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Original article

Implementation of intensity-modulated radiotherapy for head and neck cancers in routine practice☆

Évaluation de la radiothérapie conformationnelle avec modulation d'intensité utilisée en pratique quotidienne pour les carcinomes de la tête et du cou

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ABSTRACT

Purpose. – To report on patterns of relapse following implementation of intensity-modulated radiotherapy and subsequent changes in practice in a tertiary care centre.
Patients and methods. – Between 2008 and 2011, 188 consecutive patients (mean age 59 years old) received intensity-modulated radiotherapies with curative intent for squamous cell carcinomas of the oral cavity (17.5%), oropharynx (43%), hypopharynx (21%), larynx (14%), sinonasal cavities (6%), nasopharynx (1.5%) at the university hospital of Besançon. There were stage I and II 9%, III 24.5%, IV 66.5%. One hundred and thirty-eight underwent exclusive intensity-modulated radiotherapy, 50 underwent postoperative intensity-modulated radiotherapy, 174 had concurrent chemotherapy, 57 had induction chemotherapy. Dynamic intensity-modulated radiotherapy with static fields was performed for all patients using sequential irradiation in 174 patients and simultaneous integrated boost irradiation in 14 patients.
Results. – With a median follow-up was 27.5 months, there was 79% of locoregional failures occurred in the 95% isodose. Two-year overall survival, disease-free, local failure-free and locoregional failure-free survival rates were73%, 60%, 79% and 72%, respectively. Prognostic factors for disease-free survival were stage (IV vs. I–III) with a relative risk of 1.7 [1.1–2.8] ($P = 0.02$) and T stage with 1.6 [1.04–2.5] ($P = 0.03$).
Conclusion. – The current series showed similar patterns of failure as in other tertiary care centres. We did not identify intensity-modulated radiotherapy specific relapse risks.

Mots clés :
Planification de traitement
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RÉSUMÉ

Objectif de l'étude. – Identifier les sites de récidives locorégionales dans les carcinomes de la tête et du cou après radiothérapie conformationnelle avec modulation d'intensité (RCMI) utilisée en pratique quotidienne.
Patients et méthodes. – Entre 2008 et 2011, 188 patients consécutifs âgés en moyenne de 59 ans (27–82), atteints d'un carcinome de la cavité buccale (17,5 %), de l'oropharynx (43 %), de l'hypopharynx (21 %), du larynx (14 %), du sinus maxillaire (6 %) et du nasopharynx (1,5 %) ont reçu une RCMI avec intention curative au centre hospitalier régional universitaire de Besançon. La répartition par stade était I et II

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pour 9 %, III pour 24,5 %, IV pour 66,5 %. Cent trente-huit patients atteints d'une tumeur en place ont reçu une RCMI exclusive, 50 en situation postopératoire, 174 ont eu reçu chimiothérapie concomitante, 57 une chimiothérapie d'induction. Une RCMI dynamique avec par faisceaux fixes a été délivrée à tous les patients, de manière séquentielle pour 174 d'entre eux et selon un schéma de « *boost* intégré » chez les 14 autres.

Résultats. – Avec un suivi médian de 27,5 mois, un échec locorégional est survenu dans l'isodose 95 % de la dose totale dans 79 % des cas. Les taux de survie globale, de survie sans échec, de survie sans échec local, de survie sans échec locorégional à 2 ans étaient respectivement de 73 %, de 60 %, de 79 % et de 72 %. Les facteurs pronostiques de survie sans évènement retrouvé étaient le stade (IV contre I à III), avec un risque relatif de 1,7 [1,06 ; 2,75] ($p = 0,02$), et le stade T de la tumeur, avec un risque relatif de 1,6 [1,04 ; 2,53] ($p = 0,03$).

Conclusion. – Il a été retrouvé dans notre série les mêmes causes d'échecs que dans les autres centres. Nous n'avons pas identifié de facteurs d'échec spécifiques à l'utilisation de la technique de RCMI.

