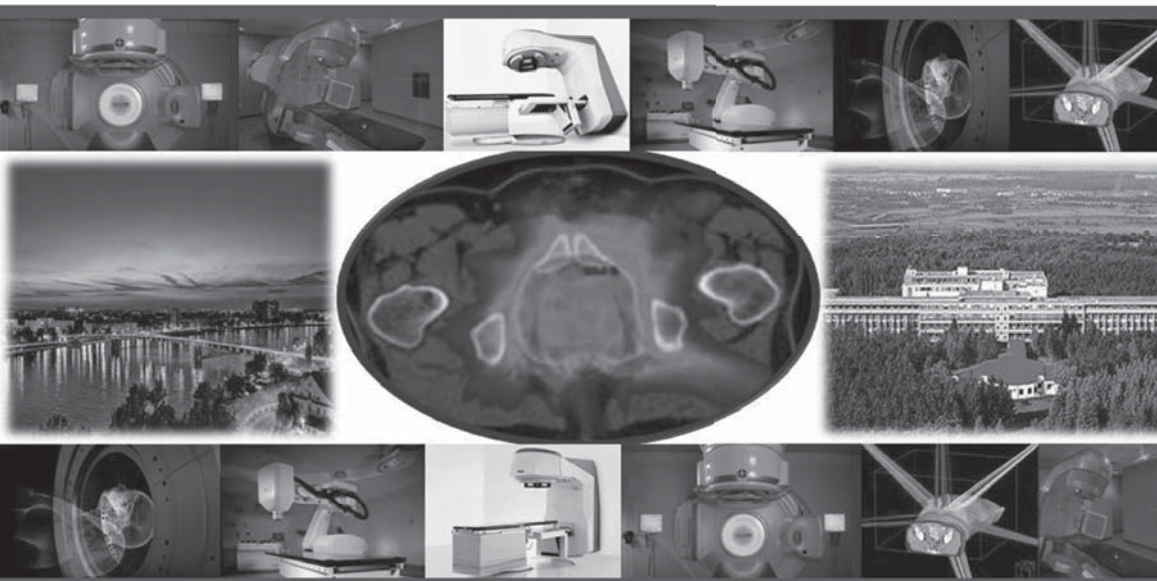


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Abstract book



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Dear colleagues and friends,

It is my great pleasure and honor to welcome You to Serbian Radiation Oncology Congress and I wish You a pleasant stay in our wonderful city!

Fast development and innovations in the field of radiation oncology imposes the need to hold one such gathering in our Region. This event is organized by the Oncology Institute of Vojvodina (OIV) and supported by the the Government of the Autonomous Province of Vojvodina and City of Novi Sad. The goals of meeting are to improve knowledge, radiation oncology skills but also to socialize and know each other better. Therefore, our activities are focused on professional development and affirmation of Radiation Oncology in Serbia through the international cooperation with special attention that is given to the cooperation of Radiation oncologists and Radiation technicians in the region.

Respectfully,
Olivera Ivanov, MD, PhD, Head of the Department
for Radiation Oncology, OIV
Congress President

Verification and correction of geometrical errors in modern external beam radiotherapy

Dušan Mileusnić, Goran Kolarević

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ABSTRACT

The goal of modern radiotherapy (RT) technology and RT techniques is to increase the likelihood of tumour control while minimizing irradiation of normal surrounding tissues by precise conforming the dose distribution to the target volume shape. Preciseness and quality assurance (QA) is an essential component of modern RT, as only tight dose conformity will allow one to escalate the dose to the levels needed for improved local control without increasing normal tissue toxicity.

Although most RT procedures are image guided, each can be related to corresponding geometrical uncertainty or error. Geometrical errors are presented as deviation between intended geometry of radiotherapy plan and real geometry of radiotherapy treatment. Total geometrical error consists of smaller errors, which can be generally classified as set-up, organ motion, organ delineation, and technical condition related errors. The clear distinction must be made between systematic and random component of these errors and its extent should be included in treatment planning process and verification methodology of treatment preciseness by diferent Image Guided RT (IGRT) procedures. Errors' measuring for specific patient group with portal imaging device and proper correction strategy enables to predict, minimize, and keep under control most of geometrical errors, improving the preciseness of treatment and consequent results.

Nature and characteristics of most frequent geometrical errors are discussed and clinically applicable methods for their proper managing are described in this presentation.

Introduction of new immobilization device in radiotherapy – postoperative whole breast irradiation in prone position

Authors Ilija Čurić

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Aim and Background

The majority of patients with early-stage breast cancer are candidates for breast-conservation therapy followed by whole-breast irradiation (WBI), typically delivered in the supine position which have limitations in the case of large/pendulous breast. Facts like dislocation of breast laterally, inclusion of lung and/or heart portion in treatment plan, respiratory movements, magnitude of high-dose regions, poor cosmetic outcome are everyday challenges for entire radiotherapeutic team. Problem becomes more pronounced in the treatment of the left breast due to position of the heart in the chest.

Method

Prone position is unique approach in postoperative WBI and includes the use of external tangential beams for treatment with patient in position so that the breast to be irradiated hangs pendulously away from the body. The method includes the steps of positioning a patient in prone (face down) position upon a special immobilisation platform on top of an accelerator table with breast to be treated through an aperture in the top surface of the platform. The healthy breast is kept close to the body in the platform, better isolating the area for treatment. All this lowers the risk of acute and late complications such as heart, skin, lung and contralateral breast damage.

Result

After analyzing dosimetric parameters we concluded that coverage with tangential fields is significantly better in supine than in prone position. Lung V5, V10, and V20 and also heart V5, V10, V20 are significant

lower in prone position. Fractionation regimen, total dose as well as daily dose are identical as in the treatment in supination.

Conclusion

Prone position is suitable only for patients in whom it is not necessary to irradiate ipsilateral regional lymphatics after surgery, but only operated breast irradiation.

