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Review

Lung cancer. Radiotherapy in lung cancer: Actual methods and future trends

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ABSTRACT

This survey is performed to update knowledge about methods and trends in lung cancer radiotherapy. A significant development has been noticed in radiotherapeutic techniques, but also in the identification of clinical prognostic factors. The improvement in the therapeutic line includes: application of the four-dimensional computer tomography (4DCT), taking advantage of positron emission tomography (PET-CT), designing of new computational algorithms, allowing more precise irradiation planning, development of treatment precision verification systems and introducing IMRT techniques in chest radiotherapy. The treatment outcomes have improved with high dose radiotherapy, but other fractionation alternations have been investigated as well.

Radiotherapy represents the basic method of treatment in lung cancer. It is used at every stage of clinical advancement, both in the non-small cell (NSCLC) and the small-cell form (SCLC) of the cancer. According to epidemiological studies, in developed countries 61–76% of all patients with NSCLC require one of radiotherapy forms at a certain stage of their disease.[1,2] At early stages of the disease advancement, in cases when the patient is not planned to undergo surgery, stereotactic radiotherapy is applied, in locally advanced stages, radiochemotherapy or radical radiotherapy are used. In cases of the disseminated disease or when the disease cannot be radically treated for various medical reasons, radiotherapy is employed as a palliative treatment. On the grounds of the analysis of data obtained from SEER-17 data base and presented during ASTRO conference, Kong et al. evaluated the effect of radiotherapy on patients' survival, comparing techniques employed before and after 2004. Application of radiotherapy was found to improve results of treatment at all stages of advancement, with better results obtained in the group treated after 2004, thus using more modern techniques.[3]

In recent years, a significant progress has been observed in radiotherapeutic techniques in general, with a significant increase in studies on the efficacy of lung cancer radiotherapy using modern tools. The areas where particular development has been detected include progress in identification of clinical prognostic factors, allowing individualization of patient's treatment as well as improved quality of anatomic imaging

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of the tumour and the regional lymph nodes, which results in a precise definition of the target volume.[4] Nevertheless, from the point of view of a radiotherapist the most important has been the improvement in the therapeutic line technological quality: application of the four-dimensional computer tomography (4DCT), taking advantage of positron emission tomography (PET-CT) studies in treatment planning, designing of new computational algorithms, allowing more precise irradiation planning, development of treatment precision verification systems and alterations in the very implementation process in administration of the recommended dose. Application of new technological solutions allowed to deliver treatment in higher biological doses with retention of treatment toxicity at a relatively low level.

1. PET-CT

In patients with lung cancer the key examination, permitting an improved quality of preliminary qualification and radiotherapy planning, is PET-CT with [18F]-FDG. Some prospective studies revealed that introducing PET-CT before planned radiotherapy disqualified radical treatment in 25–30% of the patients, most frequently due to distant metastases.[5,6] PET-CT examination manifests high sensitivity in detection of metastatic lymph nodes and distant metastases. This diagnostic accuracy allows to distinguish patients with lower stage of advancement, in whom radical treatment (surgery or local therapy) can be performed, from palliative patients. The value of PET-CT in radiotherapy planning cannot be overlooked either, as the tool which helps to define target volumes. Numerous studies have accentuated that PET-CT examination in planning of radiotherapy reduces the risk of the geographic error, particularly in outlining the mediastinal lymph nodes,[7,8] but also in distinguishing the tumour from the surrounding pulmonary atelectasis.[9] The equipment used for PET-CT examinations in radiotherapy must be appropriately calibrated.[10] The use of such imaging for planning requires compliance with certain protocols, which specify not only patient immobilization but also an appropriate interpretation of obtained results.[10,11] Quality of the image, which is supposed to be used for planning, can be improved by the use of PET-CT equipment, which additionally records patient's respiratory cycles (4DPET-CT). This causes the blurring of image patterns, resulting from patient's respiratory movements, to become reduced and in this way the region of metabolically active lesions within the lung can be better outlined. Another difficult issue is the manner in which PET-CT is used for outlining the target volume. The most frequently used method is qualitative visual evaluation of PET images (Qualitative Visual Method, QVM). The other approaches involve an automated quantitative evaluation of the result: an arbitrary SUV level can be assumed, e.g. >2.5, and on this basis the tumour can be located. However, the approach is difficult because no standard SUV value is defined for malignant tumours. Another method involves determination of a threshold SUVmax value, expressed in percents, e.g. 40%, above which the tumour region is outlined. No unequivocal data are available which may suggest an optimal character of any of these approaches. Therefore, the best solution requires the formation of an interdisciplinary team dealing with appropriate qualification and treatment planning and in this way direct cooperation with a nuclear medicine specialist. Only such a cautious approach to the obtained results allows to significantly avoid systemic errors resulting from an improper interpretation of the Images.[10,12] Radiation Therapy Oncology Group (RTOG) recommended the use of [18F]-FDG-PET-CT in radiotherapy planning of patients with non-small cell lung cancer already in 2003. Nevertheless, further investigations are necessary to define the role of this examination with higher accuracy, at least within the range of effects induced by the therapy and the effect of PET on patients' survival.

