

# Survival differences between definitive radiotherapy and surgery followed by adjuvant radiotherapy in supraglottic and hypopharyngeal carcinoma

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## Abstract

**Background:** Organ preservation has long been a consideration in the treatment of supraglottic and hypopharyngeal carcinoma to improve the quality of life (QOL). Definitive radiotherapy (DRT) with or without systematic treatment, such as chemotherapy, is always the first choice to achieve improved QOL. This retrospective study focused on the survival differences between DRT and surgery followed by adjuvant radiotherapy (S + RT) in supraglottic and hypopharyngeal carcinoma.

**Methods:** This study included adult patients with supraglottic or hypopharyngeal carcinoma undergoing single-modality treatment with either DRT or S + RT between January 2012 and August 2016. A total of 59 patients were identified, of whom 31 were treated with DRT, and 28 were treated with S + RT. In the 31 cases of DRT, 23 cases were treated with concurrent chemoradiotherapy (CRT), one case was treated with DRT plus cetuximab, and seven cases were treated with DRT alone. Of the other 28 cases of S + RT, 15 cases were treated with adjuvant concurrent CRT. Survival analysis was used to compare the overall survival (OS), local recurrence-free survival (LRFS) and distant metastasis-free survival (DMFS) between DRT and S + RT groups.

**Results:** The median follow-up was 20 months (range, 4–67 months). The patients of the two groups were similar with respect to mean age, original sites, and tumor stages. The 1-, 2-, and 5-year OS rates were 80.6%, 53.4%, and 24.7% for the DRT group and 85.7%, 67.1%, and 24.7% for the S + RT group, respectively. There was no significant difference between the two groups ( $\chi^2 = 3.183$ ,  $P = 0.074$ ). The 1-, 2-, and 5-year LRFS and DMFS were 90.4%, 61.7%, and 18.0% and 87.4%, 49.2%, and 9.9%, respectively, and no statistical difference was observed between the two groups (LRFS:  $\chi^2 = 0.028$ ,  $P = 0.868$ ; DMFS:  $\chi^2 = 3.347$ ,  $P = 0.067$ ). No significant difference was found between the two groups in acute radiotoxicity.

**Conclusions:** Without loss of laryngeal function, the survival of DRT is comparable to that of S + RT in supraglottic and hypopharyngeal carcinoma.

**Keywords:** Supraglottic; Hypopharyngeal; Definitive radiotherapy; Adjuvant radiotherapy; Survival

## Introduction

Supraglottic and hypopharyngeal carcinoma are common malignant neoplasms of the head and neck. The symptoms include dysphonia, dysphagia, and life-threatening dyspnoea. Conventional treatments for supraglottic and hypopharyngeal carcinoma include definitive radiotherapy (DRT) with or without chemotherapy and surgery followed by radiotherapy (S + RT). The lost function after surgery (eg, total laryngectomy, hemi-laryngectomy, supraglottic laryngectomy) may seriously affect the quality of life (QOL) for the patients. Therefore, DRT is chosen for the goal of organ preservation. Nowadays, intensity-modulated radiotherapy (IMRT) is the standard radiotherapy technique in the treatment of head and neck cancers, and it enables higher

conformal dose distribution to control the tumors and less toxicity to reduce side effects. To further expand on the differences of both DRT and S + RT groups, and evaluate the clinical application effects of these radiation regimen, we analyzed the data of survival and side effects in 59 supraglottic or hypopharyngeal carcinoma patients after treatment with IMRT at our institution.

## Methods

### Ethical approval

This retrospective, single-center study was approved by the Ethics Committee of Peking University First Hospital (No.

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2018-78), and written informed consent was provided by all patients before treatment.