Improving the skills of a Radiotherapy technician

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Aim & background

The implementation of new approaches in Radiotherapy requires improvement of the knowledge and skills of all members of the radiotherapy team and, therefore, the Radiotherapy Technician-RTT. Basic Skills of RTT Positioning and Immobilization, Communication, Imaging procedures need to be improved in accordance with new approaches. Skills that must be additionally acquired by formal education and education are dosimetric procedures and participation in the delineation of treatments.

Method

Positioning and immobilisation is the **MAIN** RTT skills whose proper application allows proper treatment. Additional education involves the acceptance of knowledge in the field of the application of additional laser and optical systems that enable the proper execution of this procedure.

Communication with patient are of increasing importance and further continuous education in this field is necessary.

Imaging procedures are skills that are acquired by education and developed through additional education and practice. Today's radiotherapy imaging also involves the procedures for verifying the Kv treatment by imaging on a RT treatment device.

Dosimetry procedures for controlling the operation of the machine and quality control, as well as participation in the procedures of treatment delineation, are the skills acquired by additional education.

Result

Improvements in the field of positioning and immobilization with the aim of proper handling with additional systems for correcting the patient's position ensure the quality of the procedure.

Improving communication skills with patients in the direction of mutual respect and understanding ensures easier execution of all procedures. RTT is the one that in daily contact with the patient and RTT receives from the patient all relevant information about the patient's subjective condition during the treatment.

The enhancement of RTT skills in the field of contemporary RT Imaging is of importance for the functioning of the RT team. RTT independently protocols imaging for advanced RT approaches as well as KV verification of treatment on the machine in accordance with the protocol.

Education in the field of dosimetric procedures for controlling the operation of general control devices. The quality of RTT becomes a support to other RT team members. Education in the field of delineation RT treatment, indicating regions of interest, would enable Medical Physicists and Radiation Oncologists to support their work.

Conclusion

A new era in radiotherapy CONCLUDES to allow further education of RTT to the level of Specialist Professional and Masters Professional Studies exclusively in the field of Radiotherapy.

Combination of external irradiation and androgen deprivation in high risk prostate cancer

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High risk prostate cancer (high localized and locally advanced prostate cancer) requests external beam irradiation combined with androgen deprivation therapy (ADT) to potentiate irradiation, whatever its technique, and to destroy the infra-clinical disease located outside the planning treatment volume. Randomized phase III trials have paved the way for establishing the indications and the duration of androgen deprivation therapy. Image guided intensity modulated radiotherapy delivered to the pelvis to irradiate the lymph nodes (46 Gy) with a simultaneous boost to the prostate up to 76-78 Gy is the gold standard; for suitable patients the prostatic boost can be delivered with low dose rate brachytherapy Long term androgen deprivation therapy (2-3 years) with luteinizing hormone releasing hormone agonists is recommended with one month of anti-androgen to avoid a potential flare-up.

The patients need to be informed of the potential morbidity of ADT and a close cooperation is needed with general practitioners and specialists to prevent and mitigate side effects and maintain quality of life.

Complete response after chemotherapy in HER2+ or triple negative breast cancer: surgery, radiotherapy or both?

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Neoadjuvant chemotherapy (NACT) is commonly used to treat patients with locally advanced (LABC) breast cancer. Pathologic complete response (pCR) to NACT improve disease free survival (DFS) and potentially overall survival (OS). Recent studies have shown that patients with triple negative breast cancer (TNBC) and HER2 + disease had higher pCR rates than patients with other breast cancer subtypes. However, data regarding the impact of adjuvant surgery, radiotherapy (RT) or both after NACT on locoregional relapse and patterns of failure are limited.

Downstaging allows performing breast conservative surgery in LABC patients. In TNBC the difference in DFS is not significantly associated with the type of surgery received. Some series have suggested expanding the role of postmastectomy RT to include patients with T1-2N0 breast cancer with high risk features like TNBC and HER2+. Also there are data to suggest high rates of local recurrence rate (LRR) despite the achievement of pCR in this subsets of patients. HER2 positivity do not appear to be associated with increased risk of LRR but triple negative status, however, does appear to increase the risk of LRR. This risk is high even if adjuvant radiation therapy is given. If there is nodal invasion, large residual tumor (ypT2), young patient age, lymphovascular invasion and high histological grade, RT shouldn't be omitted.

Decision for postmastectomy RT after NACT in TNBC and HER2+ patients should rely on several pre and post therapeutic factors, individual patient and tumor factors. If pCR is not obtained, further chemotherapy treatment intensification is recommended either by itself or combined with RT.

Key words: neoadjuvant chemotherapy, complete response, breast cancer

Regional treatment for breast cancer: finding the right equilibrium

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Locoregional radiation therapy (RT) improves locoregional control and survival for patients treated with breast conserving therapy and for patients after mastectomy with risk factors including involved axillary lymph nodes. In the past, however, this treatment could be linked to an increased risk for late cardiovascular morbidity and mortality as a result of cardiac exposure to radiation. This was especially the case for the treatment of the internal mammary lymph node target volume, for which this was abandoned by many radiation oncology centers worldwide. We now know that these side effects can most often be attributed to the use of outdated RT techniques. As treatment techniques started to improve, enabling to limit the dose to the organs at risk, prospective trials were initiated to evaluate the contribution of lymph node treatment to overall outcome for early stage breast cancer patients.

The results of several studies were presented over the last couple of years. They demonstrate that an increased disease-free survival rate following a decrease of the risk of distant metastases can be obtained in patients with risk factors, including those with involvement of the axillary lymph nodes and those with a centrally or medially located primary tumour. Moreover, a trend towards an improved overall and (statistically significant for some of the studies) breast cancer specific survival was demonstrated. No increase was seen in the other causes of death and, at a median follow-up of around 10 years, no significant or clinically relevant increased toxicity was found, apart from a slight increase in the risk for pulmonary toxicity.