2. Role of 4DCT in RT planning

The concept of using 4-dimensional computer tomography (4DCT) for radiotherapy planning has been discussed for a long time, due to the significant and not always predictable mobility of chest organs. The idea of 4DCT involves scanning of the patient using a spiral computer tomography, which is paralleled by the reception of signals recording the respiratory cycle. Subsequently, the collected tomographic data are separated for individual respiratory phases, with the resulting grouping of CT images into a few series, reflecting shift of the tumor.[13] Treatment planning based on 4DCT images requires the use of an algorithm grouping CT images into separate image sets, in which oncologist-radiotherapist defines independent tumour contours, which subsequently can be presented as a global contour in a selected bin. At present, the use of 4DCT is recommended both in conventional fractionation,[14] and in high dose radiotherapy.[15]

Based on 4D tomography, a few concepts were introduced for PTV defining. They include *internal tumour volume* (ITV)-PTV_{ITV}, modification of ITV based on *maximum intensity projection* (MIP)-PTV_{MIP}, determination of PTV based on respiratory gating-PTV_{GATING} and the concept of *midventilation*-PTV_{MidVen}.

Determination of PTV_{ITV} involves outlining of a tumour in 6–10 individual respiratory phases.[16] Even if relatively precise, the method is time- and work-consuming and, therefore, the potential for a faster contouring has been introduced as a facilitation of the radiotherapist's every day work, based on automatic delineation of ITV using MIP. MIP projection reflects maximum values of HU ascribed to voxels in the volume restricted to tumour location while delineation of the region itself takes place with an assistance of a specific software,[17] the so-called 3D IsoConture identifying marginal HU values which detach tumour margins from the lung. This allows restricting the time-consuming procedure of outlining the tumour, but it also carries limitations in cases of tumours situated close to the chest wall or mediastinum.

Radiotherapy using respiratory gating involves irradiation of a tumour only at a certain stage of respiratory cycle, most frequently at expiration, although breath-hold techniques can also be applied. In order to implement this concept special equipment is required, which reads out respiratory movements of the patient, synchronizing them with an accelerator.[18] In order not to needlessly extend RT procedure, 20–40% of the respiratory cycle time is used to create the

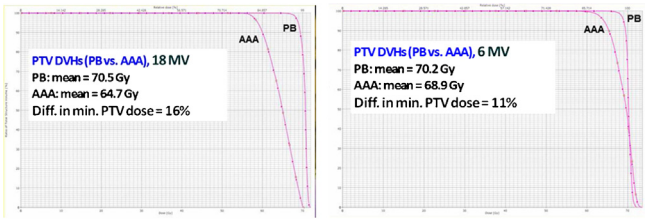
PTV_{GATING}. The method allows to reduce the irradiated region although its implementation takes 1–2 h.

A fully new approach is the *mid-ventilation* – PTV_{MidVen} concept, involving selection of the reference CT scan, in which the tumour in the respiratory cycle is situated in the averaged time, determined on calculation of a weighted mean.[19] This means that the tumour for a short period of time remains out of the irradiated region. Such a solution seems to be particularly interesting from the clinical point of view (a significant reduction of PTV region) but it requires further verification and safety of the approach should be checked.

