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Feasibility of transoral lateral oropharyngectomy using a robotic surgical system for tonsillar cancer

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SUMMARY

Conventional surgical approaches for tonsillar carcinomas have a great risk for developing treatment-related morbidity. To minimize this morbidity, transoral lateral oropharyngectomy (TLO) using the robotic surgical system was performed, and the efficacy and feasibility of this procedure was evaluated. TLO was performed using the da Vinci surgical robot (Intuitive Surgical, Inc., Sunnyvale, CA). It consists of a surgeon's console and a manipulator cart equipped with three robotic arms. The surgeon is provided with three-dimensional magnified images from the endoscopic arm and can control two instrument arms for delicate operations from the console. Safe resection of tonsillar carcinoma was possible with the three-dimensional magnified images. When proceeding with resection of the buccopharyngeal fascia, we could prevent damage to the carotid artery, which is located posterolateral to the tonsillar fossa, since the joint at the distal part of the robotic arm can be bent freely from side to side. By using the 30° endoscope, we can achieve a better surgical view of the base of the tongue area. TLO was performed successfully in all five patients without surgical complications. The mean operating time was 44 min, and an average of 19 min was required for setting up the robotic system. TLO using the robotic system will be a good option for organ preservation therapy in the treatment of carcinomas of the tonsil and the tonsillar fossa in the future.

Introduction

The current trend in the treatment of head and neck cancer is to perform conservative therapy to improve the quality of life of patients and decrease treatment-related morbidities. Malignant tumors arising from the tonsillar fossa are particularly hard to approach through the oral cavity and most require mandibular swing or composite resection, which require long operating times and have high treatment-related morbidity.[1,2] Several transoral approaches have been attempted to overcome such disadvantages, but there have been no studies that provided an anatomic foundation for deciding the extent of resection for oncologic safety.[3–5] Recently, Holsinger et al. suggested an anatomic foundation for a transoral approach called "transoral lateral oropharyngectomy (TLO)," and reported the oncologic safety and functional outcomes.[6,7]

However, TLO has a disadvantage in that three-dimensional resection of the tumor is difficult since it is performed with long, straight instruments inserted through the oral cavity and the surgeon's view starts from outside the oral cavity. It also has a possibility of damaging the carotid artery which is located posterolateral to the tonsillar fossa. To overcome these limitations, TLO using the robotic surgical system in patients with tonsillar cancer, and we evaluated the safety and feasibility of the procedure.

Materials and methods

A total of five patients participated in this prospective study to evaluate the feasibility of TLO. All patients received lateral oropharyngectomy. The Institutional Review Board of Yonsei University approved the protocol (approval number: 4-2008-0285) and informed consent was obtained from all patients.

Inclusion and exclusion criteria

The inclusion criteria were as follows: (1) patient ⩾18 years of age at the time of surgery and (2) meet the criteria indicative for treatment of a malignant tumor arising from the tonsillar fossa. The exclusion criteria were as follows: (1) a tumor fixed to the lateral oropharyngeal wall and (2) patient with contraindications to surgery and anesthesia due to medical conditions.

Patients

A total of five patients participated in this prospective study to evaluate the safety and feasibility of TLO using the robotic surgical

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system between May 2008 and November 2008. This study was approved by the Institutional Review Board of Yonsei University and informed consent was obtained from all patients prior to operation. The patients consisted of three males and two females, and the mean age was 51.4 years (range, 41–69 years). Four cases were pathologically diagnosed as squamous cell carcinoma and the remaining one case as metastatic adenocarcinoma. The metastatic adenocarcinoma confined to the tonsillar fossa was diagnosed in a 41-year-old patient (Patient 1). He was under observation after he underwent lobectomy due to lung cancer one year ago, and he complained of dysphagia and intermittent dyspnea due to the metastatic tumor in the tonsillar fossa. The patient had great fear of long-standing surgery and anesthesia from his previous experience, and his general performance was poor, being measured at 50% on the Karnofsky performance status scale. Palliative treatment was proceeded to relieve his symptoms. The other four cases were diagnosed as squamous cell carcinoma arising from the tonsillar fossa (Patients 2–5). More patient data are given in Table 1.