The concept of “any recurrences”, introduced by the EBCTCG in 2011, as important endpoint of the evaluation of the effect of all types of treatments (including locoregional ones such as surgery and RT) fits much better to the interpretation of the recently presented results. In this era of earlier diagnosis and more widespread use of adjuvant systemic treatments leading to a 10-year overall survival exceeding 80%, clinically detectable locoregional recurrences as a separate endpoint might indeed be considered as less relevant. Firstly, the patient will be affected heavily by any type of recurrence and secondly because of the complex interaction between the efficacy of systemic treatments with the influence of loco-regional treatments on overall survival. By merely focusing on locoregional control, we risk to neglect that once distant metastases are found no further efforts are undertaken to detect locoregional recurrences. By eliminating microscopically non-detectable cancer cells in the lymph nodes with RT, the risk of secondary metastasizing of those cells and thereby ultimately the overall risk of recurrence of the breast cancer will be reduced. This is in line with the findings of the EORTC trial in which a trend was seen towards more benefit for patients who were treated with both hormonal treatment and chemotherapy and less benefit for the small group of patients with 10 or more involved axillary lymph nodes: patients with a better prognosis (lower risk factors and/or better systemic therapy) experience more benefit from locoregional treatments.

With modern RT techniques, the benefits of optimizing locoregional control will likely not be counterbalanced by side effects including late cardiovascular mortality. Moreover, the well-defined ESTRO guidelines for target volume delineation clearly reduce the size of the target volumes while simultaneously considering the regional lymph nodes even more than before as a whole. We also expect that the real benefit of loco-regional RT used to be diluted in the past (including the recently presented trials) by suboptimal dose coverage of the target volumes.

Therefore, we expect that with contemporary RT techniques and appropriate target volume delineation, not only a significant reduction of the dose to the organs at risk but also a much better coverage of especially the internal mammary lymph nodes is achievable, which is likely to result in a further improvement of the benefit of locoregional RT for

patients with early stage breast cancer that have a risk for bearing microscopical tumour deposits in the regional lymph nodes.

Bullet points:

- Regional recurrence rate is a poor endpoint for evaluating the effect of regional treatments.
- (Loco)regional RT has an influence on the rate of distant metastases.
- The interaction between systemic and loco regional treatments is very important.
- The toxicity in the recent trials is very low and is expected to be lower with even more recent techniques.

Modern radiation therapy techniques for breast cancer

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Preparation and delivery of radiation therapy (RT) has considerably changed over the years. Nowadays, fully virtual simulation based on a complete set of imaging data is used to prepare sophisticated image guided individualized treatments to adequately cover the target volumes while simultaneously limiting dose to the normal structures. Quality assurance tools and guidelines are progressively being applied in daily clinical practice.

One of the first to evaluate the influence of dose homogenisation on cosmetic outcome after BCT were Donovan and colleagues who randomised patients between standard RT and RT using 3D dose optimisation techniques based on either physical compensators or step-and-shoot MLC segmented fields. The improved dose homogeneity with a decrease of the breast volume receiving >105% of the prescribed dose was associated with a decreased change in breast appearance during follow-up as scored by photographic and by clinical assessment. Several technical solutions depending on the target volumes to be irradiated (breast; boost; lymph node areas) are proposed, also demonstrating that an optimal compromise between dose coverage, homogeneity and sparing normal tissues not always requires the use of the most advanced techniques. Depending on the individual patient's anatomy, position and treatment technique should be individualised to obtain optimal dose coverage and organ sparing. A significant reduction in the volume of irradiated lung and heart tissue can be obtained with the use of breath-hold and gating techniques.

Partial Breast Irradiation is a now accepted approach towards de-escalation of RT for well-defined groups of low-risk patients. Several technical approaches to deliver this treatment have been developed over the last years. These include conventionally or hypo-fractionated external beam RT; multicatheter brachytherapy and several variations of intraoperative techniques.

Thanks to advances of both our knowledge of the biology of breast cancer and of RT techniques, both the occurrence and the severity of late side effects have been sharply reduced. We should however not forget that many non-RT-related factors, several of which might be modulated, might influence RT-induced morbidity. All these improvements are expected to further increase the net benefit for the patients, in terms of disease control, survival and quality of life. Finally, the shared decision-making process with our patients should include all available knowledge, taking into account factors related to the patient, to the tumour, to other available/administered oncological treatments and fully respecting the patients' personal circumstances.

In vivo rectal dosimetry in prostatic carcinoma irradiation

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Aims

The aim is to present the results of *in vivo* dosimetry in the rectum radiation treatment of prostate cancer and to compare them with the calculated radiation dose at the same point of radiation treatment plan. A comparison of the measured readings with the calculated dose is to enable us to evaluate the risk of rectal lining damage as well as to improve the protection of the rectum in general.

Patients and methods

Measurements with two types of ionizing radiation detectors were performed in 10 patients treated with prostate cancer radiotherapy. TLD (thermoluminescent dosimeter) and semiconductor detector were placed in the rectum, approximately 6 centimeters from the anus border, with patients treated at the University Hospital for Tumors in Zagreb.

Results

The readings of TLD doses show certain deviation from the readings of XiO programme but at the same time there is a visible tendency of growth and fall of readings when they are presented in a linear graph.

Measurements of the PFD 39 semiconductor detector also show deviations between measured and calculated dosages, which can be explained by the design and position of the detector, but due to the low number of measurements the results are not reliable especially that they can not be compared to the results of the measurements with the TLD.

Conclusion

Deviations in the measured and the calculated dose when TLD system was applied can be explained as due to inadequate equipment,

although when both doses are compared a dependance is seen in the growth or fall of both readings.

With some patients deviations in the measured and the calculated dose when semiconductor detector was applied cannot be explained and therefore the readings should be considered unreliable.

The value of this research resides with the fact that an acceptable procedure of placing the detector intracavitarily has been created. This procedure does not cause great discomfort and pain for the patient which makes him/her more cooperative during the procedure and leads to a more positive attitude towards the medical staff as well as the radiation therapy itself.

