treatment of tracheal and lung cancer. Depending on the location of the lesion in some cases brachytherapy is a treatment of choice. Efforts to relieve this obstructive process

are worthwhile, because patients may experience improved QoL in hours or days after treatment. In most cases brachytherapy has a palliative aim due to advanced clinical stage. Lack of clear consensus regarding the value of doses used in brachytherapy is the reason why different fraction doses are used in clinical treatment. Brachytherapy plays a limited but specific role in definitive treatment with curative intent in selected cases of early endobronchial disease as well as in the postoperative treatment of small residual peribronchial disease. Because of the close anatomical and clinical similarities lung and tracheal cancer are discussed together. The aim of this work is to present results of curative and palliative HDR-BT using various treatment protocols with the view to analyzing differences in survival and diminishing breathing difficulties.

Material and methods: Six hundred and forty eight patients with advanced lung cancer were treated by palliative HDR-BT at the Greater Poland Cancer Center. All the patients were divided into two groups according to their clinical stage and the Karnofsky score – those with the Karnofsky score lower than 60 were qualified for a single fraction treatment. Three hundred and three (46.8%) patients received a total dose of 22.5 Gy in 3 fractions once a week, 345 (53.2%) patients received one single fraction of 10 Gy. A total of 110 patients with endobronchial lung cancer without nodal or visceral metastases, were treated with curative HDR-BT. They had developed disease relapse after surgery (in stump, $n = 20$) or were treated after non radical surgery ($n = 14$) or as a part of primary treatment alone/with EBRT ($n = 76$). Treatment usuallly consisted of four fractions of 7.5 Gy, usually delivered 1 cm from the source. They were under clinical and endobronchial observation as regards survival rates, local remission and subsiding dyspnoea, breathing, cough and haemoptysis in the first, third, sixth and twelfth month of observation.

Results: Four weeks after the end of treatment subjective improvement (subsidence of all symptoms) was ascertained in 573/648 (88.4%) patients. There was no difference in the length of survival time between the two groups of patients. Patients showing improvement survived longer than those who showed no change or progression. In multivariate analysis others statistically important prognostic factors were: clinical stage of primary tumour (F Cox, $p = 0.000002$) and dyspnoea (F Cox, $p = 0.001$). In univariate analysis correlations between survival and Zubrod score, grade of cough, hemaptoe and pain were found. In the radical group the complete response rate, evaluated at 4 weeks after HDR-BT, was 50.9%, partial response rate – 37.3%. Overall survival, was significantly associated with local control, probably because of the high rate of deaths not related to lung cancer.

Conclusions: 1. The two palliative treatment protocols showed similar efficiency in overcoming difficulties in breathing. 2. Prognostic factors significantly correlated with survival length were: grade of remission after treatment, clinical stage and performance status. 3. Curative HDR-BT achieved a long-term cause-specific survival rate of 50.9% of the patients with localized lung cancer.

Key words: lung cancer, HDR brachytherapy, palliative, curative.

The use of para-cervical anaesthesia in brachytherapy

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Purpose: Brachytherapy (BT) represents an essential component of treatment in cervical and endometrial cancer patients with locally advanced tumours and/or medical contraindications to surgery. Dilatation of the cervical canal and insertion of the intracavitary (IC) applicator into the uterus and vagina are usually performed under general or subarachnoidal anaesthesia. However, the radiation oncologist is sometimes faced with a situation where patient's co-morbidity precludes application of these pain-control techniques. In addition, due to the infrastructural and staff requirements, general or subarachnoidal anaesthesia may not be readily available in some institutions for all patients. This may be particularly true for countries with low economic wealth, where gynaecologic malignancies, in particular cervix cancer, are highly prevalent. In such situations, pain control techniques, based on the application of local anaesthetics, may be a viable option to improve patient-tolerability and overall quality of the BT procedures.

Materials and methods: There are several methods of local anaesthesia to reduce pain during obstetric and gynaecological procedures, including topical surface application, transcervical intrauterine instillation, intracervical injection and paracervical injection (paracervical anaeasthesia – PCA) of local anaesthetic [Cooper NA, et al. Br Med J 2010]. However, to our knowledge, there are no published reports on the role of these techniques in the field of BT so far. In our study, evaluating the effectiveness of MRI-assisted pre-planning of cervix cancer BT, the ability to achieve pain control during applicator insertion by a paracervical injection of the local anaesthetic was also assessed. In this study, the patient preparation before the BT procedure consisted of a light meal and a laxative suppository on the evening before insertion and anxyolytic drug (Midazolam 7.5 mg orally) 1 h prior to the procedure. After topical application of 10% lidocaine spray on vaginal mucosa, the regional anaesthesia was aimed at by injecting 3 ml of 2% lidocaine bilaterally in the para-cervical region. In addition, a 1 hour intravenous infusion of mild analgaesics was maintained during the procedure [Petric P, et al. Journal of Contemporary Brachytherapy 2009; 1, 3: 163-169].

Results: While PCA is used for cervical dilatation in various obstetric and gynaecological interventions, the data on its effectiveness and safety are conflicting. A recent review concluded that PCA is ineffective in achieving pain control for women undergoing uterine interventions [Tangsiriwatthana T, et al. Cochrane Database Syst Rev 2009 (1): CD005056]. In this review, however, various procedures, including suction termination of pregnancy and bimanual removal of placenta were assessed. Therefore, its negative conclusion may not be applicable to cervical dilatation at BT. However, a recent meta-analysis, comparing effectiveness of various local anesthetic techniques used during