### General clinical data

A retrospective chart review was performed for those who underwent IMRT in Peking University First Hospital between January 2012 and August 2016. During that period, we performed radiotherapy in 63 newly diagnosed, biopsy-proven patients for various supraglottic or hypopharyngeal carcinomas. Four cases were lost to follow-up. Fifty-nine consecutive cases were enrolled, and 57 patients were male. The male/female ratio was 28.5:1, and patients ranged from 45 to 85 years old (median, 59 years old) at presentation at Peking University First Hospital for this disease. There were 24 cases of supraglottic carcinoma and 35 cases of hypopharyngeal carcinoma. All the patients were diagnosed with squamous cell carcinoma except for one patient with carcinosarcoma, by G1 (15.3%), G2 (57.6%), G3 (15.3%), or Gx (10.2%, unknown G degree). According to the 7th edition of the American Joint Committee on Cancer and the International Union for Cancer Control (AJCC/UICC) staging system, four (6.8%) patients had stage I disease, 13 (22%) had stage II, 12 (20.3%) had stage III, and 30 (50.8%) had stage IV. None of the patients had a history of malignancy or contraindications to radiotherapy, and all patients provided signed informed consent before radiotherapy. Acute toxicity was assessed using the Radiation Therapy Oncology Group (RTOG) acute morbidity scoring criteria.

### Treatment modalities

A total of 59 patients were identified, of whom 31 were treated with DRT, and 28 were treated with S + RT. In the 31 cases of the DRT group, 23 cases were treated with concurrent chemoradiotherapy (CRT), one case was treated with DRT plus cetuximab, and seven cases were treated with DRT alone. In the 23 cases of CRT, one case administered three times at a dose of 100 mg/m<sup>2</sup> received all planned chemotherapy cycles and the other 22 cases received weekly low-dose cisplatin at a dose ranged from 30 to 40 mg/m<sup>2</sup>. However, only 50% received all planned weekly low-dose cisplatin (more than four cycles). IMRT was used in all the patients except one (3D-CRT, 3D conformal radiotherapy). Radiation doses were 66.00 to 69.96 gray (Gy) in 31 to 33 fractions delivered from Monday to Friday over 6 to 7 weeks in the definitive setting (primary tumors and positive lymph nodes) and 50.96 to 59.96 Gy in 28 to 33 fractions over 6 to 7 weeks in the prophylactic setting (cervical).

In 28 cases of S + RT, 13 cases were treated with surgery followed by adjuvant radiotherapy, and the other 15 cases were treated with surgery followed by CRT, with patients receiving weekly low-dose cisplatin at a dose ranging from 30 to 40 mg/m<sup>2</sup>. However, only eight cases received all planned weekly low-dose cisplatin (more than four cycles). IMRT was used in all the patients. Radiation doses were 55 to 66 Gy in 25 to 31 fractions delivered from Monday to Friday over 4 to 9 weeks to tumor bed and 45 to 60 Gy in 25 to 31 fractions over 4 to 9 weeks to the prophylactic area. Ten patients with supraglottic carcinoma underwent

S + RT, including four of total laryngectomy, five of partial laryngectomy, and one of transoral local wide resection. Fourteen patients with hypopharyngeal carcinoma underwent S + RT, including five of total laryngectomy, five of partial hypopharyngectomy, and four of transoral local wide resection. Eighteen cases underwent bilateral neck dissection, and one case underwent unilateral neck dissection. The demographic characteristics of the study population are illustrated in Table 1.

### Statistical analysis

All analyses were performed with SPSS Statistics 23.0 (IBM Co., Armonk, NY, USA). A  $P < 0.05$  was considered statistically significant. The overall survival (OS) was defined as the time between the last day of the treatment and death from any cause. The OS was estimated using the Kaplan-Meier method, and treatment groups were compared using a Fisher's precision inspection or a Mann-Whitney test. The locoregional failure-free survival (LRFS) was defined as the time between the last day of the treatment and a locoregional failure. The distant metastasis-free survival (DMFS) was defined as the time between the last day of the treatment and a distant failure. The simultaneous relationship of multiple prognostic factors to OS was assessed using Cox's proportional hazard regression analysis.