Comparing the size of the target delineated on the 4DTCT to the one created based on conventional free-breathing CT (PTV_{CONV}), alterations are noted in the size of PTV region. It should be noted that in the conventional technique the size of margins is estimated in line with the principle of probability.[19] If PTV_{CONV} is compared to PTV_{MidP} and PTV_{GATING}, a marked reduction is noted in the irradiated region, particularly in tumours located in the lower parts of the lungs. In turn, definition of PTV_{ITV} may additionally increase the region. However, it should be stressed that prolonged time of implementing respiration-gated radiotherapy is frequently tiresome for the patient. Underberg et al. calculated that clinical justification for employing gating can be noted only when reduction of PTV_{GATING}, as compared to PTV_{ITV}, amounts to at least 50%. In practice, in most of patients lower reduction of the volume is noted and only in around 5% patients PTV reduction of clinical significance is encountered.[17]

3. Calculation algorithms

Correct definition of the applied dose represents an important element of properly performed radiotherapy. The accuracy and correctness of estimating the dose using computer assisted calculations are linked to analysis involving the currently available algorithms which calculate the dose in regions commonly regarded as presenting difficulties in the calculation. Such a region involves tissues of low density, e.g. lungs, surrounded by tissues of a normal (water-resembling) density. At present, two principal types of algorithms are available: type A and the more advanced type B. The type A includes the algorithms of Pencil Beam Convolution Model (PBC) used up to date, which demonstrated dose distributions as much more uniform for targets surrounded by pulmonary tissue than the simulatory Monte Carlo (MC) type B calculations. The high inhomogeneity of doses in simulations reflected the inclusion of dose transport from dispersed quants, the lower energy of which resulted in an inhomogenous distribution of the transferred absorbed dose. MC algorithms are thought to provide a gold standard for dose calculation but they are not commonly used due to restricted access. Since the AAA-type B algorithm has been introduced, which takes into account the lateral dispersion caused by the "dense" lung-surrounding tissues, reliable data could be obtained on the doses absorbed by the tumour and the lung. The AAA algorithm is thought to provide an appropriate alternative for MC.[20] The algorithms of PBC and AAA, differ from each other, first of all, in the in-homogenous doses in PTV. The curve of DVH for the PBC model pointed to a more uniform distribution in the target,



A B

Fig. 1 – DVH for a target located in the lung. Dose distribution obtained using two algorithms of PB and AAA, for the energy of: A/18 MeV, B/6 MeV.

thus causing no significant transgression of doses recommended by IRCU. On the other hand, in AAA calculations the DVH curve indicated significant heterogeneities: extensive regions of low dose appeared, which indicated that in order to obtain reference doses one had to re-normalize the DHV curve, obtained in line with AAA calculations, in such a manner that the minimum and the average doses would fulfil conditions of therapeutic doses, and this, in turn, led to relatively high doses in the region of the tumour and, consequently, elevated the dose to the lung (Fig. 1). Therefore, in several centres conducting high dose radiotherapy in lung cancer the method of prescribing the dose was altered, e.g. from 3×20 Gy to 3×18 Gy.[21]

At present, in radiotherapy planning, the use of more advanced type B algorithms is recommended.[14]

4. Techniques of IMRT and VMAT

Introduction of dose intensity modulation technique (IMRT) proved to be significant for development of radiotherapy, originally in therapy of tumours located in the head and neck region. Due to the need for dose escalation with another need of saving the critical organs, the IMRT technique has also become an interesting option for lesions located in the chest. At first, due to problems linked to respiratory mobility of the chest, IMRT was not frequently applied in this location. Due to the dynamic character of the therapeutic beam, no assurance could be given whether the elongated duration of treatment, linked to the implementation of IMRT schedule, would not cause an unexpected summation of doses. Nevertheless, the conducted simulations and statistical analyses demonstrated that the difference between implementation of 3D plan vs. IMRT plan amounts to just around 1%, which was confirmed by subsequent clinical studies.[22] According to IMRT assumptions, in most critical organs it is possible to reduce the administered dose by an average of 18% which, in turn, provides a chance for dose escalation by around 13%.[23] The clinical problem associated with the IMRT technique involved low doses of radiation administered to the healthy lung. In order to evaluate safety of the treatment, it was necessary to evaluate additional dosimetric parameters, e.g. V_5 within the lungs. The long-term observations conducted in MD Anderson centre confirmed that the application of IMRT allowed to reduce toxicity within the lungs and oesophagus. Using a 3D planning technique, the authors detected higher toxicity of the therapy.[24]