outpatient hysteroscopy (which may be more comparable to uterine insertion of BT applicator), concluded that PCA is the best method for pain control in this setting [Cooper NA, et al. Br Med J 2010]. At our department, we conducted a study on the effectiveness and feasibility of MRI-assisted pre-planning, based on IC applicator insertion in PCA, achieved by injecting the local anaesthetic bilaterally into the paracervical region prior to cervical dilatation. The preliminary results of this study were published recently [Petric P, *et al*. Journal of Contemporary Brachytherapy 2009; 1, 3: 163-169] and demonstrated that the described procedure was short, well tolerated and feasible. Excellent level of pain control was achieved, with a median patient-reported pain score of 1 (range 0-3) on the visual analogue scale. It has to be noted, however, that we only assessed the effectiveness of PCA on insertion of the IC applicator, not the interstitial needles. Our favourable results are in line with conclusions of the meta-analysis by Cooper *et al*. [Cooper NA, et al. Br Med J 2010]. In our protocol, mild sedation was instituted prior to the procedure and local anaesthetic applied topically to ameliorate pain during PCA injection, application of tenaculum, manipulation with specula and vaginal gauze packing. In addition, intravenous infusion of analgesics was given to reduce pain due to vaginal packing and applicator removal. We can assume that these additional measures had an important effect on our overall favourable level of pain control. Final results of our study are pending. About 20% of women undergoing outpatient dilatation of cervical canal are reported to experience vasovagal reactions [Finikiotis, Obstet Gynaecol 1993; 33: 61-62]. It has to be noted that similar symptoms might arise from intravasation of the local anesthetic. Meta-analysis of the studies on PCA in hysteroscopy failed to conclude on potential harms of the PCA, since most of the analyzed studies did not explicitly report on the adverse events [Cooper NA, *et al.* Br Med J 2010]. In our experience, IC applicator insertion under PCA can be regarded as a safe procedure, when performed by a trained team and under careful patient monitoring.

Conclusion: PCA may represent a strategy to improve patient care in centres where general or spinal anesthesia is not readily available for all patients that require insertion of the IC utero-vaginal applicator. Moreover, PCA-based cervical dilatation and insertion of the IC applicator has been used with success at our institution in patients with medical contraindications for anesthesia, not only in cervical, but also in endometrial cancer, where co-morbidity often poses significant challenge to the medical team. Nevertheless, further studies, evaluating the PCA-based applicator insertion are needed to further assess its effectiveness and safety and to establish its role in the field of gynaecological BT.

Key words: anaesthesia, brachytherapy, cervical cancer, endometrial cancer.

Proffered paper 1

Retrospective analysis of 303 stage II and III cervical cancer patients treated with external beam radiotherapy and HDR brachytherapy

Dubinský P, Matula P, Belánová K, Janíčková N, Varga J, Packaň T

Department of Radiation Oncology, East Slovakia Institute of Oncology, Košice

Purpose: To evaluate retrospectively long-term results of radiotherapy of stage II and III cervical cancer and to investigate known prognostic factors.

Material and methods: Records of 303 patients with stage II (36%) and III (64%) squamous cell carcinoma of uterine cervix treated between June 1993 and December 2008 were reviewed. All cases were irradiated with combination of external radiotherapy (simulator based planning) and HDR brachytherapy (dose specification in point A and ICRU points) with concomitant cisplatinum based chemotherapy (57%) or without chemotherapy (43%). Radiotherapy was followed by elective simple hysterectomy in 15% of patients. Median follow – up for local control and for survival was 54 months and 56 months respectively. Dose of several radiotherapy treatment regimens used over time was evaluated in terms of calculated EQD_2 in point A. Mean cumulative EQD_2 in point A was 79.9 Gy ± 12.1 Gy. Median overall treatment time was 8 weeks (56 days). Kaplan Meier and Cox regression analysis were used to test relationship between outcome and known prognostic factors related to a patient (age and haemoglobin level), a tumour (stage and hydronephrosis) and treatment (concomitant chemotherapy, overall treatment time and dose of radiotherapy).

Results: For all cases 5-year pelvic control rate (PCR) was 71%. Cancer specific survival (CSS) and overall survival (OS) in 5-years (10-years) was 77% (59%) and 64% (41%) respectively. The 5-year PCR was significantly better for stage II vs. stage III: 86% vs. 60% (p = 0.001) as well as OS: 86% vs. 50% (p = 0.0001). Similar magnitude of difference was found for overall treatment time up to 8 weeks vs. more than 8 weeks: 79% vs. 60% (p = 0.01) for PCR and 79% vs. 55% (p = 0.007) for OS. In subset analysis treatment prolongation over 8 weeks was significant in stage III but not in stage II. Kaplan-Meier analysis identified also haemoglobin level (≤ 80 g/l vs. > 80 g/l) and hydronephrosis (absent vs. present) significant for PCR, CSS and OS. No significance was found for concomitant chemotherapy (yes vs. no) and EQD_2 in point A (≤ 79.9 Gy vs. > 79.9 Gy) in any of treatment outcomes. Tumour stage, overall treatment time and haemoglobin level remained independent prognostic factors on multivariate analysis for all evaluated outcomes.

Conclusions: Stage, prolongation of overall treatment time and haemoglobin level were principal prognostic factors, whereas there was no significance in addition of concomitant cisplatinum and in radiotherapy dose in terms of EQD2 in point A.

Key words: brachytherapy, cervical cancer, external beam radiotherapy.

Friday 14th
Oral presentations

Clinical comparison of boost modalities in breast cancer: Brachytherapy vs. External Beam Radiation Therapy

Vratislav Strnad, MD, Prof.

Division of Interventional Radiation Therapy, Department of Radiation Therapy, University Hospital Erlangen, Germany

Purpose: It is well known, that adjuvant radiation therapy with 16 Gy boost after breast-conserving surgery significantly lowers the rate of local tumor recurrence in patients with invasive breast cancer and that all patients have a significant benefit with dose escalation above 50 Gy. Unfortunately the technique used to give this boost differed widely from one institution to another, although external-beam boosts by X-rays or electrons (sometimes as IORT) or iridium implants are the most popular. The author analyzes different risk factors for local recurrence after breast conserving surgery, particularly value of dose size and technique of boost irradiation on tumor control probability and side effects. Different techniques of brachytherapy and external beam radiation therapy (EBRT) – advantages and possible disadvantages' are discussed in detail and compared with one other. Results as well of retrospective studies as of one prospective trial comparing brachytherapy and EBRT and possible implications for daily praxis are presented and analyzed.