## Results

### Patient characteristics

The median follow-up was 20 months (range, 4–67 months). The 1-, 2-, and 5-year OS were 84.7%, 57.9%, and 43.7%, respectively. The 1-, 2-, and 5-year LRFS and DMFS were 90.4%, 61.7%, and 18.0% and 87.4%, 49.2%, and 9.9%, respectively. Of the 59 patients, 22 (37.3%) experienced recurrent or persistent disease, and 12 (20.3%) underwent distant metastasis.

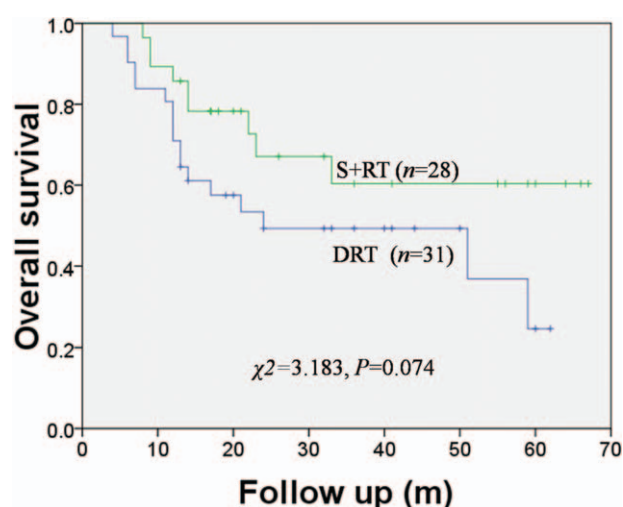
### Differences in grouping variables

The patient and treatment characteristics are demonstrated in Table 1. The patients of the two groups were similar with respect to gender, mean age, primary site, T stage, N stage, pathologic grade, clinic stage, and with concurrent chemotherapy or not. The 1-, 2-, and 5-year OS were 80.6%, 53.4%, and 24.7% for DRT group and 85.7%, 67.1%, and 24.7% for S + RT group, respectively [Figure 1]. There was no significant difference between the two groups ( $\chi^2 = 3.183$ ,  $P = 0.074$ ). The 1-, 2-, and 5-year LRFS was 93.2%, 75.0%, and 25.2% for DRT group and 96.4%, 55.7%, and 20.3% for S + RT group, respectively. The median recurrent time of DRT was 8 months, while that of S + RT was 9 months. The 1-, 2-, and 5-year DMFS was 90.0%, 49.7%, and 4.8% for DRT group and 96.3%, 57.1%, and 15.9% for S + RT group, respectively. No statistical difference was observed between the two groups (LRFS:  $\chi^2 = 0.028$ ,  $P = 0.868$ ; DMFS:  $\chi^2 = 3.347$ ,  $P = 0.067$ ). In the 31 cases of the DRT group, for the primary tumors, 27 (87.1%) of them achieved complete response (CR), three (9.68%) achieved

**Table 1: Characteristics of adult patients with supraglottic or hypopharyngeal carcinoma undergoing single-modality treatment with either DRT or S + RT.**

Variables	DRT (n=31)	S + RT (n=28)	Statistics	P
Gender			Fisher	1.000
Male	30	27		
Female	1	1		
Age			Fisher	1.000
≤50 years	4	4		
>50 years	27	24		
Primary site			0.544*	0.461
Supraglottic larynx	14	10		
Hypopharynx	17	18		
T classification			360.000†	0.237
1	3	3		
2	15	9		
3	7	6		
4	6	10		
N classification			427.000†	0.909
N0	14	12		
N1	6	6		
N2	11	10		
Pathological grades			403.000†	0.599
Well	5	4		
Moderately	18	16		
Poorly	4	5		
Unknown	4	3		
Stage			429.000†	0.934
I	2	2		
II	7	6		
III	6	6		
IV	16	14		
Concurrent chemotherapy			321.000†	0.070
No CT	7	13		
<5 cycles	11	7		
≥5 cycles	12	8		
Cetuximab	1	0		

Data were presented as n. \*  $\chi^2$  values. † U values. DRT: Definitive radiotherapy; S + RT: Surgery followed by adjuvant radiotherapy; CT: Chemotherapy.



