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Endoscopic ultrasound-guided brachytherapy of head and neck tumours. A new procedure for controlled application

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Abstract

Brachytherapy is an established procedure in primary and in recurrent cancer. We perform afterloading brachytherapy during general anaesthesia. The target organ is punctured with hollow needles which are loaded with ^{192}iridium via remote control. The depth and number of needles depend on tumour extension. In the interdisciplinary approach of our departments, this method has been improved and supplied by B-scan ultrasound control. Needles are positioned under continuous ultrasonographic guidance, and adjacent structures (e.g. the carotid artery) are localized ultrasonographically. Thus violation of the large vessels is avoided and the exact position of the needles within the tumour is improved.

In this paper, we report results on 22 patients suffering from recurrent carcinoma of the head and neck following surgery and curative radiation, and 17 patients with first onset of cancer. We did not observe any severe complications such as haemorrhage, osteomyelitis, or dyspnoea. The only side-effect was temporary oedema, sometimes associated with a short-term increase of pain. No systemic side-effects occurred.

The method is described and results from both patient groups are reported in detail. We conclude from our data that ultrasonographically-controlled endoscopic brachytherapy is a valuable procedure in locally-advanced primary, and in recurrent head and neck cancer.

Key words: Head and neck neoplasms; Brachytherapy

Introduction

Interstitial brachytherapy is a radio-surgical technique using radioactive sources which are implanted into, or in close proximity, (<5 cm) to a tumour (Pierquin and Chassagne, 1962; Fietkau, 1992). Brachytherapy with gamma-emitting isotopes can be performed by various methods: surface contact (endoluminal and endocavitary), percutaneous-interstitial, and endoscopic-interstitial (Buentzel and Kuttner, 1995). Interstitial brachytherapy may be applied by radium, ^{198} gold seeds, ^{192} iridium (Ir), or ^{125}iodine (Buentzel and Kuttner, 1995). The great advantage of ^{192} Ir is that it can be used for afterloading. This implies the insertion of non-radioactive substances into the tumour which are later loaded quickly with the radioactive source. ^{192}Ir is a high-dose rate and low-energy gamma emitter (Pierquin and Chassagne, 1962). Because the radiation dose declines rapidly outside the tumour, this radio-surgical method allows limitation of exposure of healthy tissue in the neighbourhood of the tumour. ^{192}Ir is applied with flexible afterloading catheters which are placed in the target organ for several days and loaded several times in this period (Hentschke *et al.*, 1963). Another way is to place hollow needles in the tumour once or repeatedly with an interval of some days. In head and neck tumour therapy, both methods can be performed by direct percutaneous puncture, or endoscopically (Buentzel and Kuttner, 1995).

Ultrasonography is a valuable method for differentiation of soft tissue structures in the subcutaneous and deeper regions. It allows more accurate orientation; so we decided to improve the guidance of brachytherapy needles by B-scan ultrasonography. This application of ultrasonography has not yet been described before.

To evaluate the clinical relevance of ultrasound-guided endoscopic-interstitial afterloading brachytherapy in head and neck cancer, we performed a retrospective follow-up of 39 patients who underwent this therapy in our clinics. In this publication, we demonstrate the method and the results of our follow-up.

Patients and methods

Patients

In a retrospective analysis, we analysed the data of patients who had received brachytherapy for treatment of head and neck carcinoma in our departments during 1991 to June 1997. Side-effects,

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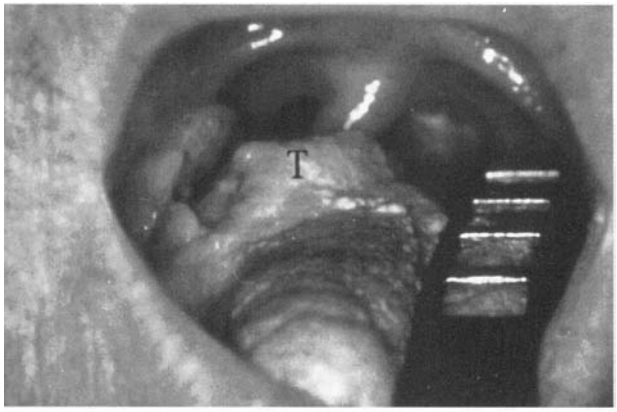
the influence on local tumour extension, period of remission, and survival time were evaluated. Patients were divided into two groups. One group (A) consisted of patients suffering from recurrent cancer, the other group (B) of patients on whom head and neck cancer was diagnosed for the first time.