Conclusion: Boost reduces the local recurrence rate at least with F = 0.5 without benefit regarding overall survival. As standard dose applies 16 Gy, but risk adapted doses should be used more often. It seems that the best techniques for boost irradiation are Interstitial Brachytherapy and IORT. In individual hospitals as benchmark for quality of boost irradiation [at least for small tumors (pT1-2)] should be the recurrence rate in value of 0.5%/year or less. The interstitial brachytherapy for boost irradiation should be preferred particularly if the tumor is located < 2-3 cm below skin or below nipple or if the boost dose > 16 Gy should be given.

Key words: brachytherapy, breast cancer, external beam radiotherapy.

Proffered paper 2

Is the improvement of dose distribution possible for single or multi-lumen interstitial breast balloon used for accelerated partial breast irradiation using IPSA optimisation algorithm?

Bieleda G[1], Zwierzchowski G[1], Skowronek J[2], Dymnicka M[1]

[1]Medical Physics Department, [2]Brachytherapy Department, Greater Poland Cancer Centre, Poznan, Poland

Purpose: Interstitial breast brachytherapy can be performed using several types of applicators. Recently introduced Contura multi-lumen balloon is an alternative to earlier presented single lumen balloon. To achieve best treatment plan parameters different applicators and various optimization methods are confronted. The aim of the study was to verify dose distribution parameters for Contura and artificially created single-lumen balloon applicator application for the same patient using two optimization algorithms: Inverse Planning Simulated Annealing (IPSA) and dose point optimization with distance option.

Material and methods: Group of 24 patient with Contura multi-lumen balloon applied were investigated. Each had ten-fraction treatment with prescribed dose of 3.4 Gy

per fraction. For every patient 4 treatment plans were prepared. First for five-lumen balloon optimized with IPSA algorithm, with optimization parameters adjusted for each case. Second for the same applicator optimized with dose point optimisation with distant option. Two other plans were prepared for single-lumen applicator, created by removing four peripheral lumens, optimized with both algorithms.

Results: The highest D95 parameter was obtained for plans of Contura patients optimized with IPSA algorithm, mean value 99.32 percent of prescribed dose, and it was significantly higher than Contura plans optimized with dose point algorithm (mean = 83.50%, $p < 0.0001$), IPSA single-lumen balloon plan (mean = 83.50%, $p = 0.0037$) and optimized to dose point single-lumen balloon (mean = 85.51%, $p < 0.0001$). There was no statistically significant differences concerning maximum doses distributed to skin surface for neither application nor optimization method. On the other hand the mean maximum dose deposited to ribs were lower for Contura plan IPSA optimized (92.52%) than single-lumen IPSA optimized plans (105.96%) with $p = 0.0067$. Volumes receiving 200% of prescribed dose in PTV were higher for Contura dose point optimized plans (mean = 8.78%) than for other plans (IPSA Contura plan – mean = 7.37%, $p < 0.0001$, single-lumen IPSA – mean = 7.20%, $p < 0.0001$, single-lumen dose point – mean = 7.19%, $p < 0.0001$).

Conclusions: Basing on performed survey, better dose distribution parameters are obtained for patients with multi-lumen balloon applied and optimized using IPSA algorithm with individualized optimization parameters.

Key words: brachytherapy, Contura, interstitial breast balloon, IPSA.

Proffered paper 3

Whole scalp surface HDR brachytherapy – 2D and 3D reconstruction method: 2 cases report

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Purpose: In 2008 and 2010 we treated two patients with developed extensive skin cancer on the parietooccipital region after frequent local recurrences and surgery interventions. Brachytherapy with individual moulage and implanted flexible plastic catheters was considered more suitable than other RT techniques. Expected homogeneity and conformity of dose distribution close to the skin surface with brachytherapy application could be better, easier to reproducible and not be effected by patient movements in comparison to external beam radiotherapy (EBRT).

Material and methods: We developed individual moulages (Fig. 1) for both patients made of waxy material (used routinely as bolus in EBRT) shaped as helmet and enforced with thermoplastic mask. 34 and 30 catheters, respectively, were used for the moulages. Fractionation schemes used for patients were 17 × 3 Gy and 15 × 3 Gy referred to 85% isodose in depth of 3 mm. TPS Plato SUNRISE BPS ver.13 and Brachytherapy ver.14 were used for planning. Patients were irradiated with Microselectron HDR. 2D reconstruction method base on 2 orthogonal X-ray images (Fig. 2) was performed for the first patient (Fig. 3) and CT based planning for the second one (Fig. 4).

Results: The treatment was well tolerated in both cases. Complete remission was resulted in second patient although longer surveillance term is needed. The first patient with less accurate 2D planning procedure developed local recurrence and was dedicated to chemotherapy.

Conclusions: The presented treatments of cutis carcinoma that infiltrated the whole scalp by using brachytherapy moulage technique are exceptional by their extent and workload. This technique complemented with CT planning can be safe, accurate, comfortable for the patients and able to achieve local tumor control.

Key words: brachytherapy, moulage, sculp, skin cancer.