A sophisticated form of IMRT involves the volumetric modulated arc therapy (VMAT). Due to such a technique, the dose becomes deposited during a continuous gantry rotation. The principle resembles that used in tomotherapy, except that VMAT may be implemented using a conventional accelerator, which significantly increases the accessibility of the method. As indicated by investigations, the application of VMAT allows to obtain a highly conformal plan, as compared to co-planar and non-co-planar IMRT techniques.[25] Based on our experience, it can be concluded that the application of VMAT is particularly useful upon reduced size of the low dose region (<10%) and, in particular, within the healthy portion of the tumour-containing lung (Fig. 2). Doses delivered in the technique to critical organs are appropriately controlled even with a potential for dose reduction in pulmonary tissue.[26] The fact of the reduced irradiation time, even to <70% of the time required to implement IMRT procedure, cannot be overestimated. Due to the frequently applied high dose techniques (SBRT), it is recommended to use two dynamic arcs in order to properly distribute the dose in the course of its short administration. In the other case, extensive inhomogeneities of the dose may occur, resulting from excessively rapid rotation of the gantry, movement of collimator leaves and a variable dose power (Fig. 3).

During irradiation using any of the techniques, despite precise calculations, a poor deposition of the dose may occur due to inaccurate placement of the patient or physiological movements within the body of the patient. As demonstrated by Purdie,[27] extended irradiation times should be avoided: the author showed that a mean shift of patient's body depends on the duration of the procedure and approximates 2.2 mm if irradiation is administered during up to 34 min. Upon longer irradiation, the shift may exceed 5 mm. In such a situation the appropriate position of the patient should be verified again, which in turn additionally extends the procedure and requires an additional engagement of the staff. Due to its short duration, the application of VMAT approach allows to by-pass the problem.

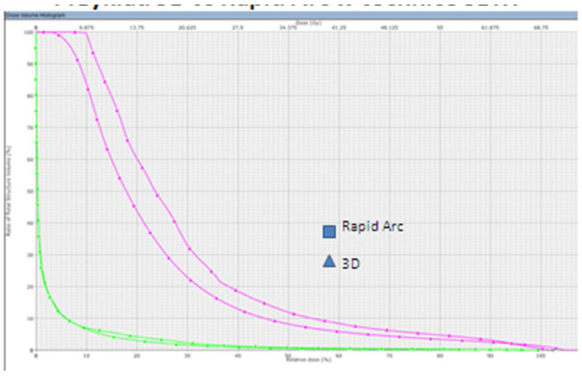


Fig. 2 – Comparison of 3D and VMAT techniques, for the region covered by the dose of 10%.

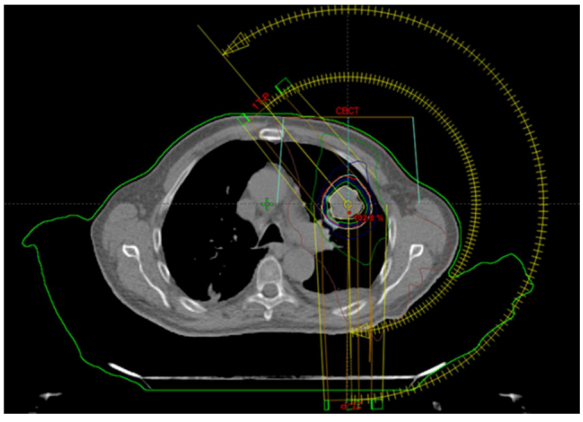


Fig. 3 – The system of two dynamic arcs with dose distribution.

