THE IMPACT OF RADIOTHERAPY COURSE LENGTH ON THE TREATMENT RESULTS OF NASOPHARYNGEAL CARCINOMA (NPC)

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Analyses were made among four radiotherapy schedules for NPC in order to determine whether there is an impact of radiotherapy course length on treatment results.

A series of 320 NPC patients were divided into four radiation treatment branches each with a schedule, this clinical trial was non-randomized. Radiotherapy course length factor was considered with a derivative LQ model formula that biological effective dose (BED) = nd [1 + d/(α/β)] - k(T - 28). The four branches were: 1. split-course 103 cases, with an intermediate rest of 3–4 weeks, mean total dose 70Gy/35fx, 73d, BED 51.6 Gy; 2. continuous 115 cases, 72Gy/36fx, 61d, BED 62.6 Gy; 3. hyperfractionation I 52 cases, 1.5 Gy b.i.d., time interval (T_i) > 6 hr, 75Gy/49fx, 57d, BED 65.5Gy; 4. hyperfractionation II 50 cases, 1.2 Gy b.i.d., T_i ≥ 6hr, 76Gy/60fx, 59d, BED 63.0 Gy.

Treatment results were compared with 1-, and 3-year loco-regional recurrent rates, and 1-, and 3-year survival rates, and these rates were of a negative interrelation with prolonged course duration, but of a positive one with BED values. Continuous branch was of a course mean 12 days shorter than the split-course one, its treatment results were nearly 10% higher in some subgroups; and hyperfractionation branches were slightly better than continuous one.

Key words: Radiotherapy course, Biological effective dose (BED), Nasopharyngeal carcinoma (NPC).

Tumor cells regeneration exists during the whole radiotherapy course, especially an accelerated regeneration presents during the latter segment of the course, which is about four weeks after the start of radiotherapy for epithelially originated carcinoma such as squamous cell carcinoma that most commonly found in NPC. Many clinical trials reported that treatment results were influenced by treatment course length while other treatment conditions were the same. A series of 320 NPC patients treated with their first definitive radiotherapy course in our department were analyzed in order to determine whether there is an impact of treatment course length on their treatment results, and the course length factor was considered with a derivative LQ model formula.¹

MATERIALS AND METHODS

This series of 320 patients were of histo-
pathologically proven NPC, and were treated with their first definitive radiotherapy course at our department from Jun 1988 to Sep 1990. The patients were aged 15—76 years old (mean 58 y), the male to female ratio was 3.4 : 1. All patients were staged after CT scanning, and followed the Changsha Staging System (1979). The split—course schedule was applied before 1990, and after its disadvantages were discussed extensively, the routine radiotherapy schedule has been changed to a continuous one since 1990. A non—randomized hyperfractionation clinical trial (hyperfractionation I) was in progress in 1990, and it was then changed to another hyperfractionation schedule (hyperfractionation II) because of higher oral mucosal and skin reaction rates. Unplanned interruptions were met within continuous and hyperfractionation courses not uncommonly because the patients' tolerance was not quite good, and radiation leukopenia, dermatitis, and complicated oral fungal infections were main causes, but generally, those unplanned interruptions were less than two weeks in a sum for each case who had in the continuous branch.

The biological effective dose (BED) was calculated with a derivative LQ model formula that \( \text{BED} = nd \left[ 1 + \frac{d}{(\alpha/\beta)} \right] - k(T - 28) \), in which nd = D, the total dose; \( \alpha/\beta \) ratio is 10 Gy for carcinoma that mostly squamous cell carcinoma; T is the radiotherapy course length in days, \( k = 0.6 \) Gy \((1 + 2/10) = 0.72 \) Gy (BED) for treatment course length every one day beyond four weeks; and the incomplete recovery of SLD at the time interval between irradiation fractions of hyperfractionation on daytime was neglected in this formula.

The four radiotherapy schedules in this series were: 1. split—course 103 cases, 2.0 Gy/fx, and 5 fx/week, with an intermediary rest of 3—4 weeks, mean total dose 70Gy/35fx, 73d, BED 23.7—67.9 Gy (mean 51.6 Gy); 2. continuous 115 cases, 72Gy/36fx, 61d, BED 42.0—76.1 Gy (mean 62.6 Gy); 3. hyperfractionation I 52 cases, 1.5 Gy b.i.d., time interval (Ti) \( \geq 6 \) hr on daytime, 75Gy/49fx, 57d, BED 48.5—82.3 Gy (mean 65.5 Gy); 4. hyperfractionation II 50 cases, 1.2 Gy b.i.d., Ti \( \geq 6 \) hr, 76Gy/60fx, 59 d, BED 43.0—84.7 Gy (mean 63.0 Gy).

This series of patients have been followed—up for at least three years, 55 cases who lost of follow—up within three years were considered as dead from the month of the last follow—up, and the rate of follow—up was 83%.

**RESULTS**

The treatment results of this series were listed and analysed in Tables 1—3.

**DISCUSSION**

It has well been recognized that the clonogenic tumor cells may regenerate vigorously during radio—

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**Table 1. Relations between radiotherapy course length in days and 1—, and 3—year loco—regional recurrent rates, and 1—, and 3—year survival rates of the present series.**

<table>
<thead>
<tr>
<th>Course length (days)</th>
<th>( \leq 60 )</th>
<th>( 61— )</th>
<th>( 71— )</th>
<th>( \geq 81 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of cases’ %</td>
<td>137 %</td>
<td>85 %</td>
<td>62 %</td>
<td>36 %</td>
</tr>
<tr>
<td>R1</td>
<td>19 13.8 *</td>
<td>21 24.7</td>
<td>18 29.0 *</td>
<td>11 30.5</td>
</tr>
<tr>
<td>R3</td>
<td>45 32.8 **</td>
<td>38 44.7</td>
<td>32 51.6 **</td>
<td>28 77.7</td>
</tr>
<tr>
<td>S1</td>
<td>121 88.3 ’</td>
<td>68 80.0</td>
<td>42 67.7 ’</td>
<td>23 63.8</td>
</tr>
<tr>
<td>S3</td>
<td>85 62.0 ”</td>
<td>49 57.6</td>
<td>26 41.9 ”</td>
<td>12 33.3</td>
</tr>
</tbody>
</table>

R1: 1—year loco—regional recurrent rate
S1: 1—year survival rate

* \( u = 2.35, P < 0.05; \)  
** \( u = 2.25, P < 0.05; \)  
’ \( u = 3.1, P < 0.01; \)  
” \( u = 2.6, P < 0.01. \)