Fig. 1. Moulage helmet with 34 implanted flexible catheters

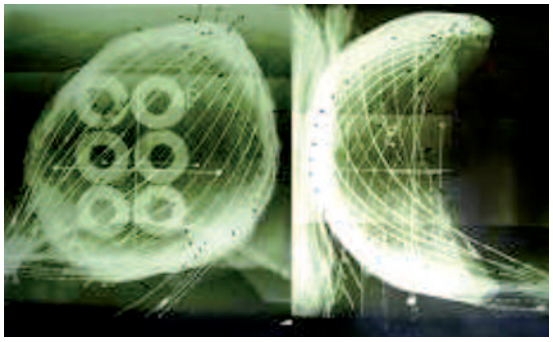

Fig. 2. 2 orthogonal x-ray

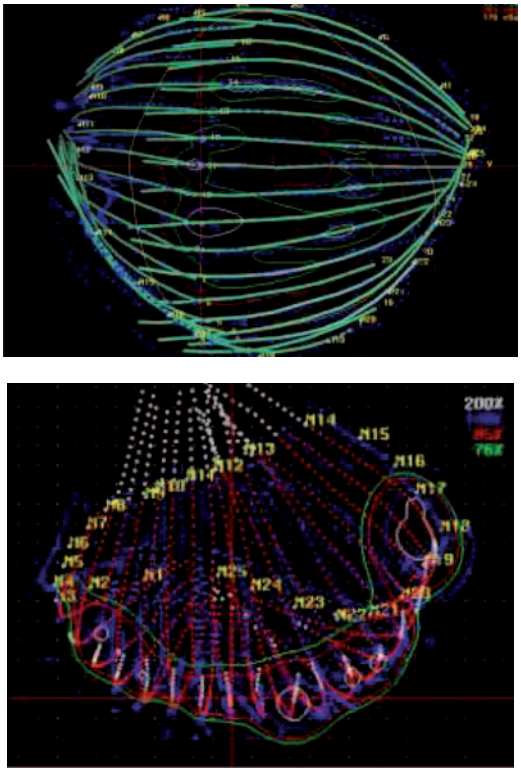

Fig. 3. View of reconstructed catheters and images of moulage helmet calculated dose distribution for the first patient

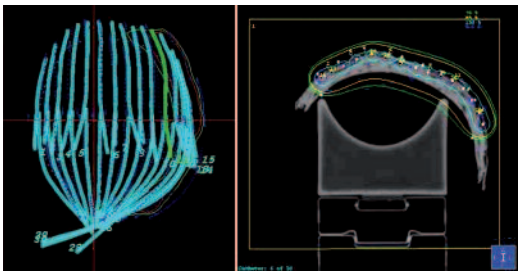

Fig. 4. View of reconstructed catheters and calculated dose distribution for the CT based planning

Treatment planning and dosimetry in prostate LDR-brachytherapy

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Purpose: The aim was to report the clinical experience and treatment planning concept for permanent I-125 implant prostate brachytherapy at the Medical University of Vienna.

Material and methods: Between Sept. 2004 and Dec. 2010, 162 patients with low (n = 118) and intermediate risk (n = 44) prostate cancer were treated with I-125 stranded seeds. Mean age and initial PSA were 68 years and 7,3 ng/ml. Implantation was performed under spinal (or general) anesthesia with patient in lithotomy position. A treatment planning system (TPS) Variseed 8.02 (Varian Medical Systems, Palo Alto, CA USA®) was used. The pre-planning, which is the preliminary prostate volume study, was performed 2-3 weeks before the patient was scheduled for implantation to evaluate the prostate size for ordering a sufficient number of seeds and to guarantee a sufficient large pubic-arch angle. For Ultrasound (US) image acquisition a ProFocus Typ 2202 scanner (BK-Medical, Mileparken, DK®) in combination with the stepper unit ACCUCARE and template 17GY grid UA2006 (CIVCO Medical Instruments, Kalona, IA®) were used. Right before the implantation the actual seeds activity (~0.46 μGy m²/h per seed) had to be verified. Discrepancies up to 3% were accepted, while differences > 5% were reported to the manufacturer. Intraoperative pre-planning was used by recording a 2nd volume study from the positioned and immobilized prostate, taken in 5 mm US sections (steps) from base to apex. Prescribed dose to the prostate was 145 Gy (= 100%) to cover the delineated prostate volume, taking into account a safety margin of 3-5 mm, and accepting an under-dosage of the fibromuscular zone. Requested dose-volume constraints were as follows: Prostate: D90 > 145 Gy (100%), V150 ≤ 50%; Urethra: $D_{0.1\,cc} \sim D_{10} < 217$ Gy (150%), $D_{30} < 188$ Gy (130%); rectum: $D_{0.1\,cc} < 200$ Gy /138%) and $D_{2cc} < 145$ Gy. The seed positions within the prostate gland were pre-planned on the TPS by taking into account a source-to-source spacing of 1cm, a baseline of seeds at the peripheral zone and a generous sparing of the urethra. In general a minimum inter-seeds-distance of 8 mm was respected to avoid high-dose regions according to the traditional Paris system. Nevertheless, it may occur that this rule was violated due to the individual patient anatomy. Needles were manually loaded with stranded seeds by the radiotherapy technologist (RTT) in a separate shielded room. Loaded needles were then inserted into prostate through the perineum according to the intraoperative preplan. Seeds were dropped under transrectal US and fluoroscopy (C-arm, ArcadisVaric, Siemens, Erlangen, GER®) control. The distribution of seeds within the prostate was verified and if necessary, additional seeds were positioned to avoid cold spots within the target volume. The number of implanted seeds and the quality of the implant were checked by X-ray and CT images. Patients were discharged one day after implantation if the maximum dose rate in 1 m distance from the I-125 implant was found below 2.0 μSv/h (according to national law ÖNORM S5238). Post-implant CT scans were evaluated for 130 patients (whole data set will be presented in Bratislava).

Results: The mean number of seeds was 66 ± 16 covering a mean prostate volume of 47 ± 15 cm³ by 88 ± 6%. The mean D90 was 141 ± 17 Gy and the V150 59 ± 9%. Minimum dose to the most exposed 2 cm³ and 0.1 cm³ of the rectum contour was 78 ± 19 Gy (D_{2cc}) and 120 ± 36 Gy ($D_{0.1cc}$). 10% and 30% of the delineated urethra volume (1.3 ± 2 cm³) received 220 ± 37 Gy and 199 ± 34 Gy respectively.

Proffered paper 4

Salvage HDR brachytherapy for local recurrences of prostate cancer – preliminary results

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Purpose: Radiation therapy for localized prostate cancer is a standard option of treatment. The risk of local recurrences (biochemical and clinical) depend on the initial stage, Gleason score and PSA level. Usually local recurrences have ominous prognosis. The standard treatment is palliative hormonal therapy. Alternatively salvage prostatectomy, brachytherapy or cryotherapy can be used in selected patients. In MCS Memorial Institute of Oncology in Gliwice a researched program on salvage HDR brachytherapy for local recurrences of prostate cancer treated earlier with radiotherapy has been opened in February 2008. The aim of the study was to analyze early effects and toxicity of salvage high dose rate brachytherapy for local recurrences of adenocarcinoma of prostate after external beam radiotherapy.