5. Treatment delivery

Until recently, patient set-up was verified mainly using megavoltage radiograms, basing on skeletal anatomy. Currently, many more precise and safe methods are available for appraisal of treatment delivery. One of the more precise imaging techniques involves cone-beam CT (CBCT). Such an imaging allows to visualize not only the bony structures but also the tumour, with its shifts and positions between fractions. Such an appraisal can and should be conducted both *on-line* and *off-line*. In the case of stereotactic plan implementation, just a few fractions are administered and an extremely accurate verification of patient's position is required: the standard involves *on-line* evaluation before every exposure.[28] In turn, when conventional fractionation is used, such a procedure should be applied not more than, e.g. once a week, due to the risk of administering an additional dose of irradiation.[14]

6. Modification of radiotherapy fractionation schemes

Following the application of definitive, conventionally fractionated RT, results of treatment in pulmonary carcinoma are unsatisfactory. One of the possibilities for increasing treatment efficacy involves a change in the manner of fractionation and, in effect, of the total biological dose of RT. The above mentioned technological improvements enabled further studies on increasing treatment efficacy by an increase in the total dose. The problem of whether administration, in correlation with chemotherapy, of a conventionally fractionated higher total dose is justified was resolved by preliminary results of RTOG 0617 trials. This randomized trial of III phase, started in 2007 and compared effects of 60 Gy vs. 74 Gy radiotherapy, accompanied by a concurrent and consolidational chemotherapy (carboplatin/paclitaxel ± cetuximab) in patients with more advanced stages (IIIA and B). The total survival time in the patients amounted to, respectively, 21.4 and 20.7 months with a similar toxicity of the treatment. Although the multifactorial analysis of the study results confirmed a comparable toxicity of the applied treatments despite different doses of irradiation, it demonstrated worse results of treatment in the group of patients with a higher volume of tumour, in patients with squamous cell carcinoma and with radiation dose 74 Gy.[29] The trial showed that the application of only slightly augmented dose using a standard form of fractionation brought no expected results.

7. Hyperfractionated and accelerated radiotherapy

Basing on radiotherapeutic premises related to abbreviating the interval between fractions in order to reduce intensity of cell repopulation and to reduce the post-irradiation late reaction in normal tissues, RTOG introduced a number of studies on the application of the fractionated dose of 1.2 Gy, applied twice daily (hyperfractionation). Improved results of treatment were noted upon the total dose of 69.6 Gy in 28 fractions, with no further improvement with dose escalation. Subsequently, this manner of fractionation was compared in a prospective study comparing hyperfractionated radiotherapy with standard radiotherapy and with the standard radiotherapy with induction chemotherapy. A therapeutic advantage was detected only in the group receiving induction chemotherapy. Moreover, subsequent studies of RTOG 9106 and 9204 manifested another problem affecting the effects of the applied therapy, the learning curve detected upon the use of hyperfractionated therapy: in centres treating at least 5 patients per year the mean survival amounted to 20.5 months while in the remaining ones it was 13.4 months.[30] Most clinical studies employing this manner of fractionation were collected by specialists from the Meta-Analysis of Radiotherapy in Lung Cancer Collaborative Group and subjected to meta-analysis. According to the investigators, the application of hyperfractionated radiotherapy and/or accelerated radiotherapy improved results of treatment in the form of elongated 5-year total survival (OS) by 2.5% although it was burdened by an increase in toxicity, particularly in the oesophagus. An additional problem involved organizational difficulties linked to treatment delivery of therapy based on this type of fractionation.[31]

8. Hypofractionated radiotherapy

The above quoted clinical data demonstrate that neither the increase in total dose (upon conventional fractionation) nor hyperfractionation bring the desired effect. Therefore, the interest was focused on another model of treatment fractionation, the hypofractionation. Due to improvement in the earlier described technical aspects of irradiation planning and implementation, the precision was increased in determining the target and reduction of irradiated volumes of critical organs (mainly the lungs) which, in effect allowed to apply higher fractional doses with no escalation of the complications. The level of hypofractionation may vary, from moderate (doses of 2.4–4 Gy order) to high doses, such as used in stereotactic radiotherapy (10–20 Gy per fraction). Both manners of fractionation continue to be intensely studied. One of the prospective studies related to hypofractionation is NCIC CTG BR.25 study performed by Cheung et al.[33] The patients qualified to the study had T1-3N0M0 tumours, and the planning employed 4DCT or fluoroscopy technique for better imaging of tumour shifts. The recommended dose was 60 Gy with fractionation by 4 Gy. The two-year results of treatment were as follows: local control 88%, distant control 76%, total survival 69% at the 3 degree toxicity at the level of 10%. Results of treatment were less favourable in the group of patients with tumour >3 cm, therefore the justification was considered for chemotherapy administered in parallel to such a fractionation. However, undoubtedly, results of such a scheme of hypofractionation were better than those of conventionally fractionated radiotherapy. Therefore, currently a few multicentre trials are being performed, aimed at determining significance of a moderate hypofractionation for a definitive RT (NCT01459497), RT with chemotherapy (NCT01345851) or with anti-angiogenic drugs (NCT00745732).[31]