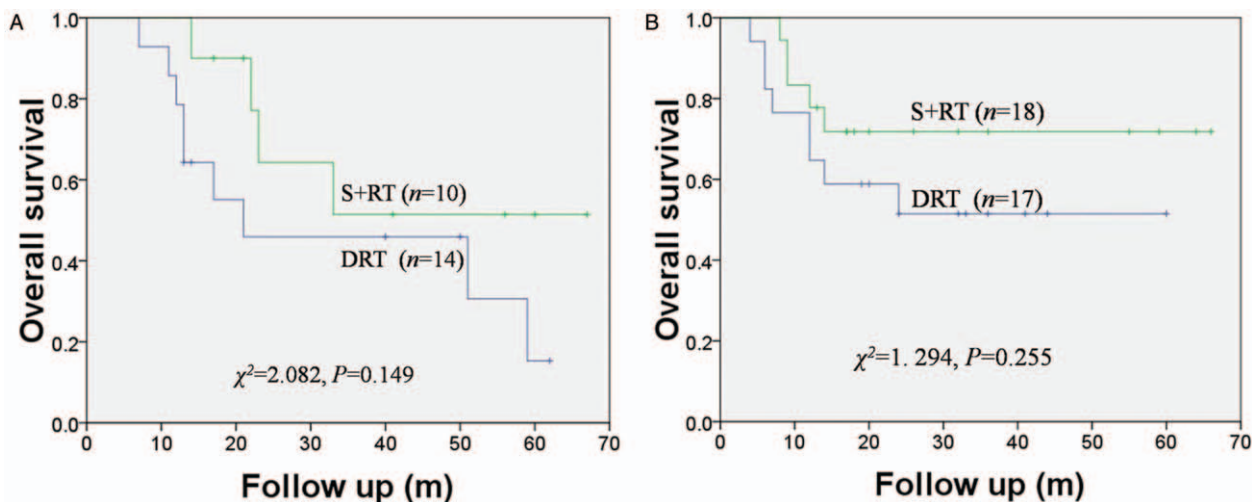
**Figure 1:** Overall survival rate of adult patients with supraglottic or hypopharyngeal carcinoma undergoing single-modality treatment with either DRT or S + RT. The blue curve shows the overall survival of the DRT group, and the green curve shows the S + RT group. There was no significant difference between the two groups ( $\chi^2 = 3.183, P = 0.074$ ). DRT: Definitive radiotherapy; S + RT: Surgery followed by adjuvant radiotherapy.

partial response (PR), and only one (3.2%) case had a stable disease (SD). In the 31 cases of the DRT group, for the positive cervical lymph nodes, 24 (77.4%) of them achieved CR, six (19.4%) achieved PR, and one (3.2%) was SD. No significant difference was found between the two groups in acute radiotoxicity.

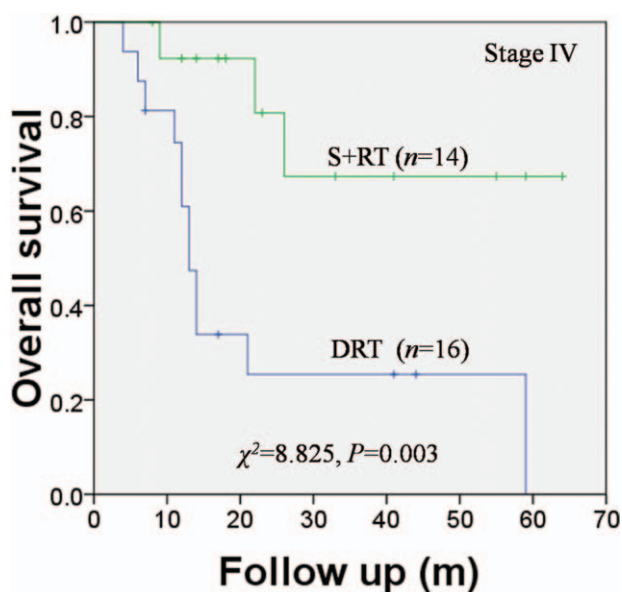
**Stratified analysis**

The 1-, 2-, and 5-year OS of these cases of supraglottic carcinoma was 85.7%, 45.9%, and 15.3% for DRT group and 90%, 64.3%, and 51.4% for S + RT group, respectively. It seemed that S + RT group had a higher survival rate, but there was no significant difference between the two groups ( $\chi^2 = 2.082, P = 0.149$ ) [Figure 2A].