Material and methods: Forty one eligible patients were treated and analyzed from February 2008 until now. All patients had confirmed local recurrence after radiotherapy. HDR brachytherapy was delivered using an Iridium-192 stepping source. Treatment planning was performed intraoperatively. Needle applications were performed during spinal anesthesia. The treatment consisted of 3 fraction 10 Gy each given every 14 days. Maximal urethral doses were constrained to be equal or less than 120% of prescribed dose. Maximal bladder and rectum doses were constrained to be equal or less than 70% of prescribed dose. Mean age of patients during salvage treatment was 60-80 (mean 70). It was an inhomogeneous group of patients in terms of initial prognostic factor and treatment (Mean Gleason score 6 (4-10); Mean PSA level before diagnosis: 20 (11.19-96.6) ng/ml Treatment: 20 pt. – EBRT: 70-76 Gy, dfx – 2 Gy, 1 pt – 52 Gy , dfx – 2.6 Gy; 19 pt – EBRT + BT: 54 Gy, dfx – 2 Gy + 10 Gy Ir 192; 24 pt had WPR (45-46 Gy), 17 pt had adjuvant HT). Mean time to recurrences was 5.4 years (2-10 y.) PSA nadir range was 0.004-7 ng/ml; mean 0.6 ng/ml. PSA before salvage BT range from 1.05 to 11.87 (mean 3.5). Gleason of recurrences range from 6 to 8 (in 10 pt only foci adenocarcinomatosi), 4 pt had perineural invasion and 4 pt had seminal vesicle invasion. Six pt had hormono-resistant cancer Twenty three patients on hormonal therapy (2 on the second line).

Results: Mean follow-up was 12 months. Forty patient completed treatment. One patient stopped treatment after 2 fraction because of acute side effect (IPPS – 35, rectum toxicity according to EORTC/RTOG – 3). Patients usually complain on macroscopic hematuria, pain in lower part of the abdomen and transient dysuria. A Foley catheter was removed on day 2nd to 5th. No complication after spinal anesthesia were observed. In 27 pt IPPS were checked – significant increase after procedure was noticed. Four pt. (10%) developed urinary retention required TURP. Two patients experienced stool incontinences as early and late side effect. Eight patients (20%) had biochemical recurrences, 5 (13%) of them had distant metastases (4 to bone, one to lymph nodes). Three patients with isolated biochemical recurrence had hormonal resistant disease and were follow for longer than 12 months. The median PSA level 3, 6, 9 and 12 months was 0.27 ng/ml, 0.2 ng/ml, 0.198 ng/ml and 0.158 ng/ml respectively. In non-parametric tests for depended variable differences between PSA level before and after sBT was significant.

Conclusions: The analysis confirmed the feasibility of HDR brachytherapy as salvage treatment for patients with recurrent prostate cancer. Although side effects of the treatment must be taken into account as sever toxicity can be expected in about 18% patients. Biochemical and/or clinical recurrence may occurred in 20% patients during 12 months of follow-up. Longer follow-up should allow to defined the role of salvage brachytherapy in patients with advanced recurrence disease and in patients after earlier brachytherapy given as a boost. On 2011 Central European Users Meeting we would like to present in form of poster presentation, updated analysis of about 50 patients.

Key words: HDR brachytherapy, local recurrence, prostate cancer, toxicity.

Proffered paper 5

Volume assessment of the dose in the ICRU rectal and bladder points for the cervical cancer brachytherapy

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Purpose: Introduction of the three dimensional (3D) imaging modalities (CT and MRI) for brachytherapy planning of the gynecological malignancies allowed volumetric analysis of the dose distribution in the target, surrounding normal tissue and critical structures. Analysis of the dose to volume relationship (DVH curve) for each delineated structure has become an integral part of the treatment plan

evaluation process. Experience obtained based on 2D Brachytherapy has now to be translated to the 3D treatment planning routine, so as to benefit from the image modalities newly introduced to the brachytherapeutical practice. The aim of this study was to compare the dose values in the rectal and bladder points defined according to the guidelines from the ICRU38 Report with the volumetric dose values from the 3D treatment plans, in brachytherapy of the cervical tumors.

Materials and methods: In 2009-2011, 30 patients with cervical carcinoma stage IIIB were treated in Center of Oncology Gliwice Branch, with HDR brachytherapy (^{192}Ir). Ring applicator was used for afterloading source delivery. Total dose in the reference points localized 2 cm from the surface of the applicator (point A according to the ICRU 38) was 25-30 Gy delivered in 5 Gy fractions (2 fractions per week). Each patient had Foley catheter with the balloon in the bladder filled with 7cc of contrast, and marker in the rectum. Treatment plans, calculated with Oncentra MasterPlan® (Nucletron B.V.), was prepared based on the CT scans acquired with Simulix Evolution simulator (Nucletron B.V.). $D_{0.1cc}$, D_{1cc}, D_{2cc} parameters (doses delivered to the 0.1 cc, 1 cc and 2 cc of the rectum and bladder) and dose value in the reference points were analyzed and compared with dose values in the rectal and bladder points (ICRU38 definition). ICRUb (bladder) and ICRUr (rectum) points were defined based on the DRR images (Digitally Reconstructed Radiograph), generated from the series of CT images. ICRU points were than transferred to the CT scans and visualized in the 3D view. Dose in the ICRU points were compared with the volumetric dose values in the critical organs.

Results: Mean dose in the reference points on the right (Ar) and left (AL) side of the applicator were 100.4% and 99.4% respectively. Difference between dose in Ar and AL points resulted from the different number of the dwell positions on the left and right segment of the ring, and dwell time optimization depending on the right or left side location of the tumor. Mean $D_{0.1cc}$, D_{1cc}, D_{2cc} in bladder were 65%, 52% and 45% of the reference dose respectively. While in rectum, values of these parameters were 70%, 54% and 48% of the prescribed dose. ICRU rectal point received mean dose of 52% of the prescribed dose. Mean dose in ICRUb point was higher and equal to 60% of the prescribed dose.