Radiation therapy for prostate cancer - VMAT technique -

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Introduction:

With the acquisition of new modern linear accelerators VERSA HD1 and HD2, new techniques for irradiating patients were introduced, including VMAT (volumetric-modulated artherapy) techniques for irradiating prostate cancer patients.

The goal:

The aim of this lecture is to listen to the listeners about the procedures, the application and the advantages of this advanced technique when irradiating the prostate.

Methodology:

This method is performed on the IOV since March 2017.

The results:

Thanks to the application of this advanced technique, the treatment of patients with prostate cancer is currently confirmed by the high efficiency of treatment by this method.

Conclusion:

In the near future, in our institute, this technique combined with internal radiation (brachytherapy) will be the most effective way of irradiating patients with prostate cancer with the belief that there will be a minimal possibility of repetition of the disease.

The role of HDR brachytherapy in the management of prostate cancer

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In last decades, there has been an constantly increasing number of patients with prostate cancer in develop countries. A different radiation modalities were developed in the treatment of prostate cancer according to initial risk group, patient condition and modality of treatments available in radiotherapy center. The radiotherapy (RT) dose with curative intent have to be high, in general >70Gy as prostate cancer cells are relatively radio-resistant. An dose-escalation (increased RT dose) gives better biochemical control of disease and is achieved mostly by IMRT, brachytherapy (BT) or combination of this two modalities. In clinically localized prostate cancer (T1-2, N0) RT produces treatment results similar to those produced with radical prostatectomy. By PSA values and biopsies at 2 years, an 90% of clinical response was achieved with a dose of 75,6Gy or 81Gy vs. 76% with 70,2Gy and 56% with 64,8Gy. Neo-adjuvant hormones can be used to reduce pre-treatment volumes and to decrease the dose to organ at risk.

In the recent decades, brachytherapy has become an alternative to radical prostatectomy for early disease, and as a boost is combined with external beam RT (EBRT) for locally advanced disease. Radiobiology studies show that the prostate cancer is more sensitive to a large RT dose and hypo-fractionated dose regime as a consequence of low α/β ratio in adenocarcinoma of prostate. Interstitial HDR brachytherapy with Ir 192 combined with EBRT are comparable with surgery and are even better than EBRT alone. Recent studies show an effective results in the brachytherapy treatment of prostate cancer recurrence (termed "salvage" therapy).

Stereotactic Body Radiation Therapy (SBRT) for Liver Oligometastases: RTTs role

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Introduction. The aim of this study was to examine and explain RTTs role in the SBRT of liver oligometastases, focusing on patient preparation, immobilization, simulation, motion management techniques as well as specificities of IGRT for that technique.

Material and Methods. Specific technical and clinical components that were identified as being important during the development of liver SBRT at Affidea IMC Center for Radiotherapy are described. The clinical system that evolved from these is outlined. Although, at first glance, liver SBRT might seem methodologically similar to conventional radiotherapy, there are important differences in its execution that require particular consideration. We discuss practical challenges that have been encountered in the implementation of liver SBRT at our institution with the focus on RTTs role in every step of radiotherapy process emphasizing the importance for systematic approach in designing liver SBRT services.

Results. Using this clinical framework, the practical topics addressed include: patient assessment, simulation and treatment planning, motion management, tumor and organ at risk delineation, trial set up before treatment, on-line image-guidance, and patient follow-up.

Conclusions. The potential gain in therapeutic ratio that is theoretically possible with liver SBRT can only be realized if the tumor is adequately irradiated and normal tissue spared. The RTTs role is a complex process and has specific challenges that need to be overcome to achieve satisfactory transition of liver SBRT into routine practice.

Keywords: Liver metastases, Immobilization, SBRT, IGRT.

Lung SBRT, RTTs role

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Introduction. The aim of this paper is to highlight RTTs role to contribute to safe and effective diffusion of lung SBRT.

Material and Methods. Stereotactic body radiation therapy (SBRT) has shown efficacy as upfront treatment for stage I non-small cell lung cancer as well as for oligometastatic disease. Specific technical and clinical components that were identified as being important during the development of lung SBRT at Affidea IMC Center for Radiotherapy are described. This study examines and explains RTTs role in the SBRT of lung cancer, focusing on patient preparation, immobilization, simulation, respiratory synchronization and specific IGRT techniques. With the anticipation of improved outcomes, especially for patients with early-stage non-small cell lung cancer, stereotactic body radiation therapy (SBRT) has been rapidly introduced into the thoracic radiation oncology community.

Results. Using this clinical framework the practical topics addressed include: patient preparation, simulation, motion management, tumor and organ at risk delineation, trial set up before treatment, on-line image-guidance, and patient follow-up.

Conclusions. The potential gain in therapeutic ratio that is theoretically possible with lung SBRT can only be realized if the tumor is adequately irradiated and normal tissue spared.

Keywords: Lung cancer, Radiotherapy, SBRT, IGRT.

Implementation of advanced techniques in treatment planning of gynecological radiotherapy cases and comparison to standard 3DCRT treatment plans

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Purpose

The transition from three-dimensional conformal therapy (3DCRT) to intensity modulated (IMRT) or volumetric modulated arc therapy (VMAT) requires implementation of advanced dosimetry, fully commissioned treatment planning system (TPS) and machine as well as skills of employees.

Methods

Twenty one gynecological patient was selected for the study. Clinical plans were generated either for IMRT or VMAT, and in parallel 3DCRT. The TPS used was Monaco 5.11 (Elekta) with Monte Carlo (VMAT) and Collapsed Cone (3DCRT) algorithm. The treatments were delivered by Versa HD (Elekta, Crawley, UK) using 10 MV (VMAT) and 15MV (3DCRT). The patients were prescribed 50.4 Gy/28 fractions (4) and 45 Gy/25 fractions (17 patients).