1. Introduction

Head and neck cancers represented 15,000 new cases in France in 2012 and accounted for 4100 deaths per year [1]. Over 90% of head and neck cancers are squamous cell carcinomas and are predominantly due to tobacco and alcohol consumption. In latest years, oropharyngeal head and neck squamous cell carcinomas have been increasingly associated with human papilloma virus and are of relatively better prognosis [2]. Over 80% of head and neck squamous cell carcinomas are diagnosed at an advanced stage and treated with chemoradiation performed alone or postoperatively are a major component of treatment. Relapse rates vary between 20 and 57% and occur in irradiated areas [3–5]. Intensity-modulated radiotherapy has been implemented in the 1990s and accepted as a standard of treatment to limit toxicities, including definitive grade 2 xerostomia [6,7]. Given the steep dose gradients obtained with intensity-modulated radiotherapy compared with three-dimensional irradiation, structured implementation programs and the accuracy in the definition of target volumes are necessary to avoid any risk of geometric miss.

Intensity-modulated radiotherapy has been used at the university hospital of Besançon since 2008. This study aims at analysing failure sites and practices in all consecutive patients with head and neck squamous cell carcinomas treated with a curative intent with intensity-modulated radiation during the first three years of treatment.

2. Patients and methods

2.1. Patient selection

Tumours included all American Joint Committee on Cancer (AJCC) stage 1–4 non-metastatic, histology-proven head and neck squamous cell carcinomas of the oral cavity, oropharynx, hypopharynx, nasopharynx, larynx and maxillary sinus. Cervical lymph nodes from an unknown primary, salivary gland, cervical oesophagus tumours were excluded, as well as in situ carcinomas. Patients' charts were analysed retrospectively. Patients received dynamic exclusive/postoperative intensity-modulated radiotherapy (with static fields), with or without concurrent chemotherapy or targeted therapy and with or without concurrent neoadjuvant chemotherapy at the university hospital of Besançon from June 2008 to 2011. Treatment decision-making was performed in a multidisciplinary board.

2.2. Treatment planning

Patients were immobilized in a supine position with a 5-point thermoplastic mask including the shoulders. The 2.5 mm thick-slice contrast enhanced planning CT included from vertex to 5 cm under the clavicles. CT images were imported into Eclipse v 8.6© treatment planning system (TPS). Dosimetries were computed using the Anisotropic Analytical Algorithm (Eclipse Varian medical system) with a 120 multileaf collimator, and seven 6 MV photon coplanar fields in 95% of cases. Electrons and brachytherapy were not used.

2.3. Target volumes

Gross tumour volume included the tumour as defined clinically on physical and panendoscopic examination and lymph nodes as defined on clinical examination and enhanced postcontrast CT. Clinical target volume included the operative bed, wound, postoperative tissue changes and flaps and preoperative gross tumour volume. Tumour and nodal clinical target volumes were defined anatomically as the areas of microscopic involvement with knowledge of locoregional spread patterns and anatomic barriers for each tumour site and based on pathology (perineural invasion, nodal involvement etc) as reported by Eisbruch and Lapeyre [8,9]. The low-risk clinical target volume (CTV1) included low-risk nodal areas. The second clinical target volume (CTV2) was delineated at the discretion of the radiation oncologist and included intermediate risk nodal areas, between involved nodal areas and low-risk ones. The third clinical target volume (CTV3) included high-risk areas of primary and nodal microscopic involvement. Nodal areas were delineated according to International guidelines [10,11]. Planning target volume was defined as a 5 mm expansion around the clinical target volume to account for setup uncertainties.

2.4. Organs at risk

Dose constraints to organs at risk were adapted based on the estimated risk benefit ratio. A 5 mm expansion was generated around the spinal cord and brain stem to create a planning organ-at-risk volume. Maximal dose was 45 Gy and 54 Gy to the spinal cord and brain stem, respectively. Mean dose was limited to 26 Gy to at least one parotid whenever possible with respect to tumour extent.

2.5. Dose prescription

Doses were prescribed according to the 83 International Commission on Radiation Units and Measurements guidelines, delivered 5 days per week in 2-Gy fractions [12]. From 2008 to 2009, the dose was delivered to different planning target volume levels sequentially to 50 to 60 and 70 Gy. From 2009, simultaneous boost treatment plans were accepted.