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Short Communication

Postoperative radiotherapy for advanced head and neck cancer in patients with cardiac pacemakers

Federico L. Ampil[1], Cherie-Ann Nathan[2], Ghali Ghali[3], David Kim[3]

[1]*Department of Radiology,* [2]*Department of Otolaryngology-Head & Neck Surgery,* [3]*Department of Oral & Maxillofacial Surgery, Louisiana State University Health, Shreveport, LA, USA*

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Abstract

The clinical situation of coexisting significant cardiac arrhythmias complicating head and neck cancer (HNC) is uncommon, accounting for <11% of comorbid illnesses present in this particular cohort of individuals. Little is documented about the outcomes of these people with cardiac pacemakers (CP) when surgery combined with postoperative radiotherapy is rendered. The authors report two cases wherein full-course postoperative irradiation was administered without any patient mishap. Appropriately indicated adjuvant radiotherapy for locally advanced HNC can be conducted safely and effectively in patients with CPs. Implementation of essential precautionary measures is encouraged to avoid any serious, unwanted cardiac events.

Keywords: arrhythmia; cardiac pacemaker; head neck cancer; radiotherapy

INTRODUCTION

Co-morbid illness (CI) in head and neck cancer (HNC) patients is important because it may affect treatment decision making, influence the selection of treatment, and impact on overall survival. In the Washington University Head and Neck Cancer Comorbidity Index, some of the comorbid conditions, like congestive heart failure, cardiac arrhythmia, peripheral vascular disease, renal disorder and pulmonary disease, were significantly related to survival.[1] Cardiac arrhythmia, an infrequent CI, represents ~3–10% of the various simultaneously observed medical conditions in people with HNC.[1–3] Patients with cardiac pacemakers (CP) and stage IV HNC may present a therapeutic challenge for the oncologist as these individuals can be at a higher risk for complications arising from cancer therapy. Little attention has been paid to these people regarding this concern perhaps because of the poor prognosis associated with advanced stage cancer. Choosing between treatment options and deciding prognosis in this cohort of patients will depend on how ill the individual appears to be. For example, people with significant CI may be treated less aggressively or for palliation alone. We describe two cases of long-term disease-free survival devoid of PM malfunction resulting from adjuvant postoperative radiotherapy (APR) use for locally advanced HNC.

METHOD AND DESCRIPTION OF CASES

A retrospective review of head and neck oncology multidisciplinary conferences case notes over

Correspondence to: Federico L. Ampil, Division of Therapeutic Radiology, Louisiana State University Health, 1501 Kings Highway, Shreveport, LA 71130, USA. Tel: (318) 675 5334. E-mail: fampil@lsuhsc.edu

Table 1. Combined therapy for locally advanced head and neck cancer[a] in patients with cardiac pacemakers

Case no.	Age in years	Reason for pacemaker	Tumour site	Tumour stage[b]	Tumour treatment[c]	Outcome
1	76	Atrial fibrillation	Retromolar trigone	T4aN0M0	Composite resection and postoperative radiotherapy	ANED[d] 38 months
2	86	Sick sinus syndrome	Parotid gland	T4aN0M0	Total parotidectomy and postoperative radiotherapy	ANED 71 months

Notes: [a]Head and neck cancer (squamous cell carcinoma).
[b] American Joint Committee on cancer system.
[c] Doses (for postoperative radiotherapy) to the primary tumour bed/upper neck, 60 Gy (and with lower neck, 50 Gy for case no. 2).
[d] ANED = alive without cancer.

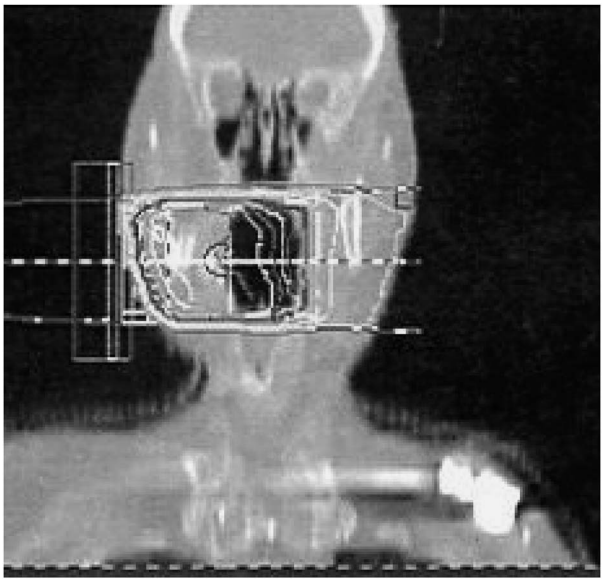

Figure 1. Coronal view showing the cardiac pacemaker location in the non-irradiated, upper outer quadrant aspect of the left anterior chest wall (case 1).

the 9-year study period (2004–2012) revealed 51 people with a medical history of compromised hearts such as those who have undergone coronary artery bypass grafting or stent insertion, heart valve or transplant surgery, or experienced congestive heart failure or a CP. Two patients with CPs treated by definitive surgery plus APR for stage IV HNC are the subjects of this report.