Conclusions: ICRU 38 Report assume that ICRUb and ICRUr doses correlate with the maximum dose in these organs. Volumetric analysis of the 3D dose distribution showed that ICRU doses represent the dose value that cover organ's volume in the range between 0.1 to 1 cc for the bladder and 1 to 2 cc for the rectum. It leads to the conclusion that location of the hot spots in the critical structures has different coordinates than those from the ICRU 38 Rapport.

Key words: 3D treatment planning, cervical cancer, imaging.

Image-Guided Interstitial Brachytherapy for Head and Neck Cancer: Basic Rules and Current Results

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Purpose: Excellent local control rates of interstitial brachytherapy in oral cavity cancer and oropharyngeal carcinoma have been demonstrated in different retrospective studies. Compared to external-beam radiation therapy the interstitial brachytherapy offers the possibility to give high doses without inevitably leading to high complication rates. The author evaluates the role of interstitial brachytherapy, particularly pulsed-dose-rate brachytherapy (PDR-IBT), in patients with head-and-neck malignancies as well in curative intent within the framework of primary treatment as a salvage brachytherapy by previously irradiated patients. An overview of selected basic rules of modern image-guided brachytherapy and a review of own results will be given. The analysis of own 317 patients shows a 5 years overall survival and local recurrence-free survival of 82-73% and 93-83% for T1/2, and 56% and 83% for T3/4, respectively. Grade 3 soft-tissue or bone necrosis (Centre Alexis Vautrin Classification) was seen by only 0.9% and 3.8% patients, respectively. By another group of previously irradiated patients (n = 83) the local tumor control was achieved in 59/84 (77%) Soft tissue necrosis and osteradionecrosis Grade 3 was the only serious side effect seen in 1.2% and 2.4% patients, respectively.

Conclusion: PDR-IBT with 0.4-0.6 Gy/h and 1 h between pulses for 24 h/day given for tumors of the oral cavity and oropharynx in selected patients is a proven, safe and effective treatment method with excellent long-term data. Current results confirm that PDR-IBT of head-and-neck cancer is at least comparable with low-dose-rate (LDR) brachytherapy – equally effective and less toxic. As well for patients with previously irradiated head-and-neck cancer is the interstitial pulsed-dose-rate brachytherapy an effective sole treatment method with minimal toxicity.

Key words: brachytherapy, head and neck cancer, image-guided.

Posters

Radiotherapy (3DCRT) with high-dose rate (HDR) brachytherapy boost or high-dose 3DCRT for patients with prostate cancer?

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Purpose: To evaluate the effectiveness and normal tissue reactions of 3DCRT with HDR brachytherapy boost and high-dose 3DCRT for patients with prostate cancer.

Materials and methods: Between March 2003 and January 2005, 230 patients with T1-T2N0M0 prostate cancer were treated in Maria Skłodowska-Curie Memorial Cancer Center and Institute of Oncology, Gliwice Branch, Poland. The clinical characteristics of the groups were comparable. The median age was 66 years (range 49-83). The PSA level range from 0.34 to 64 ng/ml (median 12.3) and the Gleason score range from 2 to 10. The analysis included 99 patients who underwent 3DCRT with HDR brachytherapy boost (group A) and 131 patients who were treated with high-dose 3DCRT to the median dose of 74 Gy (group B). The combined schedule comprised external beam treatment delivering 52-56 Gy followed by temporary HDR afterloading implant delivering 10 Gy in one fraction. Whole pelvis irradiation depended from risk factors and oncologist decisions (40% in goup A and 34% in group B). The efficacy of the treatment was evaluated by biochemical relapse-free survival (bRFS), local recurrence free survival (RFS), metastases-free survival (MFS) and overall survival (OS).

Results: Grade 2 and 3 acute rectal symptoms occurred in 18% in group A and in 27% in group B ($p = 0.1$), acute urinary symptoms were observed in 42% in group A and in 33% in group B ($p = 0.13$). Grade 2 late rectal reactions had developed 9% cases in group A and 23% in group B, 2 patients (1,6%) in group B presented grade 3 late rectal toxicity ($p = 0.004$). Grade 2 and 3 late urinary complications occurred in 12% in both groups. No patient developed grade 4 rectal or urinary complications. The median follow up was 6 years. Biochemical relapses occurred in 37% in group A and 21% in group B, local recurrences in 17% and 5%, distant metastases in 11% and 7%, respectively. For group A and B, the 7-year bRFS was 58% and 68% ($p = 0.014$), RFS was 71% and 80% ($p = 0.0002$), MFS – 80% and 91% ($p = 0.42$), OS – 80% and 73% ($p = 0.57$), respectively.
Conclusions: The analysis has shown statistically longer biochemical relapse free survival and local recurrence free survival in high-dose 3DCRT group. Acute and late rectal complications were more severe in group treated with high-dose 3DCRT, in comparison to urinary symptoms which were more intense in 3DCRT with HDR brachytherapy boost group. The result of our analysis suggest that the combined was suboptimal and required modification.

Key words: HDR brachytherapy, prostate cancer, radiotherapy.

HDR endobronchial brachytherapy for patients with metastatic breast cancer

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Purpose: From the beginning of disease the breast cancer is considered to be a systemic process. Incidence of pulmonary metastases at presentation of breast cancer is 4%, at the time of autopsy up to 60%. Endobronchial component of airway metastatic spread significantly affects quality of patient's life by causing dyspnoea, cough, haemoptysis and post obstructive pneumonia.