Group A

Twenty-two patients suffering from recurrent cancer of the mouth, the faucial arch, the tongue, the larynx, or the hypopharynx were examined clinically and by sonography of the neck. Fourteen patients suffered from carcinoma of the tongue, in 12 of whom the primary localization was the tongue-base. An example is shown in Figure 1a. In most cases, computerized tomography (CT) scans or magnetic resonance imaging (MRI) of the tumour site and the adjacent lymph path ways were done. In addition, we performed complete staging (sonography of the abdomen, scintigraphy of the skeleton, and X-ray of the thorax). All patients complained of increasing pain and dysphagia. They underwent complete endoscopy only if curative surgery was not already excluded by clinical or imaging diagnostics. On all patients curative external beam radiation therapy had been performed at the time of the first onset of the tumour (in most cases following curative or palliative surgery). At the onset of tumour recurrence, curative surgical procedures were either impossible for reasons of tumour extension, or declined by the patient in all cases. For prior external beam radiation, another course of external radiotherapy was not possible, either. The median age of the patients was 68 years (33 to 85). The average follow-up period was nine months (range from four to 18 months, according to survival time).



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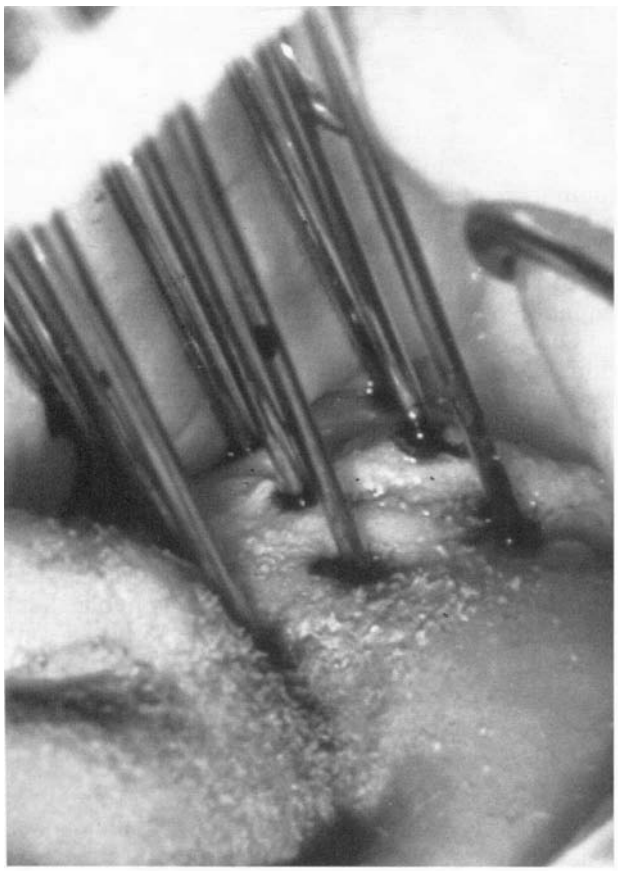

(b)

FIG. 1

Patient suffering from recurrent carcinoma (original stage T4) of the oropharynx. (tongue-base). (a) Pre-operative inspection (T = exophytic part of the tumour). (b) Intra-operative aspect with brachytherapy needles inserted in the tumour.

Group B

In 17 patients, head and neck cancer was diagnosed for the first time. The median age was 53 years (four to 78). In most cases, CT scan or MRI of the head and neck were performed additionally. A complete staging (sonography of the abdomen, scintigraphy of the skeleton, and X-ray of the thorax) was performed, excluding distant metastases in all cases. Local staging included endoscopy under general anaesthesia in all 17 patients. In these cases, external beam radiotherapy was performed with curative intent and at a dose of 60–66 Gy. One child, suffering from laryngeal sarcoma, received combined external radiation (32 Gy) and chemotherapy (EVAIA scheme). In 12 of those patients, no curative surgery on the primary tumour was done. This was either for reason of tumour extension, or because the patient declined surgery. In some of these cases, we performed palliative reduction of the primary tumour, or neck dissection for lymph node metastases. In five patients, curative surgery prior to brachytherapy was done. Patients underwent a boost of endoscopic brachytherapy following external beam radiation (one or two sessions; dosage varying individually from 6 to 8 Gy). The median follow-up period in this group was 38 months (range from six to 26 months).