The clinical presentation and management of advanced stage HNC are summarised in Table 1. The patients were overly elderly and possessed the indication for the administration of APR – squamous cell carcinoma that locally invaded the mandible or facial nerve, which was adjacent to the parotid gland. The presented malignancies consisted of a primary neoplasm in the retromolar trigone or metastatic disease in the parotid gland from a previously resected nearby skin cancer. In both cases, the resection margins were free of tumour. None of the 29 nodes from the ipsilateral modified neck dissection (in case no. 1) contained metastatic disease; on the other hand, neck dissection was omitted (in case no. 2) because of the severe arrhythmia. Pacemaker use was indicated by the presence of sick sinus syndrome or atrial fibrillation with arrhythmias signifying the presence of moderate cardiovascular decompensation according to Chen's[4] classification of cardiac illness severity. Conventional fractionated external beam megavoltage APR was administered daily using a 6 MV linear accelerator (LINAC) until the total prescribed dose was completed. The CPs were not located within the irradiated head and neck area at risk (Figure 1). Clinically manifested pacemaker malfunction was not observed in any patient during the entire course of APR and afterward. Disease-free survival of at least 3 years was achieved after the application of the combined therapy in both cases.

DISCUSSION

The presented cases of stage-IV HNC and arrhythmia requiring the use of CP have two important aspects. First, the natural history of HNC, with its tendency to be a locoregional disease condition, argues for the application of aggressive local treatment modalities in advanced stage resectable disease. Second, they highlight the precarious situation of irradiation of a patient with a CP, and the need for great care in the administration of APR.

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A T4 malignant tumour of the head and neck region is generally considered a risk factor for local recurrence,[5] and therefore, APR after definitive surgical resection of the primary neoplasm is often advocated. The advantage of improved tumour control associated with the use of APR for advanced stage HNC, based on retrospective studies, was summarised in a recent report[6] denoting the fact that, to date, no large randomised clinical trials comparing surgery alone versus surgery plus APR for such cases have been conducted.

CIs in individuals with HNC have been investigated, but some limitations in a few of these reports exist like the absence of CI severity description and the influence on treatment selection when the seriousness of comorbidity was declared.[2,3] Considering the impact on prognosis of comorbidity in this cohort of patients, several researchers reported that those people with the least mortality were those without coexisting illnesses, and as the CI became more dreadful, so did the prognosis.[1,2,7]

Traditionally, the therapeutic goal of CP use is the prevention of bradycardia, with its potential for syncope and occasional cardiac arrest. Cardiac arrhythmias such as atrial fibrillation, sick sinus syndrome, congenital heart block or atrioventricular block are the usual reasons for employing artificial CPs. Like cancer, cardiovascular disease is usually represented in the elderly (as depicted in our cases). Fortuitously, within the last three decades, life expectancy of individuals after CP implantation has doubled; the mean survival in the overall population of 1627 CP recipients was 7·6 years for women and 6 years for men.[8]

A typical 'demand' CP, usually composed of a pulse generator, pacing leads and a basic programmer, has dual functions—sensing electrical signals from the myocardium/monitoring the heart rate and generating a pulse at a fixed rate only when bradycardia develops. Modern CPs, incorporated with complementary metal-oxide semiconductor (CMOS) circuitry, are more radiosensitive and, hence, prone to malfunction during radiotherapy.[9] Therapeutic irradiation may cause CPs to malfunction through the effects of ionising radiation (IR) itself or electromagnetic interference (EMI) from the LINAC treatment unit.[10] Pacemaker malfunction is a consequence of damage due to ionisation of the semiconductor material, abnormal current flows, or changes in threshold voltages.[11] With IR, a net positive charge accumulates on the silicon dioxide insulator, an essential part of the CMOS circuitry,[12] and this excess positivity gives rise to the formation of short circuits; consequently, changes in the CP include altered sensitivity, increased or decreased pulse width and frequency, or complete cessation of pacemaker function.[13] On the other matter of EMI affecting CPs, EMI happens when the human body is placed within an electromagnetic field such as that from a LINAC radiotherapy unit. The CP may interpret the electromagnetic field as a signal from the heart, and the usual transient effect of this is a dropped beat, an event considered unlikely to cause a clinical problem. Fortunately, this EMI-caused temporary effect on a CP occurs intermittently and is observed only when the LINAC is turned on or off.[14] LINAC use for irradiation is considered safe because PM malfunction may or may not happen. In contrast, radiotherapy employing betatron units is not recommended on account of the fact that temporary malfunction of PMs occurs in almost all cases.[15]

CP malfunction resulting from irradiation can be a life-threatening situation. Accounts of clinical problems found with modern CPs after irradiation have been mostly from case reports, about immediate pacemaker malfunction, and observations that the CPs were not in the center of, partly within, or outside of the radiation field; scant data exists regarding late-occurring CP malfunction.[11] To date, only three cases, with findings similar to ours, of PM non-malfunction after irradiation of patients with advanced stage HNC have been published.[9,12] Unfortunately, malignant tumour control status in the described instances was not documented.

In conclusion, although we have not presented a large case series, our patients with stage-IV HNC aggressively managed by surgery combined with APR have had more than 3 years of progression-free survival. Furthermore, irradiation was safely accomplished and CP malfunction did not occur during and after radiotherapy.

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Implementation of the promulgated precautionary measures are necessary since there is no safe dose threshold for a CP from megavoltage irradiation.[9] The precautions, to name a few, consist of avoidance of direct irradiation of a CP; assessment of the patient's coronary and CP status before and soon after completion of radiotherapy; the utilisation of adequate monitoring of the patient during irradiation; and the non-employment of a betatron treatment unit to administer the radiation treatments.[14] These management suggestions may seem natural, but they present an opportunity for averting what may be otherwise a potentially fatal outcome.

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