This paper presents a technique of special irradiating of which oneness consists of the corrections which have to be applied to absorbed dose in the tissue, because of the beam’s crossing through the lung tissue of smaller density than normal tissue. The radiotherapeutic treatment of lung cancer imposed the applications of corrections for tissue inhomogeneity. From isodose curves we noticed that where the correction for tissue inhomogeneity wasn’t introduced, the irradiation simulate was sub-optimal in the tumoral volume, being necessary a meaningful extension of the beams and involving excessive irradiation of organs at risk. Thus, introducing the correction for tissue inhomogeneity, is obtained the best alternative of the treatment planning with perfect framing of the tumour volume in prescribing isodose and with irradiation of organs at risk in normal boundary.

1. Introduction

The treatment of the malign tumours with radiation’s help is one of the most used methods in the Oncological Institute from Cluj-Napoca. The lung
carcinoma is important to be studied because of the great number of cases from the total ills, 100-130 new cases /year. Radiotherapy is usually associated with surgery and chemotherapy. In this paper are analyzed the results obtained in the case of one patient in IIIa (T3N2M0) state with a 4 cm primary tumour in the left lung and a mediastinal and hilar invasion. 

2. Experimental

The treatment of the lung tumours is exclusively radiological, the purpose of the therapy being curative. The treatment plan was made at IOCNI using the linear accelerator Saturne 41 GE and the system planning treatment Theraplan Plus.

3. Results and discussions

The irradiation plan is the final step of a long activity including the measurements of physical and dosimeter dimensions of apparatus (tissue-air report, retro diffusion factor, collimator factor, profundity rating), introducing and modelling in the treatment planning system, to obtain doses distributions and the exposed time calculus for every clinical situations.

The risk organs are medullary channel and the right lung.

The prescribed dose at standard irradiation is 40 Gy in 20 fractions, 2 Gy/fraction, five days on week, four weeks, continued with 20 Gy supra-impressions in 10 fractions, 2Gy/fraction, two weeks.

The accepted dose in the risk organs must be the smallest possible. At the medullary channel level, the maximal dose is 44 Gy. The health right lung mustn’t receive more than 20 Gy in 10 fractions with inhomogeneity
correction. To elaborate the treatment plane we must consider the CT section in the middle of GTV (gross tumor volume).

Tumoral volume is irradiating in two steps:

1. Initial irradiation of the treatment volume (PTV I) is made with two fixed fascicles AP-PA coaxial opposed, equal charged (50%-50%) under 0º, respectively 180º. Both X photon beams (15 MV) are from the linear accelerator (LINAC) Saturne 41 GE (Fig.1.). Irradiation field dimension is 13x21 cm.

![Fig.1. Two coaxial opposed fascicles AP-PA, 50%-50%, irradiation.](image)

2. The irradiation technique continues with one supra-impression on the whole tumoral volume (PTV II) through two oblique left fascicles 15 MV equal charged, from LINAC Saturne 41 GE, under 30º and 140º; dimension of irradiation field is 8x9 cm² (Fig.2.). The inhomogeneity correction is introduced, too.
In the both irradiation steps there is used the izocentric technique, source-axe distance being 100 cm. In the treatment planning system Theraplan Plus the inhomogeneity correction is made with tissue-air equivalent report method.

Fig.2. Irradiation with two oblique fascicles, equal charged under 30º and 140º with inhomogeneity correction.

The differences at the isose curves level appears because of different treatment plan with (Fig.2.) or without (Fig.3.) inhomogeneity correction.
Fig. 3. Isodose distributions of the treatment plan without inhomogeneity correction.

From treatment planes we observed that optimal distributions of isodose in tumoral volume is realised when is applied the inhomogeneity correction (Table 1).

Table 1. (a) with and (b) without inhomogeneity correction isodose distribution in tumoral volume (MC-medullary channel, PTV-planning target volume, GTV-gross tumor volume, CTV-clinical target volume).

<table>
<thead>
<tr>
<th>Structure</th>
<th>Min (%)</th>
<th>Max (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(b)</td>
<td>(a)</td>
</tr>
<tr>
<td>External</td>
<td>1.06</td>
<td>1.20</td>
<td>112.21</td>
</tr>
<tr>
<td>Vertebræ</td>
<td>4.33</td>
<td>3.84</td>
<td>49.86</td>
</tr>
<tr>
<td>MC</td>
<td>33.25</td>
<td>28.54</td>
<td>38.81</td>
</tr>
<tr>
<td>Right lung</td>
<td>1.65</td>
<td>1.46</td>
<td>52.74</td>
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<tr>
<td>Left lung</td>
<td>3.07</td>
<td>2.87</td>
<td>96.91</td>
</tr>
<tr>
<td>PTV</td>
<td>101.36</td>
<td>92.96</td>
<td>112.21</td>
</tr>
<tr>
<td>GTV</td>
<td>105.88</td>
<td>96.80</td>
<td>112.21</td>
</tr>
<tr>
<td>CTV</td>
<td>101.49</td>
<td>93.20</td>
<td>112.21</td>
</tr>
</tbody>
</table>
Final dose distribution is observed on the summate plane of the treatment steps: initial irradiation and supra-impression (Fig. 4).

Fig. 4. Final doses distribution.

For the irradiation plan optimization is necessary that 100% isodose passing through the centre of the PTV, at intersection of central axis of the fascicle, at the middle of AP diameter, respectively ICRU point.

At the radiation beams lung traversing, absorbed dose in lung and in normal tissue behind of him is bigger than in usually cases, because radiation is less attenuate by the small density tissue, so the primary fascicle contribution is prominent.

4. Conclusions

From the isodose curves is notice that where the inhomogeneity correction wasn’t introduced, the simulate irradiation was suboptimal in the tumoral volume, being necessary a significant largeness of the fascicles, implied the excessive irradiation of the risk organs (cord, medullary channel).
The inhomogeneity correction offers the real, optimal irradiation plan, with normal limits for the risk organs irradiation.

5. References

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