9. SBRT

A threshold in treatment of lung cancer was provided by introduction of high fractional doses in studies conducted at Indiana University by Timmerman. In the studies, using fractional doses of 20 Gy up to the total dose of 60 Gy for T1 tumours and 22 Gy for T2 tumours administered on three fractions, the local control in 2-year follow-up observation amounted to 95%, giving results comparable to those of surgical treatment. Toxicity of the treatment approximated 15% for reactions of 3–4 degree although reaction of 5 degree were also encountered, mainly within the respiratory system. Studies of Timmerman et al.[34] proved to be of critical value in treatment of previously inoperable cases of early tumour forms and also they provided premises for numerous studies in the scope. Results in most of the studies were surprisingly good: local relapse <10%, distant metastases <20%, at the toxicity level of <10%.[35] It was significant that every of the research centres applied different fractional doses, distinct ways of normalization and also distinct calculation algorithms, frequently even not described in the studies, which made direct comparisons between the studies difficult.[36]

For several years, an improved local efficacy of treatment has been known to be expected following administration of a biologically effective dose (BED) $\geq$100 Gy, with further improved results at $\geq$120 Gy or $\geq$140 Gy.[37] At present, most of fractionation manners take into account this dependence. If the standard model of dose fractionation according to Timmerman in the study of RTOG 0236 is accepted, i.e. 3×20 Gy, the BED amounts to >140 Gy. However, due to the high risk of toxicity, such fractionation could not be applied for centrally located tumours, close to the mediastinum. Nevertheless, numerous groups of investigators, altering the scheme of fractionation, proved safety of SBRT also for centrally located tumours. Location of the tumour was proved to exert no effect on survival following SBRT. Also the toxicity level proved to be acceptable as well as the risk of death linked to this way of treatment, at the level of <1%.[38] The scheme of treatment which used to be applied in centrally located tumours involves 50 Gy in 5 fractions, 54 Gy in 6 fractions, 60 Gy in 8 fractions.[38] In Fig. 4, the typical distribution of 55 Gy dose was presented, normalized in 80% isodose for PTV region, which permitted to receive a conformal distribution in GTV-PET, amounting 95% of the dose in 98% volume.

The above mentioned multiplicity of studies with variable schemes of treatment makes the choice of appropriate manner of fractionation difficult. In this case, studies from the scope of radiobiology and determination of biological dose

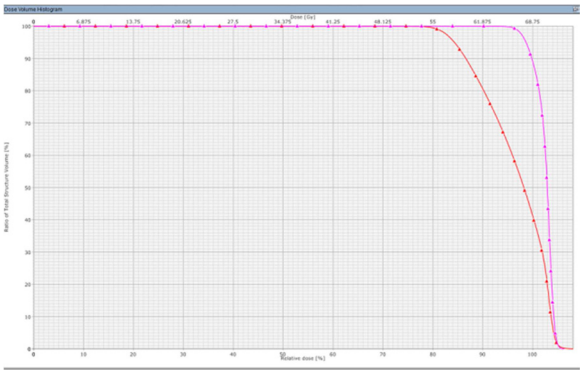


Fig. 4 – Normalization of dose for PTV 55 Gy in 80% isodose, which determines distribution in PET_GTV, 95% of the dose in 98% volume.