The 1-, 2-, and 5-year OS of these cases of hypopharyngeal carcinoma was 76.5%, 58.8%, and 51.5% for DRT group and 83.3%, 71.8%, and 71.8% for S + RT group, respectively. It seemed that S + RT group had a higher survival rate, but there was no significant difference between the two groups ( $\chi^2 = 1.294, P = 0.255$ ) [Figure 2B].



**Figure 2:** Overall survival rate of adult patients with supraglottic (A) or hypopharyngeal (B) carcinoma undergoing single-modality treatment with either DRT or S + RT. The blue curve shows the overall survival of the DRT group, and the green curve shows the S + RT group. For both supraglottic ( $\chi^2 = 2.082, P = 0.149$ ) and hypopharyngeal ( $\chi^2 = 1.294, P = 0.255$ ) carcinoma, the S + RT group had a higher survival rate, but no significant difference was found. DRT: Definitive radiotherapy; S + RT: Surgery followed by adjuvant radiotherapy.



**Figure 3:** Overall survival rate of adult patients with supraglottic or hypopharyngeal carcinoma with stage IV undergone single-modality treatment with either DRT or S + RT. The blue curve shows the overall survival of the DRT group and the green one shows the S + RT group. The S + RT group had a higher survival rate (1-, 2-, 5-year OS: 85.7%, 53.6%, 42.9%) than DRT group (1-, 2-, 5-year OS: 68.6%, 22.5%, 22.5%), and the difference between the two groups was significant ( $\chi^2 = 8.825, P = 0.003$ ). DRT: Definitive radiotherapy; S + RT: Surgery followed by adjuvant radiotherapy.

As shown in Table 1, the patients of the two groups were similar with respect to clinic stages. The follow-up data showed that for patients with stages I and II who underwent DRT ( $n = 9$ ) or S + RT ( $n = 8$ ) either alone or in combination with chemotherapy, experienced long-term survival except for two patients of the S + RT group who died of non-neoplastic reasons. For patients with stage III, there was no significant difference between the two groups in OS ( $\chi^2 = 0.252, P = 0.156$ ). However, for 30 patients with stage IV, the S + RT group had a higher survival rate (1-, 2-, and 5-year OS: 85.7%, 53.6%, and 42.9%) than DRT group (1-, 2-, and 5-year OS: 68.6%, 22.5%, and 22.5%),

and the difference between the two groups was significant ( $\chi^2 = 8.825, P = 0.003$ ) as shown in Figure 3.

**Analysis of factors affecting survival rate**

We evaluated the association between the clinic pathological factors and the prognosis of these 59 patients using the Cox proportional hazards model [Table 2]. We included gender, age group ( $\leq 50$  years or  $> 50$  years), therapeutic method (DRT or S + RT), stage (I + II or III + IV), with or without chemotherapy and pathological grade as explanatory factors in the multivariate analysis. Only clinic stages (I + II or III + IV) and therapeutic methods (DRT or S + RT) were found to be significant prognostic factors.

In this series, three of the nine patients who underwent total laryngectomy as initial therapy had recurrent diseases, and two of them received salvage surgery. Four of the 12 patients who underwent partial laryngectomy/hypopharyngectomy as initial therapy had recurrent diseases, and two of them underwent salvage total laryngectomy. Six patients with various stage (T1: two cases, T2: three cases, T4: one case) underwent transoral local wide resection as initial therapy, and only one of them had recurrent diseases and underwent salvage partial laryngectomy. A total of 11 (18.6%) patients lost their whole function of larynx or hypopharynx. A total of 13 (22.0%) patients lost partial function of the larynx or hypopharynx.