Methods

The tumour is shown endoscopically during general anaesthesia, and the target organ is punctured with hollow needles (Figure 1b) under simultaneous B-scan ultrasound monitoring (Figure 2). During this procedure, the large vessels of the neck and the tumour are continuously visualized. The needles

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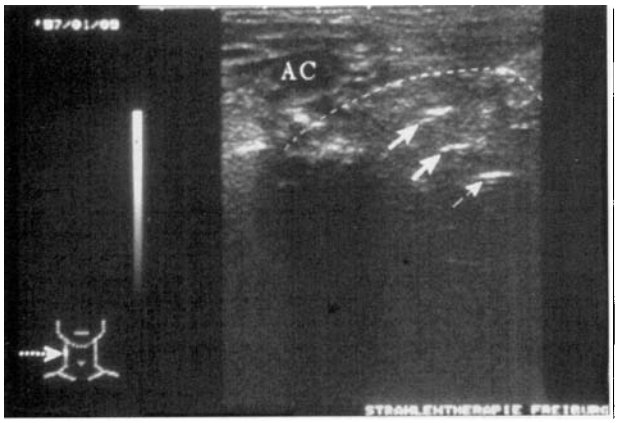

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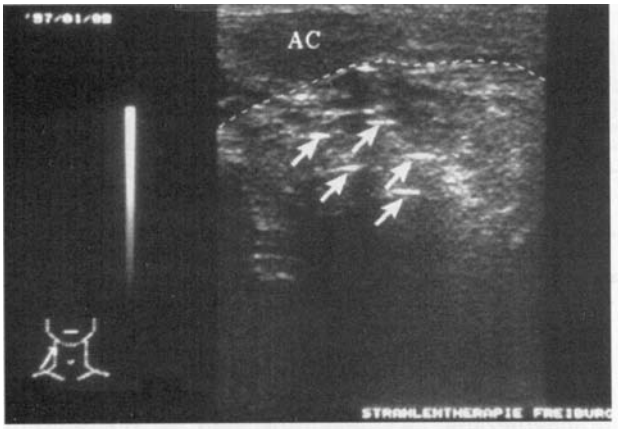
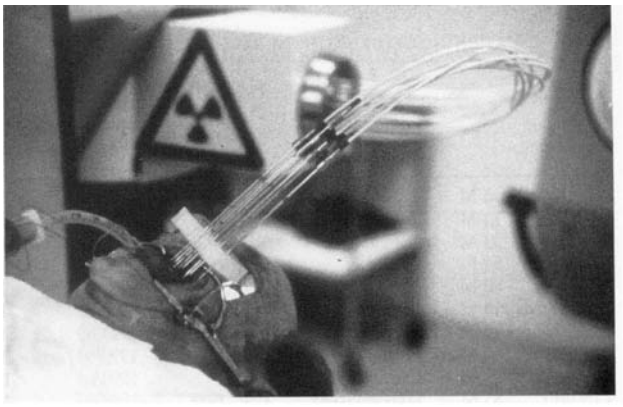


(b)

FIG. 2

Ultrasonographic guidance of brachytherapy needles (arrows) in a recurrent carcinoma of the tongue base; AC: common carotid artery. The white line indicates the margin of the tumour. (a) Transverse section. (b) Oblique section.



(a)

(b)

FIG. 3

Intraoperative site after insertion of all needles. (a) It can be seen that all needles are kept parallel by a template. (b) X-ray in lateral projection demonstrates parallelism and a sufficient distance from the needles to the spine.

must not come closer to the carotid artery than 10 mm and they should be placed within the margin of the tumour. Thus, the depth and number of needles depend on tumour extension and adjacent organs (e.g. the carotid artery; see Figure 2). The needles are kept parallel and at a distance of 10 mm by a template (Figure 3a). When all needles have been placed into the tumour, X-ray control in two projections is performed and distance to the spine and the mandibular bone is controlled (Figure 3b). If necessary, we alter the position of the needles according to X-ray and B-scan results. Peri-operatively, single-dose antibiotic prophylaxis is applied intravenously. When positioning of the needles is finished, dosage and distribution of the radiation field are calculated by a computer system. The dose distribution is calculated individually and adjusted to the position and depth of insertion of the needles. Brachytherapy is performed by a gamma-emitting ^{192}Ir source which is loaded to the needles via remote control from another room. We used the Microselection HDR system manufactured by Nucletron-Odelft Inc.

