

CLINICAL OUTCOME OF POSTOPERATIVE INTENSITY-MODULATED RADIOTHERAPY FOR ESOPHAGEAL CANCER

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Purpose : To evaluate the clinical outcome and dosimetry analysis of postoperative intensity-modulated radiation therapy (IMRT) for esophageal cancer.

Materials and Methods : A total of 30 patients with stage II-IV esophageal cancer were treated with curative surgery followed by postoperative radiotherapy. All postoperative radiotherapy was planned using an intensity-modulated radiotherapy (IMRT) treatment planning system and was administered 4-6 weeks after operation. Seven out of 30 patients received post-radiotherapy adjuvant chemotherapy. Radiation from 6-7 beam angles, which was designed according to specific shape of clinical target volume (CTV), was delivered by a linear accelerator with energy of 6 MV photons. The CTV included the whole esophageal region plus the supraclavicular region for tumors at the upper and middle thoracic portion of the esophagus or celiac region for tumor situated at the lower thoracic portion. A total dose of 50 Gy to 60 Gy was aimed at the PTV over 5 to 6 weeks. Treatment response was evaluated and toxicities were assessed. The organ at risk dose profile was calculated under isocenter dose of 50 Gy.

Results : Radiotherapy related acute toxicities were mild. Organs at risk such as lungs, heart, and spinal cord were spared from the prescribed doses. The mean doses for right and left lungs were 13.1 Gy and 13.3 Gy, respectively. The lung volume received doses of 2000 cGy or more (V_{20}) for right and left lung was 19.7% and 19.8%, respectively. The mean dose to heart was 22.4 Gy and only 9.8% of heart tissue received a dosage over 40 Gy (V_{40}). For spinal cord, the maximum dose was 36.5 Gy which is relatively low. An average conformity index (CI) of 0.8 implies high treatment conformity to the target. An average homogeneity index (HI) of 0.94 indicated good dose homogeneity within the target. After a mean follow-up of 14 months, 5 local recurrences were found over anastomotic site in 1 patient, supraclavicular region in 1 patient and subcarina region in 3 patients, the local recurrence rate in 2-year period is 22.4%. The 2-year overall survival rate was 45.1%. Distant metastasis is the most important reason for those who died within 2 year period of follow-up.

Conclusion : Postoperative IMRT using 6 to 7 beams has good coverage of the target and high dose homogeneity while decreasing doses to normal tissue. Local control was good with an acceptable 2-year survival rate. However, early distant metastasis

remains to be a problem. New approaches are needed to improve the clinical outcome.
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Key words: Esophageal cancer, Intensity-modulated radiotherapy, Post-operative radiotherapy

INTRODUCTION

Esophageal cancer is the ninth most common cause of cancer death in Taiwan. Since the tumor is often initially asymptomatic, most cases are diagnosed at an advanced stage. The 2-year overall survival rate is about 20% to 30% in non-metastatic patients who undergo curative surgical resection alone [13]. The loco-regional recurrence rate can be as high as 42% in patients who undergo complete resection via transhiatal esophagectomy in previous study [3]. The benefit of postoperative radiotherapy in local control and survival has been reported in some studies [16, 17, 18].

However, radiotherapy for thoracic tumors often causes lung injury. The percentage of lung volume receiving more than 20 Gy of radiation and mean lung dose were related to the incidence of acute radiation pneumonitis in one study of lung cancer treated with continuous hyperfractionated accelerated radiotherapy [10]. By using intensity-modulated radiotherapy (IMRT), an advanced form of conformal therapy, dose conformity to target can be improved and better normal tissue sparing can be achieved. Chandra et al. reported that normal lung dosage can be reduced by IMRT in treatment planning for distal esophageal cancer [5]. In the study of Wu et al., IMRT is superior to three-dimensional conformal plans in terms of tumor control probability and target dose conformity [15]. However, no clinical outcomes of esophageal cancer treated by postoperative IMRT have been published. In this study we report the preliminary results of postoperative IMRT for patients with esophageal cancer.

MATERIALS AND METHODS

Patient population, surgery and adjuvant chemotherapy

Between December 2003 and January 2006, 30 consecutive patients with thoracic esophageal cancers underwent esophagectomy in this institute and entered this retrospective study. Esophagectomy was performed through a 3-phase incision with extensive 2-field lymph node dissection of mediastinum, and abdomen. The stomach was mobilized to the neck via the retrosternal route and a cervical esophageal anastomosis was performed. All patients in this study were male with a mean age of 59 years (range 36-83). The pathologic stages of these patients were assigned according to the recommendation of the American Joint Committee on Cancer's TNM classification [1]. Patient characteristics and tumor stage are shown in Table 1. Nearly all patients had squamous cell carcinoma except for one that had adenocarcinoma. Over half of our patients had regional lymph node metastasis at the time of surgery (Table 1). Twenty-three patients underwent postoperative radiotherapy only, while 7 underwent post-radiotherapy adjuvant chemotherapy by surgeon's suggestion. The adjuvant chemotherapy consisted of four cycles of cisplatin and 5-FU. Cisplatin was administered by doses of 20 mg/m²/day i.v. within 60 minutes for 5 days and 5-FU was administered via continuous infusion of 800 mg/m²/day for 5 days every 4 weeks.

Radiotherapy

Radiotherapy was administered 4-6 weeks after operation using an IMRT treatment plan.