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Original Article

Peer-assisted Learning: Intensity-modulated Radiotherapy Transition in Developing Countries☆

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Abstract

Intensity-modulated radiotherapy (IMRT) is not widely used in developing countries due to technical challenges and a lack of expertise and resources. We outline head and neck cancer IMRT implementation challenges and highlight how improvised solutions allowed successful IMRT transition in Jordan. This article showcases a 'peer-assisted learning' model, promoting IMRT transition in other developing countries. Unlike the 'top-down' approach, this model is uncommonly addressed in oncology journals. Developing countries could benefit from this article to enhance the adoption of modern radiotherapy technology.

Key words: Chemoradiotherapy; developing countries; head and neck cancer; implementation; IMRT

Introduction

Radiotherapy is integral to head and neck cancer (HNC) treatment [1–3]. HNC intensity-modulated radiotherapy (IMRT) decreases side-effects and improves quality of life [4]. Although initial evidence was inconclusive [5], a recent population database study suggests that patients treated with IMRT experience improved cause-specific survival compared with non-IMRT [6]. For these reasons, IMRT is regarded as the standard HNC radiotherapy delivery technique. Although there is no census on the state of IMRT implementation worldwide, IMRT utilisation in developing countries is probably low. This is due to limited resources resulting in a lack of modern radiotherapy equipment, long radiotherapy waiting times, lack of experienced staff and staff time constraints, barriers resisting change and lack of national radiotherapy guidelines.

In 2010, a HNC IMRT implementation programme was contemplated in our centre (King Hussein Cancer Center [KHCC], Amman, Jordan). It was clear from the outset that additional challenges, on top of those applicable to developed countries, needed to be overcome to allow successful IMRT transition. Radiotherapy departments in developing countries considering launching IMRT programmes should be aware of these challenges and potential solutions, based on successful IMRT transition models conducted in similar healthcare settings. According to our knowledge, there are no published articles specifically addressing these points. Furthermore, most articles addressing radiotherapy in developing countries are written by authors from developed countries (e.g. *Clinical Oncology* special issue:

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'Radiotherapy in low and middle income countries', Volume 29, Issue 2, 2017). Articles written in collaboration with centres in low and middle income countries primarily deal with infrastructural issues and radiotherapy access [7,8], rather than examine directly how to develop advanced radiotherapy techniques, such as IMRT. The aim of this article is to outline HNC IMRT implementation challenges and highlight how improvised solutions allowed successful IMRT transition. This article showcases a 'peer-assisted learning' model promoting IMRT transition in other developing countries. Unlike the 'top-down' approach, this model is uncommonly addressed in oncology journals. Developing countries could benefit from this article to enhance the adoption of modern radiotherapy technology.

Materials and Methods

Following institutional review board approval, the KHCC registry database was queried to identify HNC patients treated with IMRT between 2010 and 2014. IMRT implementation challenges were explored via critical reflection and staff feedback. Nasopharyngeal cancer cases were reviewed to outline how clinical decisions were tailored according to local practice settings and logistics to optimise patient care.

Radiotherapy Department Setting

KHCC is an independent, not-for-profit, comprehensive cancer centre. The radiation oncology department treats about 1500 cancer cases annually. The radiotherapy department is staffed by 12 board-certified radiation oncologists, six nurse specialists, eight medical physicists, two dosimetrists and 20 radiotherapy technicians. It also houses a radiation oncology physician training programme. The radiotherapy equipment consists of one Big Bore computed tomography simulator (Philips, Netherlands), four Synergy linear accelerators (Elekta, Sweden), Pinnacle^3 treatment planning (Philips) and Mosaiq (Elekta) for recording and verification.

Statistical Analysis

Nasopharyngeal cancer local recurrence-free and overall survival were evaluated using the Kaplan–Meier method. Statistical significance was accepted when the *P*-value was <0.05. Statistical analysis was carried out using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA).

Intensity-modulated Radiotherapy Challenges, Solutions and Implementation

Modern Linear Accelerator Acquisition

In view of overwhelming evidence in favour of IMRT, we decided to acquire new and/or upgrade linear accelerators to allow IMRT implementation in 2010.

Staff Training

To overcome limited staff experience in IMRT, we formed collaborations with the International Atomic Energy Agency (IAEA) and leading cancer centres in North America (e.g. MD Anderson Cancer Center, Houston, TX, USA). The latter was organised via a formal institutional sistership agreement signed in 2010. This agreement enabled the senior physicist to attend a 1 month IMRT-focused physics training course covering planning, quality assurance and linear accelerator commissioning at MD Anderson Cancer Center. Furthermore, the lead HNC radiation oncologist attended a 1 year fellowship at Princess Margaret Cancer Center (Toronto, Canada), after being selected in an open fellowship competition by the host institution. This was supplemented by *ad hoc* virtual consultations (three virtual consultations with physicists and clinicians organised in the initial 6 months), onsite visits (three onsite visits by physicists and clinicians organised over 12 months), invitation of the European Society for Radiotherapy and Oncology (ESTRO) faculty to deliver a local multidisciplinary IMRT training workshop and attendance of relevant radiotherapy training courses (e.g. ESTRO courses: 'Target volume determination - from imaging to margins' and 'IMRT and other conformal techniques in practice').

Linear Accelerator Commissioning

There was no national linear accelerator commissioning guidance. We decided to commission our linear accelerators to American Association of Physicists in Medicine (AAPM) task group 106 and 142 reports.

Provision of Computed Tomography Simulator and Planning Protocols

There were no computed tomography simulation and planning protocols, nor an agreed departmental contouring nomenclature to allow comparisons between plans. Protocols were set to standardise computed tomography simulation and challenges overcome to allow intravenous contrast administration to enhance target definition. Automated organs at risk (OAR) and target volume scripts were created and a standardised contouring nomenclature established to streamline the planning process. The simultaneous transition from Emami to QUANTEC dose constraints posed an additional complexity during the initial IMRT implantation [9,10]. The QUANTEC papers were appraised in a dedicated educational departmental meeting involving radiographers, physicists and clinicians.

Overcoming Contouring Challenges

The transition from two-dimensional to IMRT planning necessitates accurate target volume definition to avoid geometrical misses that could diminish any IMRT gains. In patients with bulky tumours, subtle contouring inaccuracies could significantly affect outcome by limiting the deliverable dose to avoid toxicity. To mitigate these challenges,