Results

Intra-operative procedure and post-operative phase (one week following radiosurgery)

In all patients ultrasonographic monitoring allowed exact puncture of the tumour, avoiding violation of adjacent structures. We did not see any severe complications and no systemic side-effects occurred. There was no intra- or post-operative bleeding requiring surgical intervention. No nerve palsy nor osteomyelitis nor soft tissue infection were seen. The only side-effect was a temporary oedema of the target organ and, in some cases, of the cheek of the mouth floor. In some cases, this oedema temporarily interfered with swallowing (for one to three days). A few patients complained of temporary increase of pain for two or three days. None of the patients complained about respiratory problems in the post-operative phase. One patient, suffering from recurrent tongue-base cancer, had some dyspnoea before brachytherapy, and increase of dyspnoea by oedema following therapy was thought to be probable. In this case, we performed tracheostomy before brachytherapy, in order to avoid post-operative complications.

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TABLE I

PATIENTS SUFFERING FROM RECURRENT CANCER OF THE HEAD AND NECK AND RECEIVING PALLIATIVE BRACHYTHERAPY

Stage	Age/ Sex	Localization	Palliative/ Curative/ Surgery/ Year	Ext. beam radiation (Year/Gy)	Recurrence site	Brachytherapy (Year/Gy)	Local tumour remission	Period of remission (months)	Present status (Dead/alive after ..... months)
T4N3M0	53 M	Tongue-base	Pall. 1994	1994/60	Tongue-base	1996/2 × 8	Partial	3 mo.	Dead 9 mo.
T4N2M0	73 M	Tongue-base	No	pall. 96	Tongue-base	1997/3 × 8	Partial	2 mo.	Alive 4 mo.
T4N2M0	33 M[3]	Tongue-base	Pall. 1996	cur. 96	Tongue-base	1997/3 × 8	No.	0 mo.	Dead 4 mo.
T4N2M0	84 F	Larynx	Pall. 1990	1990/58	Trachea	1995/3 × 6	Partial	6 mo.	Dead 12 mo.
T4N0M0	60 M	Hypopharynx	Cur. 1992	1992/66	Tongue-base	1994/3 × 6	Partial	4 mo.	Dead 6 mo.
T3N2M0	58 M	Hypopharynx	Cur. 1986	1986/60	Tongue-base	1995/3 × 8	No	0 mo.	Dead 6 mo.
T3N2M0	75 M	Tonsil	No	1994/66	Tongue-base	1995/3 × 8	Partial	6 mo.	Dead 13 mo.
T3N2M0	66 M	Larynx	Cur. 1990	1990/60	Tongue-base	1996/4 × 8	Partial	2 mo.	Dead 6 mo.
T3N2M0	75 M	Larynx	No	1990/60	Larynx	1994/3 × 8	Full[1]	9 mo.	Dead 15 mo.
T3N2M0	85 M	Hypopharynx	Cur. 1988	1988/66	Oesophagus	1995/3 × 8	Partial	3 mo.	Dead 9 mo.
T3N2M0	65 M	Tongue-base	Cur. 1988	1989/60	Tongue-base	1997/3 × 8	Partial	2 mo.	Dead 4 mo.
T3N2M0	73 M	Tongue-base	Cur. 1995	1995/60	Tongue-base	1996/2 × 8	No	0 mo.	Dead 6 mo.
T3N2M0	82 F	Tongue-base	Pall. 1991	1991/60	Tongue-base	1992/2 × 8	Full	4 mo.	Dead 9 mo.
T3N0M0	67 M	Mobile tongue	Pall. 1991	1991/60	Tongue-base	1995/3 × 8	Partial	4 mo.	Dead 9 mo.
T3N0M0	83 M	Tongue-base	No	1990/66	Tongue-base	1992/3 × 8	Partial	3 mo.	Dead 9 mo.
T3N0M0	38 M[3]	Tongue-mouth	Pall. 1995	1995/60	Tongue-base	1997/3 × 8	Full[1]	6 mo.	Alive 12 mo.
T3N0M0	62 F	Tongue-base	Cur. 1994	1995/64	Tongue-base	1996/3 × 8	Partial	4 mo.	Dead 12 mo.
T2N2M0	74 M	Tongue-base	Cur. 1994	1994/60	Tongue-base	1995/3 × 6	Partial	2 mo.	Dead 6 mo.
T2N2M0	67 M	Hypopharynx	Cur. 1987	1987/60	Tongue-base	1995/3 × 8	Partial	6 mo.	Dead 18 mo.
T2N0M0	70 M	Tongue-base	Cur. 1994	1994/68	Tongue-base	1995/3 × 8	Partial	6 mo.	Dead 12 mo.
T2N0M0	71 M	Mobile tongue	Cur. 1976	1976/60	Tongue-base	1994/3 × 8	Partial	4 mo.	Dead 9 mo.
T2N0M0	82 M	Mobile tongue	Pall. 1990	1985/60[2]	Tongue 91	1990/3 × 8	Full[1]	8 mo.	
						1991/3 × 8	Little	2 mo.	Dead 6 mo.