Results

Coverage PTV: ICRU 83 criteria for PTV coverage were fulfilled in all 3DCRT /VMAT/IMRT plans. Doses to OARS: in average, the V45 in small bowel in IMRT/VMAT plans was 6 times smaller than the same of 3DCRT plans. In case of femoral head, significant reduction in V30 (9.8 % vs. 33.1%) and mean dose in case of IMRT/VMAT plans. Rectum was planned with significantly less dose in terms of V30 (79.5% vs 95.2%) in IMRT/VMAT plans. Bladder was better spared in VMAT plans in terms of

V40 (51% vs. 91%), but maximum dose was higher in VMAT plans than in 3DCRT (50.1 Gy to 48.1 Gy in average). Homogeneity index was in average 0.11 for VMAT plans and 0.09 for 3DCRT plans.

Conclusion

Both 3DCRT and IMRT/VMAT provided good clinical coverage of PTV, but analysis of dosimetric data revealed significant differences in normal tissue doses.

The impact of age on radiation dermatitis incidence in breast cancer radiotherapy

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Introduction

Ages of life has an important influence on skin condition. Radiation dermatitis (RD) is the most common adverse effect of external radiotherapy used in breast cancer treatment. The incidence and severity of RD may be influenced by extrinsic factors, such as radiation dose, target volume, radiation technique, and also by intrinsic factors. The purpose of this study was to evaluate the influence of age on the RD incidence in radiotherapy of breast cancer.

Material and methods

In this prospective study we included 60 patients who underwent breast conformal radiotherapy from June 2017 to January 2018. None of the participants had other skin diseases, nor other significant comorbidities or previous radiotherapy. They were divided in 2 groups: under and over the age of 50. Pearson correlation and Spearman's rho tests were used to analyze influence of patient's ages on RD incidence.

Results

Of the total number of patients 11 were younger than 50 years old and 49 older than 50 years. In the group younger than 50 years were 4 patients with RD, 3 patients developed grade I and one grade II. In the group of older than 50 years 16 patients had RD, 7 patients grade I, 5 patients grade II and 4 had grade III. Statistical tests compared separately incidence of radiation dermatitis in two groups. Both tests didn't show statistically significant impact on radiation dermatitis development comparing two groups.

Conclusion

Ages of life is not an independent factor for RD development. Radiation dermatitis had multifactorial origin and other factors might play significant role.

Keywords: breast, radiation dermatitis, age

Stereotactic body radiotherapy for liver metastasis: treatment planning and dose constraints

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Introduction. Purpose of this study was to evaluate treatment planning and dose constraints of high-dose stereotactic body radiation therapy (SBRT) in the treatment of liver oligometastases.

Material and Methods. Twenty two patients with 1 to 2 liver metastases were enrolled and treated by SBRT in this study. Dose prescription was 60 Gy in 8 fractions (BED=105 Gy). SBRT was delivered using the volumetric modulated arc therapy by RapidArc (Varian, Palo Alto, CA) technique. Treatment planning was done with two partial arcs with the couch rotation of $\pm 10^\circ$ and calculated with AcurosXB calculation algorithm. The protocol dose constraints for normal liver (total liver minus cumulative GTV) specified that a minimum volume of 700ml should receive a total dose less than 21.6 Gy. The percent of right kidney volume to receive a total of 21.6 Gy had to be less than 33%. The maximum total dose to any point in the spinal cord and stomach/duodenum/small intestine could not exceed 27.2 Gy and 44 Gy, respectively. The chest wall volume receiving 44 Gy in eight fractions should be limited to $<30 \text{ cm}^3$. Esophagus should receive less than 40 Gy.

Results. Twenty one patient passed protocol dose constraints. One patient didn't fulfill dose constraints for normal tissue.

Conclusion. Liver SBRT is dosimetrically achievable for a 8-fraction regimen and recommended when allowed by dose constraints from adjacent normal tissues.

Keywords: SBRT, Liver oligometastasis, Treatment planning, Dose constraints

Stereotactic Body Radiation Therapy (SBRT) for Liver Oligometastases: A Single Center Experience

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Abstract

Introduction. The aim of this study was to examine the efficacy and safety of SBRT, as a primary ablative method, for liver oligometastases and to publish our first results.

Material and Methods. This prospective study in a consecutive sample included 10 patients (12 metastases). Patients were treated at the Center for radiotherapy Banja Luka in the period from February 2016 until September 2017. Inclusion factors were: primary tumor under control, chemotherapy treatment conducted in first-line of oligometastatic disease, ECOG 0-1 and ≤ 2 metastases. Patients were treated with VMAT SBRT technique on LINAC. Treatment planning was based on 4D-CT. Prescribed dose was 8x7.5 Gy (Gray) to the surrounding 95%-isodose (BED 105 Gy). Quarterly follow-up were performed after treatment completion and included functional liver analysis, tumor markers and abdominal MRI scan.

Results. Expected 1-year overall survival (OS) was 100%. Progression free survival (PFS) median time was 7.6 months, and 1-year local control (LC) was 70%. There were no side effects on liver or the surrounding organs. Primary tumor in 7 patients was colon and breast tumor in 3 patients, male-female ratio was 50% -50%.

Conclusion. SBRT for liver oligometastases is very efficient and safe primary ablative method.

Keywords: SBRT, liver oligometastases, Banja Luka.

Review on intensity modulated radiotherapy for prostate cancer in University clinic for radiotherapy and oncology, Skopje, R. Macedonia

**G. Petkovska, V. Stojmenovska, B. Petrevska, I. Stojkovski,
V. B. Trajanovska**

From March 2015 until May 2018 total of 30 patients with prostate cancer have undergone radical treatment with IMRT in our center. Eligibility criteria were: localized prostate cancer, ECOG 0-1, no gastrointestinal comorbidities and age under 75 years. All of the patients received ADT before, during and after radiotherapy. 13% (4 patients) of the patients had intermediate risk, 70% (21 patients) had high risk and 17% (5 patients) had very high risk prostate cancer. In the first two patients total dose of 70.4Gy was applied, the third patient received 72Gy and all other patients received escalated dose of 74.4Gy. Two patients (6%) decided to end up the treatment earlier. Two patients (6%) reported Grade 2 proctitis during the treatment and 50% of the patients reported Grade 1 urinary symptoms. Only one patient (3%) didn't achieved normal range of PSA level after treatment and additional diagnostic evaluation was done where bone metastasis were discovered.