equivalent (BED) might be helpful. The principal tool for determining the BED involves the linear-quadratic (LQ) model, the value of which, however, is restricted for radiotherapy implemented using fractional doses >6 Gy. Basing on experiments on NSCLC cell lines, the new method of estimating BED was introduced, based on the universal survival curve (USC). Analysis of numerous publications related to application of SBRT in lung cancer, in respect to the relationship between the applied value of BED and the resulting effects of the therapy, permitted to develop curves, which may be very useful in every day practice, in selecting an appropriate type of fractionation.[39,40]

In view of its insignificant toxicity, SBRT finds application in therapy of patients who, due to co-existing diseases, cannot be subjected to surgery. In several studies safety of SBRT was proved in treatment of patients older than 75 years,[41] patients with reduced respiratory efficiency, e.g. in the course of chronic obturative pulmonary disease (COPD),[42] following pneumonectomy,[43] and even in cases of bilateral lesions in the lungs.[44]

In view of the precision of irradiation and application of high fractional doses in SBRT, a particular attention is given not only to contouring of target volumes but also to determination of critical organs. In RT of the lungs, the need appeared to define new critical regions and to specify principles of contouring involving volumes of protected organs and evaluation of risk for development of complications. This prompted the formation of atlases presenting contouring principles.[45]

In technical terms, SBRT takes advantage of all achievements of modern technology: planning based on PET-CT, use of immobilizing systems, determination of targets based on 4D-TK, planning using advanced algorithm, IMRT, arc techniques, gating and the precise verification of position under the therapeutic machine, e.g. CBCT. Lung stereotactic radiotherapy uses various techniques of irradiation, depending on available equipment in a centre and experience of its staff. The efficacy of SBRT applied at lower advancement stages matches the results obtained using proton therapy.[46]

It is worth mentioning that SBRT in early inoperative lesions in the course of NDRP, in recommendations of numerous oncological societies, including NCCN and EORTC, represents at present the standard way of treatment.

Beyond doubt, pulmonary tumours represent cancer with a high risk of distant metastases, in which stereotactic radiotherapy is also widely used. Generally known restrictions in SBRT, depending on size and location of lesions, also apply to metastatic lesions. Therefore, from the clinical point of view, it seems significant to separate in the group of patients those with a restricted metastatic form (oligometastasis), in whom relatively good results of treatment can be obtained.[31] Interesting seems to be the concept of separating from the extensive group of NSCLC patients those in whom tumour biology favours development of a restricted form of metastatic disease to whom a more intense treatment may be suggested. It seems that the differentiating variable might involve evaluation of microRNA, in particular that belonging to the microRNA-200 family. Detection of an increased expression (enhancement) of microRNA-200c may in future provide a patient-stratifying variable, selecting a group of patients in whom a more intense, dedicated radiotherapy is justified, using in particular stereotactic procedures.[47]

10. Conclusions

Contemporary studies on improvement in treatment of lung cancer are strictly connected to the enormous technological progress which has taken place in radiotherapy and in related branches, including diagnosis. Beyond doubt, optimistic are results of studies in the group of patients with a tumour of low advancement in whom the chance exists to perform SBRT. Results of studies on the application of this form of treatment prove that desired effects may be obtained only when biologically effective doses $\geq$100 Gy are applied. Studies should continue on other forms of radiotherapy hypofractionation, particularly in association with chemotherapy, which might improve results of treatment in patients with more advanced stages of the disease. In order to reduce mortality induced by lung cancer a high stress on primary prevention should continuously be exerted, particularly involving efforts to reduce the proportion of smokers and this goal should also fall within the scope of oncologists' activities. More attention should be paid to increased frequency of early diagnosis in lung cancer and, therefore, start of its treatment at an early stage of the disease, which is a basic condition for an effective therapy. Technical potential for diagnosis and treatment expands, although in their every day practice oncologists who deal with treatment of lung cancer still face the problem of an appropriately rapid access to modern diagnostic tools and, in effect, the potential to introduce an effective therapy. Like in the case of breast cancer, multidisciplinary teams should be formed dealing in a complex manner with problems of diagnosis and treatment of patients with lung cancer. Only the common activities of the entire team of specialists, supported by appropriate organizational processes may lead to improvement in results of treatment in patients with lung cancer.

Conflict of interest

None declared.

Financial disclosure

None declared.

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