[1]Pain disappeared for more than three months in these patients.
[2]This patient had a preceding curative external beam radiation for nasopharyngeal carcinoma in 1985; only the first cyclus of brachytherapy (in 1990) was included in the calculation of average remission time.
[3]These patients additionally received polychemotherapy.

Long-term follow-up

Group A (brachytherapy in recurrent carcinoma)

The median follow-up period in these 22 patients lasted for nine months (four to 18 months, depending on the survival time of the patients). We observed a temporary complete tumour regression in four patients, and in 15 patients a partial regression was achieved; no effects on tumour extension were seen in three patients (for details see Table I). We observed complete regression of tumour and pain, and restoration of organ function for nine months in one patient. This man suffered from recurrent laryngeal cancer (Figure 4) and declined laryngectomy. In this case, a biopsy two months after three sessions of brachytherapy did not give any evidence of residual tumour. Several months later, recurrence of carcinoma was observed. In most cases, detailed information on pain could not be obtained, for the study was retrospective, and most patients had not been questioned according to a standardized protocol.

When comparing results in younger patients with those in elder patients, there is a tendency towards longer tumour remission and survival time in the elder patients (for details see Table I). Average remission time following brachytherapy was 3.8 months (2.8 months in patients younger than 65 years, and 4.3 months in those older than 64 years). Average survival time was 9.7 months after brachytherapy (8.1 months for patients younger than 65 and 9.9 months for those older than 64 years). In three patients with no response of the tumour following brachytherapy, we observed rapid tumour progression. None of them survived for longer than six months. In patients with remission following brachytherapy, we did not find a relationship between the completeness of remission and survival periods. Up to now, the longest survival period, 18 months, was observed in a patient with partial remission.

Group B (Brachytherapy as a boost following external beam irradiation)

Fifteen of 17 patients who received a curative boost showed temporarily or consistently a complete macroscopic tumour remission, 10 of whom are still alive now. Nine of these 10 patients are free from

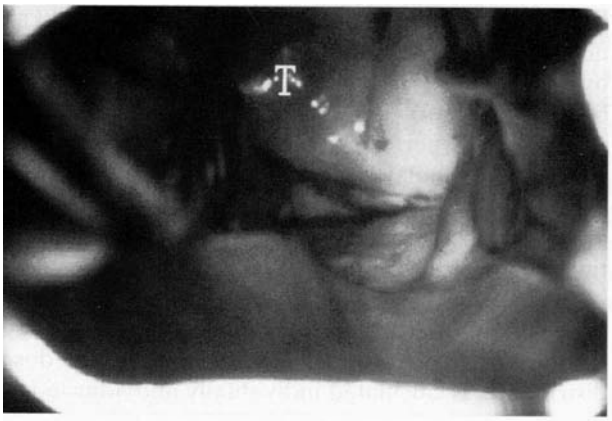

FIG. 4

Recurrent laryngeal carcinoma in a 67-year old man (T = visible part of the tumour on the arytaenoid). The left vocal fold is immobile. Brachytherapy caused complete clinical and histological (biopsy under general anaesthesia two months after three sessions) remission.