IMRT up to 74.4Gy is standard of care for radical treatment of patients with prostate cancer in University clinic for radiotherapy and oncology, Skopje, R. Macedonia. Our experience is positive due to better conformity of the dose delivered to the tumor and lymph nodes, while avoiding irradiation of adjacent healthy structures.

Key words: prostate cancer, radiotherapy, IMRT.

The impact of dose escalation in rectal cancer radiotherapy on clinical response-Initial Clinical Experience

Popović I, Ivanov O, Ličina J, Savić D, Novaković M, Trivković J.

Purpose. The aim of this study was to determine the efficacy and toxicity of volumetric modulated arc therapy (VMAT)–simultaneous integrated boost (SIB) in neoadjuvant chemoradiotherapy applied in cases of locally advanced rectal cancer.

Methods. Radiation therapy was performed using the VMAT-SIB technique. The dose to mesorectum and pelvic lymph nodes was 45 Gy (1.8 Gy/fraction). A concomitant boost was delivered on GTV + 2-cm margin with a total dose of 57.5 Gy (2.3 Gy/fraction). The following concomitant chemotherapy was administered during radiotherapy. Efficacy was evaluated in terms of complete pathological response (pCR). Acute toxicities were evaluated according to RTOG/EORTC Radiation Toxicity Grading. All participants have signed written consent.

Results. A total of 8 patients were observed. 2 patients (25%) had a pCR. Acute grade 3 gastrointestinal toxicity was observed in 1 patient (12,5%) who also had to abort treatment at 20th fraction. Considering low grade skin and gastrointestinal toxicity, 2 patients (25%) experienced grade 1 skin toxicity, 1 patient (12,5%) experienced grade 1 gastrointestinal toxicity and 1 patient (12,5%) experienced grade 2 gastrointestinal toxicity which was followed with 8 day interruption during treatment.

Conclusion. According to our study, the results of this kind of pre-operative treatment appears to be effective considering loco-regional outcome. Moreover, incidence of high grade acute toxicity is very low which leads to very low incidence of treatment interruptions.

Key words. VMAT, rectal cancer, pCR, acute toxicity.

Prostate cancer radiotherapy treatment – comparison of VMAT to standard 3DCRT treatment plans

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Introduction. This study was designed to compare treatment plans and doses received by target and organs at risk, in patients treated by VMAT and 3DCRT.

Materials and Methods. Twenty randomly selected prostate patients were selected for the study. Patients were planned for VMAT, and dosimetrically verified before treatment delivery. The patients were prescribed 70 Gy/28 fractions (SIB) for VMAT and for comparison purpose 3DCRT plans were generated in 70 Gy/35 fractions scheme.

Results. Coverage PTV: The ICRU 83 criteria for PTV coverage were fulfilled in all 3DCRT /VMAT plans. Doses to OARS: in average, the V45 in small bowel in IMRT/VMAT plans was almost twice as much lower than the same of 3DCRT plans. The V45 of small bowels was in average 22,4cm³ in VMAT plans, while in 3DCRT plans it was 64,3 cm³. In case of femoral head, significant reduction in D50 (22,1Gy vs. 35,7Gy), Dmax (44,6Gy vs. 51,0Gy) and mean dose (23,1Gy vs. 35,4Gy) in case of VMAT plans.

Rectum was planned with significantly less dose in terms of D50 (39,1% vs 52,2%), also D20 (52,2Gy vs. 61,1Gy) in VMAT plans. Bladder was better spared in VMAT plans in terms of V65 (12,2% vs. 29,3%), also D60 (36,6Gy vs. 55,6Gy)but maximum dose was higher in VMAT plans than in 3DCRT (73,5 Gy to 72 Gy in average).

Conclusion. It is locally confirmed that VMAT has great benefit in terms of OAR sparing, but requires complex patient preparation, planning and verification procedures.

Keywords: radiotherapy, prostate cancer, VMAT, 3DCRT.

Side effects and the efficiency of infradiaphragmal radiotherapy in lymphoma patients

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Introduction: In the past two decades irradiation techniques for lymphomas have been improved in order to spare the critical tissues and to reduce toxicity. Study data are nowadays still mostly derived from the patients who received supradiaphragmal radiotherapy, therefore there is no agreement about the best management approach for the patients with infradiaphragmal lymphoma. **Materials and methods:** Between January 2006 and December 2014 patients with proven Non-Hodgkin's lymphoma were treated with external beam radiotherapy to the infradiaphragmal region. Patients were irradiated with 2D technique or 3D conformal radiotherapy (3DCRT).

Results: We studied 89 patients. Median follow-up was 177 months. The in-field and out-of-field recurrence rates were 4,5% and 31,5 % respectively for the entire group. Acute toxicity experienced 48 (42.9%) patients. It was nausea, fatigue and abdominal cramps. Long-term side effects were noticed in 13 (15.3%) patients. The most frequent was gastrointestinal disorder (in 7,1% patients).

Discussion: Lymphoma treatment in the abdominal area is the issue of existing controversy. Although effective, RT is a neglected modality of the treatment due to the appearance of new drugs and because of the fear of side effects after irradiation. Radiation has been shown to be effective in the treatment of all stages and forms of lymphoma. This analysis demonstrates that radiotherapy can be effective in achieving local control of the lymphoma patients, and that the toxicity was very low in abdominal region.

MeSH/ Keywords: Non-Hodgkin's lymphoma, Radiotherapy, adverse effects.

IMRT Treatment of high grade extracompartmental chondrosarcoma

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INTRODUCTION

Until present day, there is no standard effective chemotherapy regimens in treatment of high grade or extracompartmental chondrosarcoma. Dasatinib has been included so far as a modality of treatment for systemic disease. Maximal safe resection with optional radiotherapy with advanced techniques remains to be the standard of care in selected cases.