Material and methods: Between May 1997 and December 2009, 435 consecutive patients with pulmonary metastatic disease were treated in our department with HDR endobronchial brachytherapy with palliative intent. Only 99 patients (98 women, 1 man) with primary in breast were enrolled in our analysis. The material was analyzed on the basis of retrospective observation. Each patient underwent flexible bronchoscopy for direct visualization of tumor and biopsy of metastatic spread to airways prior to treatment. Median time from diagnosis of primary breast cancer to pulmonary metastases was 52 months (1-317 month). Most of the patiens (74%) received a total dose of 22.5 Gy (7.5 Gy weekly, 3 fractions) with ^{125}Ir source, dose was calculated to 10 mm from the axis of the source. In case of two or more endobronchial applicators inserted, 3D reconstruction of applicators from orthogonal X-ray films were performed in TPS. Control bronchoscopy was performed for 1-2 months after completion of brachytherapy, and local effect of treatment was evaluated. Recanalistaion of affected bronchus to more than 50% of normal bronchial lumen was considered as an excellent outcome, recanalistaion to less than 50% of the normal lumen was considered as a partial outcome.

Results: At the time of analysis (January 2011) only 7 patients from the breast group are alive (0.08%). Median OS of patients since the end of endoluminal treatment until death was 5 months (1-122 months). Symptom relief was observed in most patients after the first fiction of endoluminal brachytherapy. At the time of control bronchoscopy 68 patients (75%) reported some symptom relief, 11 patients (12%) reported no relief, 12 patients (11%) reported progression of symptoms of airway obstruction. Excellent local outcome was reported in the case of 10 patients (11%), partial outcome in the case of 60 patients (66%), no outcome in the case of 17 patients (19%) and local progression in the

case of 4 patients (4%). We did not observe severe complications related to the endoluminal brachytherapy in breast group, in the whole group of endoluminally treated patients (435 patients) we observed pneumothorax in 5 patients (1%) and one sudden death due to respiratory failure (0.2%). We did not observe fatal haemoptysis in any case.

Conclusions: Palliative HDR endoluminal brachytherapy is generally accepted as effective and safe treatment of symptoms arising from airway obstruction, which has a big potential of improving quality of life.

Key words: endobronchial metastases, endoluminal brachytherapy.

Superficial brachytherapy in the head and neck region – could we improve the quality of dose distribution using image based treatment planning?

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Purpose: The main aim of this study was to analyze the dose distribution parameters for image based treatment planning for skin cancer in head and neck region, and evaluate possible benefits.

Material and methods: The treatment plans for three localisations were prepared using Alderson® phantom and set of CT images. The forehead, cheek and nose region were selected to analyse the dose distribution parameters for different curvatures of skin surface. In the first step the doses for the skin surface and control points 5 mm below the skin surface were recalculated. The treatment plan for flat arrangement of the Freiburg Flap Applicator Set® were used for curved surfaces of the head region and compared with the dose distribution for the plans with reconstructed curvature of the applicators. In the second step the parameters of dose distribution for the simulated CTV and normal tissues were analyzed.

Results: For the forehead region the doses for 210 points were compared, for the cheek for 34 points and for the nose 60 points respectively. The statistically significant differences were observed ($p < 0.05$, Wilcoxon Test) when the plans prepared with flat arrangement of applicators were used on the curved surfaces. The observed doses 5 mm below skin surface were up to 22% higher than reference dose. For the surface of the skin the observed doses were up to 30% higher than for the plans with reconstructed curvature, for all three localization differences were statistically significant at $p = 0.05$ level. For the image based plans V100 was lower by 7.9%, 4.0% and 13.3% for forehead cheek and nose respectively. V150 (high dose area) was lower by 2.6% 18.6% and 2.0% respectively. D90 for CTV was lower by 13.0%, 8.5% and 7.3% for selected regions. The doses in surrounding healthy tissues were analyzed using D_{2cc} and $D_{0.1cc}$ parameters for the image based plans the observed values were lower by 15.0% and 7.5% for the forehead, 9.8% and 9.3% for the cheek, 10.1% and 14.0% for the nose. The maximum dose in healthy tissues were lower by 26.3%, 18.4% 26.5% for analyzed localizations.

Conclusions: Using imaging methods for the treatment planning allows to reconstruct the curvature of the applicators. The observed dose distribution were more conservative in target area. The doses for the surface of the skin were lower, the high dose area was reduced. The doses in healthy tissues was reduced significantly. When the procedure is clinically justified using Imaging methods for reconstruction the curvature of applicators could improve the quality of dose distribution.

Key words: head and neck, image based brachytherapy, superficial brachytherapy.

The external beam radiotherapy alone versus combined external beam radiotherapy and intraluminal brachytherapy in the treatment of locally advanced esophageal cancer

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Purpose: Esophageal cancer continues to have a poor prognosis despite recent improvements in diagnosis and treatment. The main objective of treatment remains palliation of dysphagia. Radiotherapy for palliation can be external beam alone, intraluminal brachytherapy (ILBT) alone, or a combination of both. The purpose of this study was to compare the effect of combined external and intraluminal radiation treatment versus external beam radiotherapy alone (EBRT).

Material and methods: Between 2006 and 2010, 130 consecutive patients received EBRT alone. Combined external and ILBT was performed in 24 patients, using high-dose-rate Ir-192 source. ILBT was applied after patients completed EBRT as a boost therapy. The external radiation was performed with a median total dose of 46 Gy given in 23 fractions. On the average a week after the external radiation a median total dose of 10 Gy ILBT was given in 2 fractions. The long-term outcomes were investigated with a median follow-up time of 20 months.

Results: The overall cumulative survival rate was 23% at 5 years. The cause specific survival rate at 5 years was

22% in the external irradiation alone group and 26% in ILBT combined group. There was no significant difference between the 2 groups of patients ($p = 0.7930$). The incidence of early and late complications did not differ according to whether ILBT was used.

Conclusion: The usefulness of ILBT, as additional irradiation in large advanced tumors has been shown similar results for dysphagia-free survival, overall survival, stenosis, and fistulas and is equally effective in palliation of advanced esophageal cancer.

Key words: EBRT, esophageal cancer, ILBT, survival.

Influence of cavities in HDR brachytherapy

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Purpose: To determine cavity influence on dose distribution in HDR brachytherapy.