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TABLE II

PATIENTS SUFFERING FROM HEAD AND NECK CANCER FOR THE FIRST TIME AND RECEIVING BRACHYTHERAPY AS A BOOST, FOLLOWING CURATIVE PERCUTANEOUS RADIATION

Stage	Age/ Sex	Localization	Palliative/ Curative/ Surgery Year	Ext. beam radiation (Year/Gy)	Brachytherapy (Year/Gy)	Local tumour remission	Recurrence site	Period of remission (months)	Present status (Dead/alive after ..... months)
T4N2M0	44 M[1]	Tongue-base	No	1995/60	1995/1 × 8	Partial	Tongue-base	2 mo.	Dead 6 mo.
T4N2M0	53 M	Tongue-base	No	1996/60	1996/1 × 8	Full	No	>15 mo.	Alive
T4N2M0	72 M	Tongue, mouth	No	1996/66	1996/1 × 8	Partial	Tongue	3 mo.	Dead 9 mo
T4N0M0	78 M	Hypopharynx	No	1995/60	1995/2 × 8	Full	Oesophagus	9 mo.	Dead 15 mo.
T4N0M0	50 F	Tongue-base	No	1995/60	1995/1 × 8	Full	No	>24 mo.	Alive
T3N2M0	35 M	Tongue-base	Pall. 96	1996/60	1996/1 × 8	Full	No	>18 mo.	Alive
T3N2M0	50 M	Tongue-base	Pall. 94	1995/60	1995/1 × 7	Full	Tongue-base	15 mo.	Dead 21 mo.
T3N1M0	55 M	Tongue-base	Pall. 96	1996/60	1996/1 × 8	Full	Tongue-base	>15 mo.	Dead 18 mo.
T3N0M0	52 M	Tongue-base	Pall. 96	1996/66	1996/1 × 8	Full	Lung	12 mo.	Dead 12 mo.[2]
T3N0M0	65 F	Hypopharynx	No	1995/60	1995/1 × 8	Full	No	>30 mo.	Alive
T3N0M0	4 M	Lary. sarcoma	No	1995/32	1995/1 × 8	Full	No	>26 mo.	Alive
T2N2M0	43 M	Mouth floor	Cur. 92	1992/60	1992/2 × 8	Full	No	>64 mo.	Alive
T2N2M0	72 M	Mob. tongue	Cur. 91	1991/60	1991/2 × 9	Full	No	>12 mo.	Dead 12 mo.[3]
T2N0M0	48 M	Mouth floor	No	1992/60	1992/2 × 8	Full	Mouth	60 mo.	Alive
T2N0M0	77 M	Tongue, mouth	Cur. 91	1991/60	1991/2 × 8	Full	No	>75 mo.	Alive
T2N0M0	47 M	Mobile tongue	Cur. 91	1991/60	1991/2 × 8	Full	No	>81 mo.	Alive
T2N0M0	53 M	Tongue, mouth	Cur. 91	1991/60	1991/2 × 8	Full	No	>78 mo.	Alive

[1]This patient additionally received polychemotherapy.
[2]Patient died of pulmonary metastases.
[3]Patient died of cardiac disease, independent from his tumour.

local or regional relapse up to now (including the child suffering from sarcoma of the larynx); the median follow-up period of these nine patients was 45.6 months (15 to 81 months after radiotherapy). Local relapse occurred in four patients with initial full remission, three of whom have died from cancer up to now. One patient, suffering originally from a T3 carcinoma of the tongue, developed distant metastases in both lungs. In this case, palliative chemotherapy was introduced, but he died several months later. One patient who was free from tumour after 12 months died of cardiac disease.

In two patients, suffering from a T4 carcinoma of the tongue, we observed only partial tumour remission by our therapy. One of them was younger than 50 years during brachytherapy, both patients died a few months later of progressive carcinoma. So we observed the shortest survival periods in patients who had only partial tumour remission. Six out of 10 patients suffering from a T3 or T4 stage carcinoma died meanwhile of their malignant disease but none of six patients with a T2 carcinoma (for detail see Table II).

Discussion

Brachytherapy has proven effective in the therapy of cancer of the oral tongue, the faucial arch, and the floor of mouth. In addition, it is carried out for primary and recurrent cancer at various tumour sites, e.g. for breast (Delanian *et al.*, 1992), bronchial (Delclos *et al.*, 1996), and hepatic (Minsky *et al.*, 1992) carcinoma, sarcoma of the brain (Matsumoto *et al.*, 1992) and soft tissue (Habrand *et al.*, 1991), and as adjuvant in therapy of rhabdomyosarcoma of children (Nag *et al.*, 1993).

