4.6 $^{198}$Au Implantation of Carcinoma of the Mobile Tongue

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1 Introduction

Radioactive gold seeds for permanent interstitial radiation therapy were introduced in 1951 by COLMERY. His technical application was rapidly perfected by SINCLAIR in 1952. Since then, the method has been applied in the USA on various tumors, especially by HENSCHKE (1958; HENSCHKE et al. 1953), and in France by PIERQUIN (1964, 1962). Today, interstitial radiotherapy with direct implantation of $^{198}$Au seeds is rarely used. It has been replaced either by interstitial afterloading therapy or interstitial direct implantation of $^{125}$I seeds, because the hard $\gamma$-rays of $^{198}$Au seeds give less protection to the treating personnel. Nevertheless, $^{198}$Au interstitial implantation offers without doubt a method of optimal local cure by intratumoral irradiation. Furthermore, it has – compared with afterloading therapy – the advantage of a continuous effective dosage, which accumulates to 90% within 8 days. This means that a tumor cell with a life cycle of between 8 and 24 h will be irradiated at least once in its sensitive phase of development, resulting in a better selective influence of the irradiation on the tumor cells, while cells of the connective tissue are spared (SCHUMACHER 1974). The encyclopedical character of the present volume therefore justifies the dedication of one chapter to $^{198}$Au-seed implantation, as in the future this method might have a renaissance.

1.1 Anatomy

The tongue is a muscular organ located in the oral cavity (anterior two-thirds) and in the oropharynx (posterior third, i.e., base of the tongue). Its borderline is the V-shaped sulcus terminalis of the circumvallate papillae. Arterially it is supplied by the two lingual arteries, which are branches of the external carotid arteries. Ligature of only one of them is allowed without running the risk of tongue necrosis. Figure 1 shows the 3-dimensional muscle system of the tongue, its innervation, and arterial supply.

Figure 2 describes the lymphatic capillary flow of the tongue (FEIND 1972). Numerous collecting vessels lead to the submental, submandibular, and jugular lymph nodes.
2 Natural History

2.1 Primary Tumor

Most frequently, the primary tumor is located at the margin of the middle third of the tongue, followed by the base of the tongue and anterior third of the lower surface of the tip, and then spreading to the floor of the mouth. Symptoms are irritation and pain. Finally, extensive infiltration of the muscle may cause fixation which results in difficulty in speaking and eating.

2.2 Regional Lymphatic Spread

Approximately 35% of patients with tumors of the mobile tongue have lymph node metastases primarily, and another 30% with no lymph node affection at the time of diagnosis will later metastasize, the incidence being proportional to the primary tumor stage (LINDBERG 1972). In most patients the lymph node metastases will be found ipsilateral, in the area of the subdigastric and submandibular lymph nodes (Table I and Fig. 3). Some 5%–10% have primary metastases in the contralateral lymph nodes, and the percentage may increase in the case of surgical irritations or disturbances of the lymphatic flow or because of tumor growth (BOHNDORF 1987).

3 Epidemiology and Risk Factors

With reference to all human tumors the incidence of carcinoma of the tongue is reported between 1% and 5% in the FRG and 7%–8% in the USA.

<table>
<thead>
<tr>
<th>Location of positive nodes</th>
<th>Ipsilateral</th>
<th>Contralateral</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L&lt;sup&gt;a&lt;/sup&gt;</td>
<td>F&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Upper jugular</td>
<td>53%</td>
<td>37%</td>
</tr>
<tr>
<td>Midjugular</td>
<td>9%</td>
<td>23%</td>
</tr>
<tr>
<td>Submandibular triangle</td>
<td>20%</td>
<td>14%</td>
</tr>
<tr>
<td>Lower jugular</td>
<td>2.5%</td>
<td>6%</td>
</tr>
<tr>
<td>Submental triangle</td>
<td>3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Posterior triangle</td>
<td>0.6%</td>
<td>2%</td>
</tr>
</tbody>
</table>

<sup>a</sup> Whole tongue: 62/125 patients with positive nodes = 49%; total number of positive nodes = 228

<sup>b</sup> Oral tongue: 105/302 patients with positive nodes = 35%; total number of positive nodes = 164