In our case, the patient was male, 54 years old, ECOG PS 0 presented with MRI verified tumor formation with retroperitoneal presentation and primarily went under maximal safe resection followed by radical left sided nephrectomy and partial resection of unilateral proportion of the diaphragmal muscle.

The pathological postoperative findings verified the existence of conventional high grade chondrosarcoma with partial low grade characteristics.

In the postoperative period of following, control MRI verified the existence of large tumor lesion (max.d=8cm) located paravertebral, with extension from 12-th thoracic vertebrae till 3-rd lumbal vertebrae, extradural infiltration, infiltration of the left m.psoas and retroperitoneal propagation and preparations were immediately done for planning radiotherapy treatment.

Additional molecular analysis on NGS platform will follow because the patient is presented with widely spread benign chordomas.

Material and methods: 3D CT based planning simulation, delineation of GTV, CTV, PTV and organs of risk (spinal cord, kidney, bones, intestines, liver), IMRT based dose intensification plan, TTD70Gy, delivered in conventional fx, 35fx x 2Gy.

Results: The entire radiotherapy plan has been delivered safely with only mild local pain occurring as an adverse event. Main aim is local control and volume reduction of primary disease.

Conclusion: Advanced radiotherapy techniques with dose escalation remain to be the standard of care in patients presented with high grade chondrosarcoma due to nonexistent impact of chemotherapy regimens.

Keywords: high grade chondrosarcoma, IMRT radiotherapy

Implementing of new radiotherapy technique counting respiratory motion using ELEKTA Symmetry software at Institute for pulmonary diseases of Vojvodina

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Introduction: Symmetry is new ELEKTA IGRT solution to help manage respiratory motion. In April 2017. we got new linear accelerator Versa HD ELEKTA at Institute for Pulmonary Diseases. Staff training was conducted and first patient was irradiated using IMRT plan and Symmetry.

Material and methods: Patient was 78 years old women, adenocarcinoma stage T2bN2M0, ECOG 1. CT simulation was performed in 3 phase: CT free breathing, CT deep inhale and CT deep exhale. In Monaco treatment planning system we did registration CT inhale and CT exhale, CT free breathing and CT inhale and delineated GTV and CTV. ITV was CTvinhale+CTVexhale+CTVfree breathing+0,1cm. PTV was ITV+0,4cm. IMRT plan was performed, dose 50Gy in 25 fractions on PTV. Prior to first treatment patient was scanned on LINAC using Symmetry 4D CBCT modul. Mask was defined as PTV plus 0 mm. Correction reference points was center of structure PTV. XVI splited the breathing curve to ten different points and found the frames for each one. Automatic registration between the mask volume of reference CT planning and those of 10 phases 4D CBCT was performed. Software found the shifts for all ten points and calculated the mean number. Software found the area where tumor spent the most of time during the breathing cycle. Shift was performed and patient was treated without interruption to the treatment beam.

Conclusion: ELEKTA Symmetry can increase the precise of the registration and it's a beneficial tool for the treatment of movable tumors.

RADIOLOGIC PRESENTATION OF IRRADIATION SEQUELAE AND COMPLICATIONS DURING TREATMENT OF BREAST CANCER

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INTRODUCTION: In addition to the standard therapy of the breast cancer using surgery, irradiation, chemotherapy and hormone therapy represent significant complementary methods. Irradiation of the breast after surgery carries high risk of complications. Irradiation-induced sequelae and complications are usually defined as early (within one month after irradiation), intermediary (from one month to several years after irradiation) and late (more than 10 years after irradiation).

AIM: to present radiological presentation of the most frequent and typical radiation-induced sequelae and complications in the treated breast, as well as in surrounding structures/ organs, dependent on the time from the treatment. Radiological methods used are: echomammography, digital mammography with tomosynthesis, CT tomography, MR imaging and PET-CT.

MATERIALS AND METHODS: All patients were treated (with surgery and irradiation) and radiologically monitored in the Center for Diagnostic Imaging, using modern radiological methods. The first radiological examination was performed 6 months after irradiation using sonography. Digital mammography with/without tomosynthesis and/or MR mammography are performed more than 6 months after completion of radiation therapy. According to the period from the therapy and patient condition, oncologist performs optional follow up examinations using CT/MR/PET-CT.

RESULTS: Most common early sequelae in our patients were: edema, dystrophic calcifications, fat necrosis, pneumonia and pleural effusion. Most common intermediary sequelae were: fibrosis of the breast, atrophy of glandular tissue, lung fibrosis, radiation myelopathy, while cardiomyopathies and secondary malignancies were observed as late complications.

CONCLUSION: Understanding of radiological presentation of sequelae and complications following radiation therapy in the treatment of breast cancer is necessary in order to monitor patients efficiently and to reduce the number of unnecessary examinations.

RADIATION-INDUCED COMPLICATIONS IN THE PELVIS IN PATIENTS WITH RECTAL CARCINOMA – MR STUDY

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INTRODUCTION: Radiation-induced complications remain a common problem in oncologic patients.

AIM: was to examine differences in type and frequency of radiation-induced changes in the pelvis in patients with rectal cancer (predominantly T3 stage), using MR imaging, who were irradiated in the period 2007-2008 and 2016-2018, on Oncology Institute of Vojvodina.

MATERIALS AND METHODS: Patients were divided into two groups (2007-2008 the first group and 2016-2018, the second group). In the first group there were 21 patients (6 females and 15 males), average age 60 years, with dose of 50,4Gy/28 fractions. In the second group there were 30 patients (5 females and 25 males), average age 61 years, with dose of 25Gy/5fractions to 45Gy/25fractions+9Gy/5fractions. The presence and frequency of radiation-induced complications were compared in two groups, comprising: fat bone metaplasia, edema of rectal mucosa, edema of the bladder wall, edema in soft tissues, fistulas, ascites, prostatic changes, fibrosis of the seminal vesicles and osteoradiation necrosis. Statistical analysis was performed using chi-square test, with significance vaule set at $p < 0.05$.