Afterloading brachytherapy has various advantages, compared to brachytherapy with implanted seeds. Firstly, following afterloading therapy, ward isolation of the patient in a protected bunker is not necessary, for all radioactive particles are removed within the therapeutical session. Secondly, the stay in hospital is short: two nights per week, repeated three times. Especially in palliative cases, this allows patients to stay at home for much of their final months. Thirdly, in contrast to surgical therapeutic attempts, organ function is preserved or even improved by radiotherapeutic reduction of tumour masses. Fourthly, as the main area of brachytherapy is *locally* recurrent cancer, the systemic side-effects of palliative chemotherapy can be avoided. A special advantage of ^{192}Ir is that this substance is a high-dose rate and low-energy gamma emitter. This provides a high local dose and a steep slope in tissue (Figure 5). Thus, these sensitive structures around the tumour are spared. A typical side-effect of afterloading therapy is violation of sensitive structures. In order

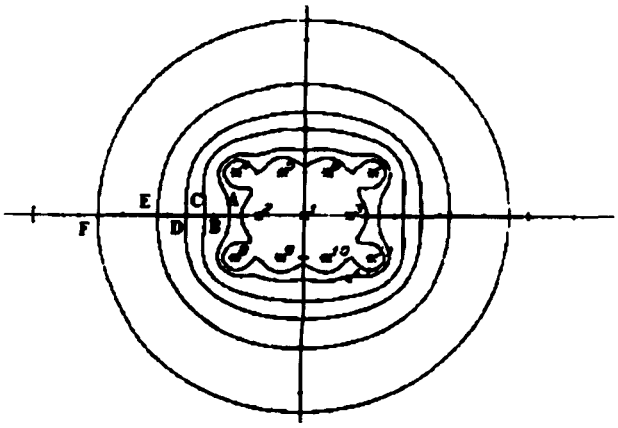

FIG. 5

Dose distribution in a case of tongue base cancer. Eleven needles are marked by numbers. The isodoses are visualized by lines. A: 200% isodose; B: 150% isodose; C: 100% isodose; D: 75% isodose; E: 50% isodose; F: 25% isodose.The 100% isodose goes along the contours of the tongue.

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to avoid this, control mechanisms of positioning are necessary. While static X-ray does not help during positioning, X-ray screening has two disadvantages. One is the fact, that the medical staff are exposed to radiation, the other is that vessels and the tumour itself are not visualized by X-ray. CT-screening goes along with difficult and expensive prerequisites: CT installation in a room protected for brachytherapy is expensive, and this technique exposites the staff as well. In addition, both techniques require some time for positioning the needles. Thus, we decided to do brachytherapy under ultrasound control. This is a cost-effective and excellent technique, visualizing the tumour and adjacent structures, and avoiding any irradiation of the staff. Thus, in our patients, adjacent structures like large vessels and the mandibular bone are not damaged. No patient suffered from severe side-effects such as bleeding, inflammation of soft tissue, or osteomyelitis. This shows that positioning of needles under ultrasonographic control is a safe method, avoiding mechanical violation of adjacent organs.

A disadvantage of brachytherapy is that it is not effective in distant metastases. In these patients, palliative chemotherapy is preferred. Patients suffering from lymphatic node recurrence are not treated with brachytherapy in our departments, either, for brachytherapy results in these patients are not conclusive (Choo *et al.*, 1993). The fact that general anaesthesia is required for the method used in our departments is offset by the advantage that the patient's stay is short and he is not impaired cosmetically by catheters.

In our departments, we see two indications for endoscopic-interstitial brachytherapy: firstly, locally advanced tumours of the tongue or the mouth, the larynx or the hypopharynx if surgery is declined by the patient or if it is impossible because of the extent of the tumour. In these cases, brachytherapy is performed as a boost following primary external radiation with curative intent. Secondly, when a tumour of the above locations recurs, and if curative surgery cannot be done, we perform brachytherapy with palliative intent.

