A COMPARATIVE STUDY FOR THE DISTRIBUTION OF ABSORBED DOSE IN TISSUE AT IRRADIATION OF RHINOPHARYNGEAL TUMOURS WITH FASCICLES OF DIFFERENT ENERGIES

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The irradiation plan for rhinopharyngeal tumour consists in target volumes delimitation, dose prescription, dosimetry and a proper technique, which requires radiation type selection and beams arrangement. Cobalt therapy has a great efficacy in the treatment of the rhinopharyngeal epithelial tumours, for the deep-seated tumours being useful low energy photon beams of the linear accelerator. The ideal external radiotherapy in the rhinopharyngeal tumour is a 40 Gy irradiation from 70 Gy total doses, in 2-3 fields, using 4 MV photon beams for PTV defined at 95% isodose. It is also indicate the posterior reduction of the field and the complete irradiation with an anterior fascicle or 2 paranasal fascicles for an homogenous distribution of dose, at the level of the medullary channel, the maxim isodose being 20-30%.
1. Introduction

The treatment of the malign tumours with radiation’s help is one of the used methods in the Oncological Institute from Cluj-Napoca. The rhinopharyngeal carcinoma is important to be studied because of the great number of cases from the total ills and because of the complexity of the treatment plan. In this paper is treating from a dosimetric point of view a clinical situation meeting in the rhinopharyngeal tumours.

2. Experimental

The treatment of the epithelial tumours of the rhinopharynx is exclusively radiological. Cobalt therapy has a great efficacy in this localisation, for the profound tumours being used low energies photon fascicles of the linear accelerator. The treatment plan was made at IOCN using the cobalt Theraton 1000E, the linear accelerator Saturne 41 GE and the system planning treatment Theraplan Plus.

3. Results and discussions

The choosing of the treatment volume (PTV) with the clinical state is one of the dosimeter steps. PTV includes the primary tumour and the cervical adenophaty. The primary tumour and her extensions are irradiating together with the first lymphatic relay represented by retropharynx and retromandibular as the target tumoral volume. The assimilated dose in the whole PTV is prescribed at the 95% isodose. The risk organs are the optical nerve, retina, the extern auditive conduction, the temporal-mandibular articulation, the
medullary channel, the larynx, thyroid and the posterior cerebral fossae, depending with the absorbed dose and the irradiation time. Prescribed dose is 70 Gy administrate in 2 Gy fractions, 35 fractions in 48 days, or 50 Gy dose in 2 Gy fractions in five weeks. To elaborate the treatment planning it must be considerate the section of maxim dimensions of the tumoral volume, and for the supra-impressions it must considerate the section at the lateral-cervical adenophaties level. The aspects of the technique choosing are: to stabilize the treatment tumoral volume; to choose the optimal fascicles for the irradiation: photons (4MV) or $^{60}$Co radiations fascicles; fascicles are perpendicular on the skin in the initial irradiation, and their direction is at 90º, 270º, 0º; 100 cm source-axe distance; izocentric techniques utilisation; the reference isodose (100%) is passing through the tumoral volume centre; PTV is between the 95%-105%, so the final doses distribution is uniform and homogenous; protection with Pb blocks at ocular globe; for the homogeneity of the profundity doses distribution it must be used the 45º wedge filters. There are a lot of factors who contributes in the obtaining of one optimally irradiation plan, started with the physical and dosimeter dimensions measurements of the apparatus, theirs interpretation, introduction and modelling in the treatment planning system, in the purpose to obtain isodose distribution and the calculus of the exposed time for every clinical situation.

A.1. By particularizing, in the situation of one small tumoral volume, without adenophaties at distance and extension of microscopic ill, the irradiation technique consist in a four fascicle geometry: two opposed lateral coaxial (90º-270º), with equal doses (35º-35º or 40º-40º) and two paranasals inclined at 340º, respectively at 20º and equals (15º-15º or 10º-10º). This case is treated in parallel, for the irradiation with cobalt fascicles (Fig.1.) and for 4 MV photon
beams irradiation (Fig.2.). Dose contributions in the tumoral volume and in the critical adjacent organs in the both situations are presented in Table 1.

Table 1. The $^{60}$Co (a) and 4MV photon beams (b) irradiation dose contributions (PTV-planning target volume, GTV-gross tumor volume and SC-medullary channel).

<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>Vertebrae</td>
<td>9.16</td>
<td>7.49</td>
<td>99.52</td>
</tr>
<tr>
<td>SC</td>
<td>76.32</td>
<td>84.99</td>
<td>95.29</td>
</tr>
<tr>
<td>GTV</td>
<td>98.90</td>
<td>99.79</td>
<td>103.92</td>
</tr>
<tr>
<td>PTV</td>
<td>98.39</td>
<td>99.66</td>
<td>104.81</td>
</tr>
</tbody>
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Fig.1. Tumoral volume irradiates with $^{60}$Co radiation beams.
2. A homogenous irradiation of the tumoral volume is realized using wedge filters in lateral fascicles way. The role of them is to compensate the air wedge from irradiation fascicle way and to homogenised the in-profundity dose. The irradiation technique is complete with an anterior fascicle to modify the dose in the anterior part of the irradiate volume. In Fig.3. is presented the standard charge, 40%-30%-30%.

2. At 40 Gy from 70 Gy total dose is realized the posterior reduction of the field, so at the medullary channel level is passing through the 20%-50% isodose; there are utilized 3-4 fascicles and the irradiation continues until 70 Gy.

C. After completed the 70 Gy dose, is evaluate the dose at the lateral-cervical adenopathies level; there is used a tangential irradiation with two oblique fascicles with 120°-140° wedge filters. In the bilateral adenopathies, the irradiation plane consists in four fascicles, two for every ganglionic volume (Fig.4.).
Fig. 3. Fascicles irradiation technique: two laterals and one with 30%-30%-40% charge.

Fig. 4. Composed isodose curves for the lateral-cervical adenopathies irradiation.
It can be observed deficiencies in the irradiation plane elaborating for the lateral-cervical adenopathies, because of the over crossing of 40 Gy maxim dose admitted at the medullary channel. Optimisation is possible only by replacing the tangential irradiation with electron beams depending of the therapeutic road.

4. Conclusions

The ideal radiotherapy in the rhinopharyngeal carcinoma implicates a 40 Gy (2 Gy/fraction) from 70 Gy total dose prescribed, in 2-3 fields with 4 MV photon beams or cobalt-60 fascicles, for the treatment volume defined at the 95% isodose.

The posterior reduction of the field and the irradiation are completed with an anterior fascicle or two paranasals fascicles charged in function of size and localization of the tumoral volume to have a dose homogenous distribution; the maximum isodose at the medullary channel level is 20%-30%. The homogeneity of doses can be assured by wedge filters utilization.

Tangential irradiation of lateral-cervical adenopathies can be replaced with electron beams, that what implicates a complex dosimetry.

5. References

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