ORIGINAL ARTICLE

Experience of Radioactive Needle Implants in the Institute of Radiotherapy Hospital Kuala Lumpur

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Summary

This retrospective study of radioactive needle implants at the Institute of Radiotherapy and Oncology, Kuala Lumpur Hospital serves as an audit of our practice as well as a demonstration of the usefulness of this technique of brachytherapy. A variety of tumour sites were implanted, of which over two-thirds involved the tongue and buccal mucosa. Although most of the implants were carried out with radical intent, one-tenth of these implants were performed for palliation. Radiotherapy techniques employed are described. The crude survival ranged from 1 month to 109 months while the disease free interval ranged from 0 months to 102 months.

Key Words: Radioactive needle implant, Brachytherapy, Cancer

Introduction

Radioactive needle implant represents a form of brachytherapy that has been carried out in our Institute for more than 20 years. The radioactive sources for the implants were changed from Radium-226 needles to Caesium-137 needles in January 1993. The source arrangement and calculation of the prescribed dose was done according to the system devised by Paterson and Parker[1-3]. This review serves as an audit of this experience with particular emphasis on crude survival, disease free interval and morbidity.

Materials and Methods

A retrospective study of patients who had undergone radioactive needle implants at the Institute of Radiotherapy and Oncology Kuala Lumpur Hospital was conducted. The study population were patients who underwent this procedure at this Institute between 1986 and 1993. The sample included all patients who met the following inclusion criteria: any primary malignant tumour which had been implanted with radioactive needles, tumours that had been histologically verified, with or without history of other malignancies. The exclusion criteria applied in this study were: patients whose tumours were not histologically verified and patients whose records could not be traced or were incomplete.

The records were retrieved manually, using the list of patients undergoing various procedures in the Operating Theatre of the Institute. Out of a total of 81 patients treated with radioactive needle implants between 1986 and 1993, 61 complete records were traced. Patients whose records could not be traced, and hence excluded from this analysis, were those treated many years earlier. Otherwise, there did not appear to be any other selection bias in excluding them. Data were collected using a check-list questionnaire. Case notes, referral letters, histolopathology reports, laboratory tests, operation findings, radiotherapy records, worksheets for the calculation and prescription

of brachytherapy and relevant investigations were reviewed. Information on patient demographic data, tumour characteristics, external beam therapy, brachytherapy, complications of treatment, crude survival, disease free interval and recurrence pattern were retrieved from these notes. Staging was based on the T.N.M. system for most sites while the F.I.G.O. system was used for the gynaecological tumours. The dose prescription for the external beam therapy was based on the International Commission on Radiation Units and Measurements, *Dose specification for reporting external beam therapy with photons and electrons,* I.C.R.U. Report 29[4] and the dose prescription for brachytherapy was based on the system of Paterson and Parker which had been compiled into the Manchester system[1-3]. Crude survival time was calculated from the date of implant to the date of last follow-up or date of death. Relapse-free interval was calculated from the date of implant to the date of first relapse after the implant. Patients who were lost to follow-up had their vital status verified by sending their National Registration Identification Card Numbers to the Director, Identity Card Section, Malaysian National Registration Department to determine the date of notification of death. The status of 7 patients are unknown as their identity card numbers were not traceable from our records or they were from areas other than Peninsular Malaysia.

Results

A total of 61 patients' records were analysed. The male : female ratio was 1:1.9. The median age of the study population was 56 years with a range from 14 to 89 years (Table I). Indians comprised 38%, Chinese 31%, Malays 28% and other races 3%.

Patients with tumours involving the tongue and the buccal mucosa made up the largest group (68.8%). Implants were also performed at the primary tumour sites in other head and neck sites (lip, alveolus, frenulum of tongue, submandibular region, maxillary region), lower female genital tract, breast and chest wall. Eighty per cent of the tumours in this series was histologically confirmed to be squamous cell carcinomas. The other histologies included adenocarcinoma, non-Hodgkin's lymphoma and soft tissue sarcoma. The grade of these tumours were well differentiated in 31.1%, moderately well differentiated in 29.5%, poorly or undifferentiated in 6.6% and unrecorded in 32.8%. Most of the patients underwent only a biopsy (83.6%) before the implant procedure and hence bulky disease was present in most patients (83.6%). Among the tumours staged by the TNM classification, T_{1-2} comprised 56.1%, T_3 made up 19.3%, T_4 was found in 15.8%, and unrecorded in 7.0%. Nodal metastases was present in at least 17.9%. One patient had distant metastases at the time of the implant. Five patients had implants being carried out for the local control of local recurrences after other modalities had failed. The WHO/ECOG performance status was 0 in 16.7%, 1 in 50.0%, 2 in 21.7%, 3 in 1.6% and unrecorded in 10.0%.

Table I
Age distribution of patients undergoing radioactive needle implants

Age (years)	Number	%
Less than 20	1	1.6
20-39	11	18.0
40-59	23	37.7
60-79	22	36.1
80 and above	4	6.6
Total	61	100.0

Prior to the radioactive needle implant, 72.1% of the patients received external beam radiation. The most frequently used dose-fractionation regimens were 50 Gy in 25 fractions (6 patients), 60 Gy in 30 fractions (3 patients), 50 Gy in 20 fractions (3 patients), and 30 Gy in 15 fractions (3 patients). The external beam radiotherapy was delivered by a two-field technique in 63.6% and a single-field technique in 34.1%. The external beam records of one patient were not completely available.