Especially in oral tongue and tongue base cancer, primary curative percutaneous radio- or radiochemotherapy combined with brachytherapy is a well-established treatment regimen (Gerbaulet *et al.*, 1992). The complication rate of brachytherapy combined with external radiation is very low. In their series, Pernot *et al.* (1995) found severe complications in 1.4 per cent and fatal complications in 0.4 per cent. At T3 and T4 stages, surgical procedures do not produce better results than primary radiotherapy (Fein *et al.*, 1994). In addition, severe side-effects of extended surgery can be avoided by primary radiation (Fein *et al.*, 1994). In these cases, a brachytherapy boost is of high value. Primary external beam radiotherapy supplemented by brachytherapy of tongue-base carcinoma results in excellent local control: Horwitz *et al.*, (1996) found local tumour control in eight of nine patients suffering from T3 or T4 carcinoma of this localization within a median follow-up time of four years. Similar results were obtained by Regueiro *et al.* (1995). In T3 carcinoma of the tonsils or the palate, combined external irradiation and brachytherapy result in a local control rate of more than two thirds (Pernot *et al.*, 1992). Hoffstetter *et al.* investigated local control rates five years after curative therapy of T1 and T2 carcinoma of the tongue base (Hoffstetter *et al.*, 1996). They found local tumour control of 39 per cent in those patients who underwent external beam irradiation combined with a brachytherapy boost. This was better than the results of mutilating surgery combined with external irradiation (32 per cent), or external beam irradiation only (19 per cent). Shibuya *et al.* (1993) performed a similar investigation and their results were close to that of Hoffstetter.

In our patients receiving brachytherapy as a boost, after an average follow-up time of 38 months, local tumour control was 64 per cent. Results were excellent in T2 stage tumours (local control rate 83 per cent), but less in T3 and T4 tumours (local control rate 40 per cent; excluded a child with a sarcoma). Brachytherapy can be combined with surgery, too, under curative (Pernot *et al.*, 1995) and palliative (Moscoso *et al.*, 1994) aspects. Some of our patients, too, underwent curative or palliative surgery prior to irradiation and brachytherapy.

In addition, brachytherapy is an effective way of palliative treatment of locally recurrent cancer in incurable patients who had received curative surgery and radiation before, avoiding mutilating surgical salvage attempts and showing a low rate of side-effects (Buentzel and Kuttner, 1995). Side-effects are restricted to the tumour region and the adjacent structures, the skin is not affected. In animal experiments, the mandible was the most affected organ of the head and neck (osteonecrosis and bone marrow suppression), followed by the carotid artery (fibrosis) and the pharyngeal mucosa (Close *et al.*, 1993). In our patients, the only side-effect was temporary oedema which sometimes accompanied a temporary increase of swallowing problems for two or three days. We did not see the high rate of soft tissue necrosis observed by Mazeron *et al.* (1987) who implanted wires into recurrent pharyngeal carcinoma and performed afterloading with ^{192}Ir. The reason may be the high dose applied to their patients: Mazeron's mean brachytherapy dose was 60 Gy (low-dose-rate), and the cumulative radiation dose (including the preceding external beam radiation at the first onset of carcinoma) was 127 Gy. More than 80 per cent of our patients receiving palliative brachytherapy showed a clinical regression (and four of them (18 per cent) even a temporary complete remission). In many patients, pain was reduced and swallowing improved. Partial or total remission continued for several months in most patients, and in one patient even for nine months. On the other hand, the patient's expense was a hospital stay three times for two or three days, short enough to avoid hospitalization effects. Overall, the

results in the elder patients are better than in younger patients. This may be due to biological reasons of tumour growth.

It is difficult to compare our results on survival time to those published by other groups (Mazeron *et al.*, 1987; Fontanesi *et al.*, 1989; Housset *et al.*, 1991; Friedrich *et al.*, 1995). In several institutions the low-dose-rate brachytherapy technique is performed, and doses and results of different brachytherapy systems are simply not comparable (Dutreix, 1988). In addition, results in patients suffering from tongue-base recurrence are usually worse than in patients suffering from recurrence in the mobile tongue or the faucial arch (Mazeron *et al.*, 1987; Langlois *et al.*, 1988). Therefore, our results show that recurrent cancer of the tongue-base is an indication for afterloading brachytherapy, too. So we cannot follow Langlois *et al.* who do not recommend brachytherapy on this specific indication (Langlois *et al.*, 1988). In the future, results of brachytherapy may be improved by simultaneous interstitial hyperthermia (Seegenschmidt *et al.*, 1992), but up to now this technique has been available at a few centres only.

Conclusion

We conclude from our data that ultrasonographically controlled endoscopic brachytherapy is a valuable procedure in locally advanced head and neck cancer. The position of needles in the tumour is optimized and violation of adjacent structures is avoided. In our patients, no severe side-effects occurred. Isolation of the patient is not necessary.

In patients receiving curative radiation, a brachytherapy boost may support local tumour control and avoids extensive radiation of skin and adjacent bone. In patients with incurable local recurrence of carcinoma, palliative interstitial brachytherapy induces temporary partial involution of the tumour in most cases.

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