**Acute radiotoxicity**

Acute radiotoxicity was assessed using RTOG acute morbidity scoring criteria. Data of the acute radiotoxicity are illustrated in Table 3. No significant difference was seen between the two groups.

**Discussion**

People are now paying increasing attention to the QOL, and the proportion of patients who choose laryngeal

**Table 2: Cox proportional hazards model of prognostic factors for adult patients with supraglottic or hypopharyngeal carcinoma undergoing single-modality treatment with either DRT or S + RT (n = 59).**

Factors	P	HR (95% CI)
Gender	0.916	0.881 (0.085–9.153)
Age group (>50 years/≤50 years)	0.881	1.089 (0.356–3.332)
Therapeutic method (DRT or S + RT)	0.028	0.319 (0.115–0.882)
Clinic stage (I + II/III + IV)	0.011	6.719 (1.545–29.216)
With chemotherapy or not	0.069	0.362 (0.122–1.081)
Pathological grade	0.628	0.876 (0.512–1.499)

HR: Hazard ratio; CI: Confidence interval; DRT: Definitive radiotherapy; S + RT: Surgery followed by adjuvant radiotherapy.

**Table 3: Compliance and acute toxicity of adult patients with supraglottic or hypopharyngeal carcinoma undergoing single-modality treatment with either DRT or S + RT (n = 59).**

Toxicity	Acute toxicity (grades 1–4) (%)			Acute toxicity (grades 3–4) (%)		
	Total (n = 59)	DRT (n = 31)	S + RT (n = 28)	Total (n = 59)	DRT (n = 31)	S + RT (n = 28)
Skin toxicity	100.0	100.0	100.0	0	0	0
Mucositis/stomatitis	96.6	100.0	92.9	15.3	22.6	7.1
Myelosuppression	61.0	71.0	50.0	8.5	12.9	3.6
Ototoxicity	0	0	0	0	0	0
Ocular damage	0	0	0	0	0	0
Xerostomia	32.2	32.3	32.1	0	0	0
Dysphagia (pharynx/esophagus)	74.6	77.4	71.4	8.5	12.9	0
Nausea/vomiting	10.2	6.5	14.3	0	0	0
Leukopenia	30.5	48.4	10.7	8.5	12.9	3.6
Anemia	45.8	48.4	42.9	0	0	0
Thrombocytopenia	8.5	12.9	3.6	1.7	1.7	0

DRT: Definitive radiotherapy; S + RT: Surgery followed by adjuvant radiotherapy.

function preservation has increased gradually. In 2011, Chen *et al*<sup>[1]</sup> analyzed a total of 131,694 cases of laryngeal carcinoma diagnosed from 1985 to 2007 identified from the National Cancer Database and found that among the patients with advanced-stage carcinoma, the proportion of using CRT increased from <7% to 45%, while the proportion of receiving total laryngectomy decreased from 42% to 32%. Moreover, in 2015, Newman *et al*<sup>[2]</sup> selected 6647 patients with hypopharyngeal squamous carcinoma between 1973 and 2003 for review from the Surveillance, Epidemiology and End Results Database. The big data showed that, since 1990, the proportion of receiving non-surgical treatment increased from 43.1% to 52.1%, while the use of surgery combined with radiotherapy was stable (43.6% *vs.* 41.8%), and the use of surgery alone decreased from 14% to 7.3%.