Radioactive needle implants were executed in a single plane in 49.2%, double plane in 45.9%, and as a volume implant in 4.9% (one patient with vulval rhabdomyosarcoma, one patient with vaginal carcinoma, and one patient with tongue cancer). The prescribed doses for brachytherapy ranged from 20 Gy

to 75 Gy. The main morbidities encountered were: mucositis (6.5%), pain (6.5%), ulceration (6.5%) and induration (3.2%). The mucositis and pain were temporary and were adequately treated with symptomatic and supportive measures. The other problems encountered were needle dislodgement (6.5%) and retained needle in one patient when the needles were removed after the end of a tongue implant; an invasive procedure under general anaesthesia was subsequently required to remove it.

The disease free interval ranged from 0 months to 102 months, with a median of 14 months. Recurrences involving the local site plus regional nodes comprised 28% while local plus distant recurrences was found in 3%.

The survival status of the patients in this series at the time of writing of this paper was as follows: Alive (54.1%), Dead (41.0%) and Unknown (4.9%). The crude survival ranged from 1 month to 109 months, with a median survival of 24 months. The only patient who had clinical evidence of distant metastases survived for 12 months while three of the five patients who were treated for their locally recurrent tumours with radioactive needle implants died between 13 and 30 months after their implants. Two of these five patients are still alive at 64 months and 11 months. Half of the patients with known regional node positive disease were still alive at the time of writing of this paper.

The characteristics of the sub-group of fifteen patients who survived for at least 60 months after their implants deserve to be highlighted. The age range in this sub-group of fifteen patients was 14 years to 78 years. One patient had a locoregionally advanced tumour of the buccal mucosa with nodal involvement whilst two patients had local recurrences in the vulva. The other patients had T_{1-2} tumours of either the tongue or bucal mucosa. Prior to radiotherapy, the majority of these patients (93%) underwent only a biopsy. The external beam radiotherapy dose ranged from 0 Gy to 55 Gy. The brachytherapy dose ranged from 20 Gy to 65 Gy with a median of 50 Gy if external beam radiotherapy was employed. When no external beam was given, the brachytherapy doses ranged from 59 Gy to 75 Gy with a median of 65 Gy. A single plane implant was used in two thirds of the patients, a double plane implant used in 27% while a volume implant was used in only one patient.

Discussion

The principal aims of radiotherapy treatment planning are to achieve a homogenous dose distribution in the target volume, i.e. within and around the tumour, whilst sparing the surrounding normal tissues. Radioactive needle implants are able to deliver the prescribed radiation dose to the target volume with less radiation to the adjacent normal tissues mainly because of the 'Inverse Square Law' of radiation attenuation. In addition, the dose-rate of radiation received by the normal tissues during an implant treatment allows sparing of late effects of radiation. Radioactive needle implants in this Institute have been used in both curative as well as palliative settings. One of the main advantages of implant treatment over radical surgery in patients who are cured of cancer is the preservation of function of the affected organ, eg. tongue. The usefulness in the palliative setting has also been suggested by the relatively long survival of the patients with locally recurrent disease for whom these implants were performed. If some measure of local control could be achieved in these patients for the remainder of their lives, then this could contribute to their relief of local symptoms and hence improve the quality of life.

The largest group of patients being treated with radioactive needle implants in this study was those with oral cavity cancers. In centres which practise intra-oral needle implants routinely, the single-plane implant is the commonest form of implant used[5]. Radioactive needles have been used, either alone or in combination with external beam, to treat lesions of the tongue and the floor of the mouth[6]. In centres which practice needle implants, the Paterson-Parker system has been used for calculations of dosimetry[1-3]. On the other hand, the Paris system[7] is used in centres which practise iridium-192 wire implants. Generally, it is not desirable to deliver the whole radiotherapy treatment solely as an implant as the treatment time would be uncomfortably long for the patient and the more distant areas such as the regional nodal areas would not be treated adequately by the implant. Hence, most

of the implants were preceded by a course of external beam radiotherapy.

The results of disease local control in this study suggest that the implants and the subsequent calculations for the prescribed dose had been carried out with acceptable quality. It has been demonstrated by other authors that local recurrence in cancers of the mobile tongue and floor of mouth were significantly related to dose; an increase in local failure was seen when the implant dose was below 62.5 Gy[8]. Typical local control rates of radiotherapy for carcinoma of the tongue and buccal mucosa are in the region of 57% and 75% respectively[9]. The overall local recurrence rate in our centre was 31%.

The morbidity experienced by patients in this study demonstrated that this procedure was generally well tolerated despite its apprarent invasiveness. The only serious complication encountered clinically was a retained needle when the implant was being removed from the tongue. In contrast to another study where necrosis (defined as soft tissue ulceration occurring or persisting longer than 3 months after implantation or osteonecrosis) was seen in 28% at 5 years for mobile tongue and 58% for floor of mouth[8], late effects appeared to be insignificant in our study. This could be due to the relatively lower implant doses used, differences in techniques employed, incomplete follow-up as well as death occurring before the late effects became evident.

The figures for crude survival, disease free interval and morbidity have to be interpreted with caution as a proportion of the data were censored (excluded due to insufficient follow-up time before the end-point was reached). The main difficulty in defining disease free intervals lies in the fact that time to recurrence is not easy to measure as an end-point. Another major limitation in this study was the inability to measure the quality of life in the patients. Moreover, the study population consists of a heterogenous group of patients.

Conclusion

Despite the above limitations, this paper has demonstrated the usefulness and practicality of radioactive needle implants in the Malaysian setting. The importance of local tumour control in patients was demonstrated in both the curative as well as palliative settings in a variety of regions in the body. This treatment is cost-effective and can be recommended for patients with tumours that may otherwise entail extensive and mutilating surgery. The role of brachytherapy, and of radioactive needle implants in particular, continues to be a significant one despite advances in other fields of oncology.

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