Material and methods: Influence of the volume and geometry of a cavity (12.5-250 cm^3) were experimentally studied. HDR Ir-192 Microselectron was used as a source of radiation. Point (diode, ion. chamber) and array detectors were used for measurements. Maximal signal and average count of 2D detector were evaluated, as well as X-profiles.

Results: When measuring in phantom, we observed that the presence of a cavity between the source of radiation and the detector increases the measured signal from the detector. This increase is dependent on the volume of the cavity and its geometry. The relative deviation of maximal signal ranged from 9 to 35%. We also observed the influence of a reflection on the interface between two inhomogeneous mediums, which was more measurable in small cavities.

Conclusions: We showed that the presence of cavities in phantom influences dose distribution for the HDR brachytherapy source. The aim of our ongoing work is to realize in vivo dosimetry for several gynecological brachytherapy applications, where cavities occur. Treatment planning and prediction for in-vivo dosimetry will be performed by OncentraBrachy. The measured and calculated data will be compared and different influences on the measurement will be discussed, as well as the influence of the inhomogeneities of the tissue.

Key words: brachytherapy, dosimetry, influence of cavities.

Our experience in LDR and HDR boost in combined radiotherapy of prostate cancer in patients with poor prognosis

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Purpose: To compare different combined irradiation techniques by effectiveness, frequency and expressiveness of irradiation damages in patients with advanced prostate cancer.

Material and methods: We studied the results of treatment in two groups of patients. Group 1 – 112 patients after combined irradiation with LDR boost, group 2 – 110 patients after combined irradiation with HDR boost. All of them were under hormonal deprivation for 3-6 months before irradiation. Brachytherapy was the first part of treatment with additional EBRT in both groups. The median max. PSA level before treatment was 27.2 vs. 20 ng/ml, the most common stage was 3 – 88 vs. 79 patients. All patients are standard by age, stage and prognostic (intermediate and poor) factors. The median follow-up is 44 months. The median age of patients is 64 ± 3.6 years. The schedule was: 110 Gy of LDR boost and 10 Gy of HDR boost, then 44-50 Gy of EBRT.

Results: The 4-years BFFS is no significantly higher in the HDR group 74.6 ± 5.0% vs 77.2 ± 4.7%, and there were no loco-regional progression in the group 2, versus 4 – 2 local, 2 pelvic lymph node metastasis in LDR group. The significant predictor factor of poor surveillance was PSA level higher than 0.1 ng/ml before EBRT in both groups. Late irradiation damages in groups 1 and 2: rectitis 48.9 ± 4.3% vs. 37.7 ± 4.1%, grade 2 – 28.6 ± 3.7% vs. 13.33 ± 3.9%, cystistis 46.2 ± 2.6% vs. 44.4 ± 2.9%, grade 3 – 38.4 ± 3.2% vs. 10 ± 2.8%. The differences in damage expressiveness are significant in two groups.

Conclusions: We consider combined irradiation technique with HDR boost more preferable in prostate cancer patients because of better results – lower complication level. And the next step in our research work will be escalation of boost dose to 12-15 Gy.

Key words: combined radiotherapy, HDR brachytherapy, LDR brachytherapy, prostate cancer.

Individual mould applicator in HDR brachytherapy of lower eyelid cancer – case report

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84-year-old patient with a recurrent basal cell carcinoma of right lower eyelid was treated with high dose rate (HDR) brachytherapy delivered via individual shielded "mould" applicator. Total dose of 45 Gy was delivered in 15 fractions of 3 Gy each (once daily, 5 days a week). In vivo MOSFET dosimetry was performed to define actual dose beneath the lead shield. The treatment toxicity was low with acute skin reaction G2/G3 occurring one month after treatment. During 7 months of follow up, clinical examination and CT showed no evidence of recurrence. Individual shielded mould applicator HDR brachytherapy seems to be adequate treatment method for tumors localized close to the eyeball.

Key words: individual applicator, shielded applicator, eyelid tumor, skin tumor, brachytherapy.

Transition from traditional to image guided cervix cancer brachytherapy – dose at ICRU 38 point versus dose-volume histogram parameters for organs at risk

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Purpose: To check the dose distribution parameters before transition from traditional to image guided brachytherapy for cervix cancer patients. To evaluate the correlation between absorbed doses at ICRU organ at risk points calculated in traditional 2D planning and dose-volume histogram parameters from CT based planning.

Material and methods: 23 consecutive brachytherapy applications for patients with cervical cancer were analysed: 13 tandem-ring and 10 tandem-ovoids applications. Traditional 2D planning was performed on the basis of orthogonal radiographs; rectum and bladder reference point doses were calculated according to ICRU 38. Additionally CT images were taken and the applicator was reconstructed on the basis of CT images. Bladder and rectum contours were delineated and previous 2D plan (source dwell positions and dwell times) was incorporated in the CT based reconstruction. According to GEC-ESTRO recommendations, the minimum dose in 0.1 cc, 1 cc, 2 cc, 5 cc and 10 cc volumes receiving the highest dose were calculated for organs at risk and compared with dose at ICRU bladder and rectum points.

Results: The dose at ICRU bladder point underestimate the bladder D_{2cc} dose (mean ratio 0.41 ± 0.1), the dose at ICRU rectum point underestimate the rectum D_{2cc} dose (mean ratio 0.85 ± 0.2). Bladder and rectum $D_{0.1cc}$ doses are respectively 4.0 and 1.8 times higher than corresponding ICRU point doses. There is a correlation between ICRU bladder point dose and bladder D_{2cc} ($p < 0.05$), there is also a correlation between ICRU bladder point dose and bladder D_{10cc} ($p < 0.05$). There is no correlation between the dose at ICRU rectum point and any of dose–volume histogram parameters analysed for rectum.

Conclusions: The preliminary dosimetric study revealed that the parameters of dose-volume histogram $D_{0.1cc}$, D_{1cc}, D_{2cc} for bladder and rectum are much higher than ICRU reference point doses. Our results are close to the literature findings so we continue our transition to image guided brachytherapy for cervix cancer patients.

Key words: brachytherapy, cervix cancer, DVH, ICRU.