Intraoperative Brachytherapy of Carcinoma of the Maxillary Sinus

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Abstract: Two patients with advanced carcinoma of the maxillary sinus were treated by intraoperative brachytherapy with a high dose-rate remote afterloading system after conventional radiotherapy with external photon beams. The technique allowed easy insertion of a small Iridium-192 source of high radiation intensity into the area even at a depth where the removal of malignant tissue seemed to be insufficient. However, results in these two cases were not satisfactory, although we feel that, if appropriate patients were selected the technique might be of help in eliminating the little localized tumors remaining after surgery, which are likely to be the source of recurrence.

Key words: Intraoperative brachytherapy, Carcinoma of the maxillary sinus

Using a high dose-rate remote afterloading system with small radioactive sources, we are able to irradiate carcinomas intracavitarily or interstitially with a rather large dose in a short period of time. This report describes performance of intraoperative brachytherapy with conventional external beam therapy in 2 patients with carcinoma of the maxillary sinus.

Case 1

A 46-year-old male was admitted to our hospital because of left cheek hypesthesia after extraction of 7th upper tooth. An X-ray revealed radio-opaque left maxillary sinus with obscured floor line. Thorough checkup confirmed that he had carcinoma of the left maxillary sinus (Fig. 1) with left submandibular lymph node metastases (T4N2M0). After the first course of IV chemotherapy with pepleomycin and cisplatin, the maxillary tumor and lymph nodes were irradiated with a 10 MV X-ray beam up to 40 Gy. During the period of radiotherapy, a second course of chemotherapy with the same agents was performed. Though the lymph nodes disappeared at this time, the maxillary tumor showed only partial response (Fig. 2). Thereafter left maxillary resection and intraoperative brachytherapy were performed. After the anterolateral wall of the left maxillary sinus and the main part of the tumor were removed, 5 flexible polyethylene tubes (6 mm diameter) were fixed against the wall of the maxillary hole, and the space around the tubes was filled with dental compound (Fig. 3). Then, the patient was carefully brought down to the irradiation room in sterile condition. After reference X-ray films were taken with dummy sources, 15 Gy at 1 cm distance from each of 5 tubes was irradiated using a high dose-rate remote afterloading system (Afterloading Buchler). On irradiation, plastic applicators (4.6 mm diameter) in which a radioactive source traveled into the incised area, were
inserted into every guide tubes. A small Iridium-192 source (1 mm diameter) with high radioactivity (6 Curies) oscillated 5 cm along the plastic applicator for each radiation. The whole procedure was completed within an hour. The patient's incisions were then closed in the operation theater. Isodose curves drawn afterwards by a computer were superimposed on the X-ray reference films (Fig. 4). About a month after the surgery, postoperative external radiation of 20 Gy was applied to the infratemporal fossa, where the first dose seemed to have been insufficient. Frequent necrotomies were performed through an opening into the maxillary sinus in the mouth (Fig. 5). One month later, the recurrence of squamous cell carcinoma in the sphenoid sinus was recognized by necrotomy.

**Case 2**

A 68-year-old female complained of swelling and pain in her right gingiva. X-ray revealed destruction of the anterolateral, posterior and inferior wall of the right maxillary sinus. She was admitted to our hospital 2 months after the onset of gingiva swelling. She was staged T4N0M0 after a thorough checkup. Biopsied
Fig. 2. After external cobalt beam therapy of 40 Gy combined with chemotherapy the patient's tumor showed partial response.

specimen from the right upper gingiva was confirmed to be well-differentiated squamous cell carcinoma. A cannula was inserted into the right superficial temporal artery, and 250 mg of 5-fluorouracil was delivered through it before each external radiation. The maxillary tumor was irradiated with 60 Gy with a 10 MV X-ray beam, however, response was partial. About 3 weeks later, surgery with intraoperative brachytherapy was performed. Operative procedures included right maxillary hemiresection, ligation of the right external carotid artery, and right mandibular muscular-process resection; after removal of the right maxillary tumor 4 polyethylene tubes were placed at the infratemporal fossa on either of the coronoid process, and on both sides of the posterior part of the pterigoidal muscle. Using steel wires, the tubes were connected with each other, and the interspace was filled with dental compound. These procedures were performed in the operating room, and then the patient was taken to the irradiation room in sterile condition. Reference films taken at the irradiation room were used for calculating irradiation time. The tumor was irradiated with 12 Gy at points 1 cm from the sources, which oscillated 5 cm from the top of the
Fig. 3. Intraoperative brachytherapy was performed through 5 guide tubes separated from each other by metallic wires and dental compound.

Fig. 4. Isodose curves and contours of estimated tumor margin (solid lines) were superimposed on frontal (a) and lateral (b) reference films. The tumor was irradiated with at least 5 Gy, and most of the maxillary wall exposed by the surgery was irradiated with 15 to 29 Gy.
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Fig. 5. After the surgery the patient’s maxilla was almost clear.

applicator during radiation. Frequent necrotomies followed the surgery. About 3 months later, necrotomy taken from the area where the coronoid process was removed indicated recurrence of squamous cell carcinoma.

**DISCUSSION**

An advantage of intraoperative radiation with a high dose-rate Iridium-192 afterloading system is that the small size of the source and the large surgical incisions allow easier access to maxillary tumors; the incisions are surgically closed after the irradiation. Under the direct visual inspection, guide tubes were placed reasonably close enough to the area where the removal of malignant tissue seemed to be insufficient. However, results in these 2 cases were not satisfactory. As we felt that the period of time in which the patient and operating staff had to be out of the operating room should be as short as possible, we fixed the guide tubes in the operating room, and could ascertain the position of the guide tubes only after we had taken the patient to the irradiation room where X-ray was also installed. In retrospect we feel that we should have inserted the tubes when the patient was in the irradiation room, where X-ray fluoroscopy would have aided us in confirming that the correct area would be irradiated. In that situation radio-opaque markers placed in the insufficiently resected areas would help in locating the areas requiring irradiation. These patients had advanced carcinoma with only partial tumor response to external beam radiotherapy. Then properly applied in the appropriate patients, such as patients with localized tumors which are likely to be the source of recurrence and which will not be fully removed by the surgery, this treatment technique may be useful. This technique may be useful as well for patients with the suprastructure-type carcinoma of the maxillary sinus, which continues to have poor prognosis; the 3-year survival rate of patients with suprastructure lesions has been reported to be 29%, while that of patients with infrastructure lesions is 68%\(^1\). Proper localization
of insufficiently resected or recurrence-liable areas and appropriate high dose irradiation in those areas will require further studies.

REFERENCES

1) UICC. TNM Classification of Malignant Tumours, 4th ed. Springer-Verlag, 1987; p27.