Despite the importance of QOL, prolonged survival is the golden standard for cancer treatment. Chen *et al*<sup>[1]</sup> also reported that the 4-year survival rate of early-stage laryngeal carcinoma treated with surgery and radiation was 79% and 71% (hazard ratio [HR]: 0.71, range 0.65–0.76), respectively. While the 4-year survival rate of patients with advanced laryngeal carcinoma treated with total laryngectomy, CRT, and RT was 51%, 48%, and 38%, respectively. Receiving CRT is a poor prognostic factor of advanced laryngeal carcinoma (HR: 1.13, range

1.06–1.21). A retrospective cohort study of 134 patients (62 patients in the surgical group and 72 in the non-surgical group) undergoing surgical (total or partial laryngectomy) or non-surgical (isolated radiotherapy, chemotherapy, or induction chemotherapy followed by radiotherapy and chemotherapy) treatment, was reported. The surgical group showed a higher disease-free survival rate (81.7% *vs.* 62.2%;  $P = 0.028$ ), especially in III/IV stages ( $P = 0.018$ ), locally advanced tumors T3 and T4a ( $P = 0.021$ ) and N0/N1 cases ( $P = 0.005$ ). The non-surgical group was 3.8 times more likely to recur (HR = 3.76; 95% confidence interval 1.27–11.14;  $P = 0.039$ ).<sup>[3]</sup> Newman *et al*<sup>[2]</sup> found that the average 5-year survival rate of hypopharyngeal carcinoma patients increased to 41.3% in those diagnosed from 1990 to 2003 from the rate of 37.5% in those diagnosed from 1973 to 1989 ( $P < 0.0001$ ). Data showed that the survival rate of the patients using surgery alone was higher than that of those using radiotherapy without surgery (46.3% *vs.* 36.0%,  $P < 0.0001$ ).<sup>[2]</sup>

Nowadays, the application of laryngeal function-preserving surgery, minimally invasive transoral laser microsurgery (TLM) surgery, and transoral robotic surgery (TORS) is increasingly performed because the progress of surgical techniques resulted in decreased operative trauma. Better functional outcomes were observed in the RT/CRT and

TLM/TORS-treated patients, although the reported oncologic outcomes of T1 to T2 hypopharyngeal cancer were comparable regardless of the modality chosen.<sup>[4]</sup> Primary surgery could also be the preferred modality of treatment for most early (T1–T2, N0) laryngeal and hypo/oropharyngeal carcinomas when this strategy offered an opportunity to reserve RT for a potential recurrence or second primary tumor.<sup>[5]</sup> The same principle is now used in our hospital.

For advanced hypopharyngeal carcinoma, the optimal treatment remains under debate. A systematic review from Habib<sup>[6]</sup> compared survival following surgical and non-surgical treatments. Two randomized trials and 11 observational studies were included. They concluded that CRT offers similar survivorship compared to surgery in advanced disease, and it can be used as a treatment in all the patients as an alternative to surgery. Some articles share the same view. Zhang *et al*<sup>[7]</sup> compared the treatment outcomes for locally advanced hypopharyngeal carcinoma between surgery plus radio (chemo) therapy (SRT) and non-surgery CRT. A total of 119 patients were divided into two groups: 42 cases in the SRT group and 77 cases in the CRT group. There were no significant differences between the SRT and CRT groups for 5-year disease-free survival (53.9% *vs.* 45.1%,  $\chi^2 = 1.251$ ,  $P = 0.263$ ) and OS (54.9% *vs.* 45.6%,  $\chi^2 = 1.749$ ,  $P = 0.186$ ). Compared to the SRT group, the CRT group did not show a significant increase of treatment complications ( $\chi^2 = 0.858$ ,  $P = 0.354$ ), but demonstrated a higher laryngeal preservation rate (50.0% *vs.* 71.4%,  $\chi^2 = 6.493$ ,  $P = 0.011$ ). Combined modality treatment is a main approach for advanced hypopharyngeal cancer. Researchers concluded that SRT offers disease-free survival and OS rates equivalent to CRT, but with a higher laryngeal preservation rate.<sup>[7]</sup> The result of our study was similar with those studies. Juloori *et al*<sup>[8]</sup> reported that patients with stages III to IVB SCC of the hypopharynx treated with definitive CRT to a mean dose of 72 Gy, gained a 5-year OS of 62% and 10-year OS of 43%.