When patients were examined initially, and therapeutic modified radical neck dissection was carried out if metastatic neck node was observed. If metastatic neck node was not observed, elective supraomohyoid neck dissection was performed. Neck dissection was performed concurrently in three patients. Therapeutic modified radical neck dissection was performed in two patients (Patients 2 and 3), and elective supraomohyoid neck dissection was performed Patient 4. Patient 5 underwent TLO using the robotic surgical system first, and then received additional radiotherapy instead of the planned secondary neck dissection since the patient refused to undergo a second operation. Postoperative radiotherapy was carried out in the following cases: if the resection margin was positive, or if there were lesions of T3 or higher stage, or if there were N2 or higher nodal stage on pathologic report, or if the lesion was N1 with extracapsular spread. In this study, four patients (Patients 2–5) received adjuvant radiotherapy because multiple metastatic neck node metastases were observed in the report of final pathology after neck dissection. The purpose of radiotherapy was not curative therapy but adjuvant therapy. So, compared to curative radiotherapy, side effects of radiotherapy were less due to the difference of radiation port and total doses. Chemotherapy was not considered as primary treatment in this study.

Procedure of study

The advantages and disadvantages of all treatment modalities including TLO using the robotic surgical system were explained to all patients diagnosed with tonsillar cancer as outpatients. The da Vinci surgical system (Intuitive Surgical) which consists of a surgeon's console and a manipulator cart equipped with three robotic arms was used. The surgeon is provided with three-dimensional magnified images from the endoscopic arm attached to the manipulator cart, and can delicately control two instrument arms from the surgeon's console. These instrument arms can deliver motion of about 6° at the joint located at the end of the instrument in the oral cavity, and this feature allows for more delicate operations. Five patients received TLO using the robotic surgical system, and postoperative status was evaluated during admission and as outpatients after discharge.

Operative procedure

All patients were operated on by the senior author (S.H.K). The surgeon underwent intensive training at the animal lab and was familiar with transoral robotic surgery. TLO using the robotic system was performed under general anesthesia. The foot of the surgical table was located 180° from the anesthesiology team, and the patient's head was then placed at the foot of the table. Rose position was undertaken. Tracheotomy was performed transiently to prepare for the risk of possible postoperative bleeding and airway obstruction due to swelling. Neck dissection was performed first when required, and the robotic surgical system was prepared for TLO after neck dissection. The manipulator cart was placed at an angle of 30° from the surgical table. A Dingman or Crowe-Davis mouth gag was used to open the mouth and obtain a sufficient operative view. The surgeon then palpated the structures around the tumor to see if the tumor was fixed to the lateral oropharyngeal wall. This is because TLO using the robotic surgical system can be impossible in cases of tumor fixation if severe adhesion exists in the dissection plane. The endoscopic arm was inserted through the oral cavity and two instrument arms were also inserted on each side of the endoscopic arm at an angle of 30° (Fig. 1). One assistant and one nurse were seated at the side of the patient's head. The assistant sucked out secretions and blood from the operative field and widened the operative field using the retractor.

We adapted the methods stated by Weinstein and Holsinger for TLO[6,8] (Fig. 2). One instrument arm was equipped with a 5-mm spatula cautery on the lesion side and another arm with 5-mm Maryland forceps on the healthy side. The 5-mm spatula cautery

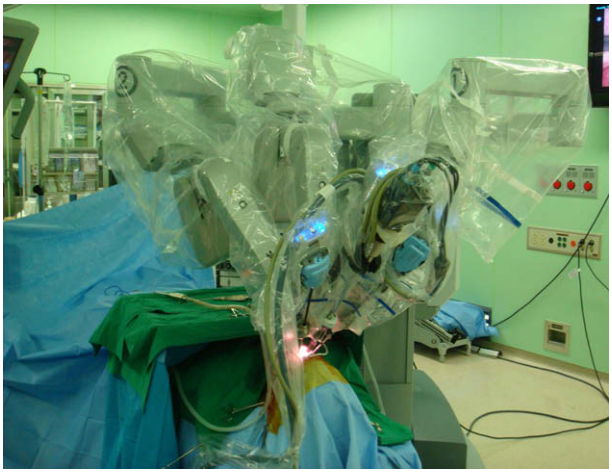

Figure 1 Robotic endoscopic arm introduced through the oral cavity with two instrument arms placed 30° apart.

Table 1
Patient profiles.

Patient number	Sex	Age	Pathology	TNM stage or extent of disease	Karnofsky performance status scale (%)
1	M	41	Metastatic adenocarcinoma	Limited to tonsillar fossa and not fixed	50
2	M	45	Squamous cell carcinoma	T2N2b	90
3	F	48	Squamous cell carcinoma	T1N2b	90
4	M	54	Squamous cell carcinoma	T2N0	80
5	F	69	Squamous cell carcinoma	T2N2b	50