RESULTS: In the first group, we observed bone fat metaplasia in 90% of patients (19/21), edema of rectal mucosa in 33% (7/21), edema of the bladder wall in 29% (6/21), edema of soft tissues in 33% (7/21), fistulas in 19% (4/21), ascites in 19% (4/21), prostatic changes in 27% (4/16), fibrosis of the seminal vesicles in 7% (1/16) and osteoradiation necrosis in 13% of patients (3/21).

In the second group, we observed bone fat metaplasia in 80% of patients (24/30), edema of rectal mucosa in 57% (17/30), edema of the

bladder wall in 27% (8/30), edema of the soft tissues in 27% (8/30), fistulas in 13% (4/30), ascites in 3% (1/30), prostatic changes in 6%(9/25), fibrosis of the seminal vesicles in 24% (6/24) and osteoradiation necrosis in 20% (6/30) of patients.

CONCLUSION: There were no significant differences in the type and frequency of detected radiation-induced changes in patients with rectal cancer, detected on MR imaging, in the patients who underwent radiation therapy in two different time periods in our institution.

Brachytherapy alone in the postoperative treatment of stage I endometrial carcinoma

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Introduction: This study evaluate the local control efficacy and toxicity of postoperative intravaginal brachytherapy (IVBT) alone among patients with endometrial cancer stage I.

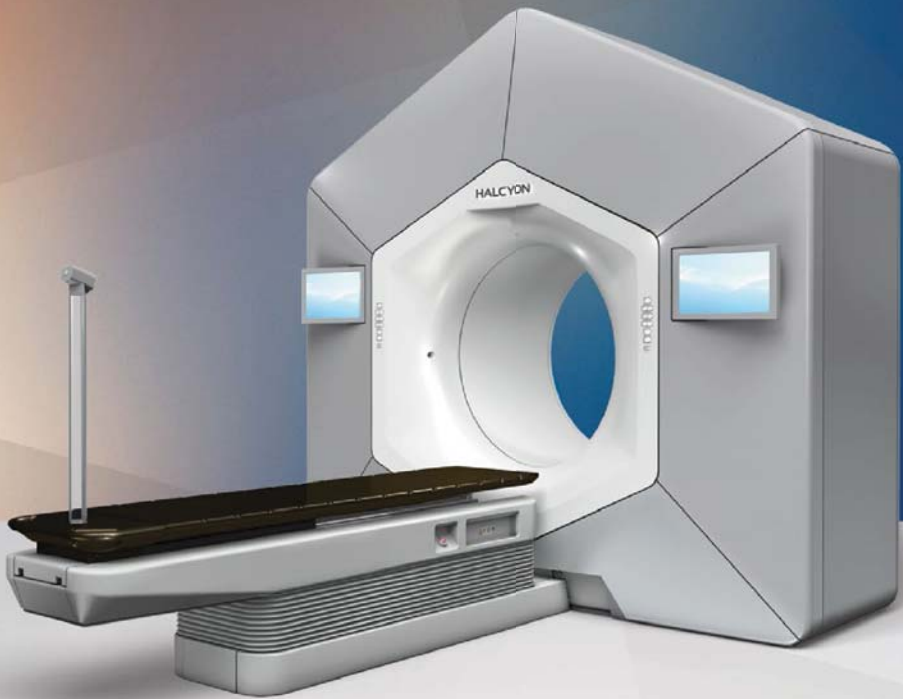
Material and methods: Between January-2004 and December-2011, 60 stage I endometrial adenocarcinoma patients were treated with IVBT alone, 47 in stage IA, 13 patients in stage IB. The surgical approaches were total abdominal hysterectomy (HTA) and bilateral salpingoophorectomy (BSO) in 45 patients, plus bilateral pelvic, paraaortic lymph node dissection in 15 patients. The mean interval between the surgery and the brachytherapy was 30-37 days. $<1/2$ miometrial invasion was found in 48 patients, and $>1/2$ in 12 patients. The brachytherapy was applied in 3 weekly fractions of 7Gy per fraction, prescribed at depth of 0,5cm from the applicator surface with HDR, Iridium-192. The mean diameter of the vaginal applicator was 3 (2-3,5) cm.

Results: With a mean follow up time of 38 months (12-84), all 60 patients are alive. Recurrence was observed in 5 patients (8,3%): 3 patients experienced local recidiv and 2 patients developed a pelvic mass. The mean rectal dose was estimated 14,1Gy and the mean bladder dose was 13Gy. Acute genitourinary toxicity was observed in 31 patients during the therapy. Vaginal stenosis as late complication occurred in 3 patients.

Conclusion: Intravaginal brachytherapy alone in the postoperative treatment of stage I endometrial carcinoma achieves local control associated with acceptable toxicity and minimal morbidity.

Key words: endometrial cancer, intravaginal brachytherapy

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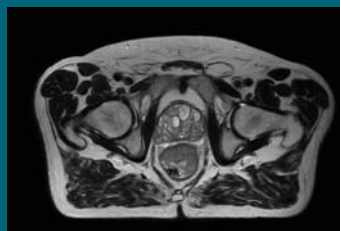
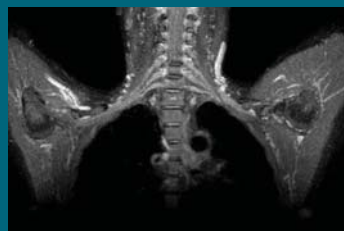
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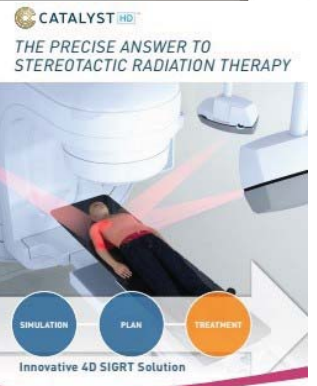
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