At the same time, great progress has been achieved in radiotherapy and chemotherapy, and the combination of these techniques can be carried out with less toxicity to obtain a greater curative effect. In the systematic review by Habib,<sup>[6]</sup> the 5-year larynx preservation rate for non-surgically treated patients was between 38% and 58%. In our study, the laryngeal function preservation rate was 59.3%, and this improved result was due to the improvement of IMRT. In Edson *et al*'s study,<sup>[9]</sup> the laryngeal function preservation rate at 2 years was as high as 76% in patients with hypopharyngeal carcinoma treated with organ-preservation therapy utilizing IMRT. With a median follow-up of 35 months, the 2-year OS, locoregional control, progression-free survival, and laryngectomy-free survival rates were 74%, 77%, 67%, and 65%, respectively. Favorable disease outcomes and functional laryngeal preservation rates can be achieved with IMRT for patients with hypopharyngeal cancer. Therefore, more data are needed to compare the efficacy and toxicity of surgical-based comprehensive treatment with

radiotherapy-based non-surgical comprehensive treatment, to establish the treatment recommendation.

Toxicity and side effects are also important factors for patients to consider in making their decision to choose RT or surgery as their initial therapy. Those treated with CRT show higher levels of dry mouth and sticky saliva, while those patients who have undergone surgery report greater levels of sensory disturbance.<sup>[10]</sup> Szuvecs *et al*<sup>[11]</sup> performed a retrospective analysis using a validated questionnaire focusing on the assessment of communicative ability, quality of voice, and swallowing after a long-term follow-up (mean 56.7 months, range 8–130 months). Patients were divided into three groups that received definitive radio (chemo) therapy, laryngectomy + radio (chemo) therapy and larynx conservation surgery + radio (chemo) therapy, respectively. After definitive radio (chemo) therapy, the patients had more frequent dysphagia and additional percutaneous endoscopic gastrostomy feeding, compared with the other two groups ( $P < 0.05$ ) and trended toward more substantial-strong hoarseness compared with larynx conservation surgery + radio (chemo) therapy ( $P = 0.2$ ). After laryngectomy, the patients were dissatisfied with their artificial larynx/electrolarynx and the tone of their voice and communicative ability in comparison with the other two groups. Larynx conservation surgery + radio (chemo) therapy is the best in terms of long-term side effects. Rinkel *et al*<sup>[12]</sup> reported that swallowing and speech problems in daily life were frequently present after CRT for head and neck cancer with a long-term follow-up (range, 6 months to 5 years). The use of IMRT may reduce psychosocial speech problems when compared with 3D-CRT. Therefore, laryngeal function-preserving surgery combined with postoperative IMRT may be the best way to treat laryngeal and hypopharyngeal carcinoma patients due to the better curative effect and lower side effects.

The trend toward minimally invasive organ and function preserving treatment regimens for laryngeal and hypopharyngeal carcinoma, has occurred in parallel with the evolution of new surgical technologies, such as transoral CO<sub>2</sub> laser microsurgery and TORS, instead of the traditional open surgery like vertical partial laryngectomy and horizontal partial laryngectomy. The safety and effectiveness of these minimally invasive organ and function preserving surgeries has been confirmed with a laryngeal preservation rate as high as 96%.<sup>[13–20]</sup> In our study, six patients in various T stages (T1: two cases, T2: three cases, T4: one case) received minimally invasive surgery combined with adjuvant radiotherapy without any serious toxicity or side effect, of whom only one patient with T2 recurred and received laryngeal conservative surgery after recurrence.

Despite the small sample size used in this study, we believe that the minimally invasive organ and function preserving treatment regimens combined with adjuvant radiotherapy for laryngeal and hypopharyngeal carcinoma would be the preferred treatment mode for selected patients in the future, as they could not only improve the curative effect and laryngeal preservation rate, but also reduce the toxicities and side effects caused by radiotherapy and chemotherapy.

What's more, due to the small sample size and the retrospective design, bias may exist, and multi-center prospective clinic trails with large samples are needed.

In conclusion, without loss of laryngeal function, the survival of DRT is comparable to that of S + RT in supraglottic and hypopharyngeal carcinoma.

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### Conflicts of interest

None.

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