

## Main Article

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# Patterns of neck metastasis and occult neck disease during recurrent laryngeal cancer

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## Abstract

**Objective.** Numerous factors are considered to impact on the rate of complications during salvage total laryngectomy procedures. Neck dissection could be one of these factors. This study analysed the pattern of lymph node metastasis and rate of occult neck disease during salvage total laryngectomy as well as the impact of neck dissection on survival and complication rates.

**Method.** This was a retrospective analysis of a prospectively maintained laryngectomy database in two large tertiary teaching hospitals.

**Results.** The rate of occult neck disease was 11.1 per cent. Most cases with occult neck disease had rT<sub>4</sub> disease. Patients with complications, advanced tumour stage and positive margins had a significant decrease in overall survival. Patients receiving elective neck dissection did not have any survival benefit. Positron emission tomography-computed tomography showed a very high specificity and negative predictive value.

**Conclusion.** According to the low risk of occult neck disease when using contemporary imaging techniques as well as the lack of impact on survival, conservative management of the neck should be considered for crT<sub>1</sub>-T<sub>3</sub> recurrence.

## Introduction

The treatment of locally advanced laryngeal squamous cell carcinoma (SCC) has undergone significant changes over the last three decades from surgical to radiotherapy based protocols. This paradigm shift followed the publication of the milestone Veterans Affairs study<sup>1</sup> followed by the Radiation Therapy Oncology Group 91-11 trial<sup>2</sup> and many others thereafter that validated non-surgical options for the treatment of locally advanced laryngeal SCC.<sup>3</sup> However, despite these non-surgical treatments, between 30–66 per cent of patients suffer persistence or recurrence depending on location and staging.<sup>4</sup> In most locally advanced recurrences, open salvage surgery remains the best treatment option with curative intent. A significant number of these surgical procedures are likely to be total laryngectomy procedures.<sup>5</sup> Salvage total laryngectomy carries a significantly higher risk of complications than primary total laryngectomy.<sup>4</sup> When planning salvage total laryngectomy, numerous factors are considered to impact on the rate of complications, and neck dissection is one of these factors.<sup>6</sup>

Neck dissection and its impact on post-operative complications during salvage total laryngectomy is a matter of debate,<sup>7–9</sup> with multiple studies trying to address this as well as its impact on survival. It is established that elective neck dissection is necessary for the treatment of primary locally advanced laryngeal SCC when the risk of occult neck disease exceeds 20 per cent.<sup>10</sup> However, the role of elective neck dissection for recurrent or persistent locally advanced laryngeal SCC is not well defined because the risk of lymph node metastasis appears to be reduced compared with primary disease. Therefore, four different meta-analyses have been conducted regarding the role of elective neck dissection during salvage total laryngectomy in the last two years alone.<sup>11–14</sup>

All studies included in these meta-analyses were retrospective except one. The only prospective study, by Wax and Touma,<sup>15</sup> included 34 patients treated between 1991 and 1997 when positron emission tomography (PET) was not available, and this was not a randomised, controlled study for ethical reasons. Therefore, all these studies have an inevitable selection bias with fewer early-stage recurrences undergoing neck dissection in comparison with more advanced stages. Overall, all the studies published reported their rates of occult neck disease with less than 50 per cent of patients being pre-operatively investigated with a PET scan. Accordingly, knowing the risk of occult neck disease at a certain neck nodal level depending on the staging and location of the primary tumour is vital in order to be able to tailor the extent of the neck dissection whenever deemed necessary.

This study aimed to analyse the pattern of lymph node metastasis of recurrent locally advanced laryngeal SCC as well as the rate of occult neck disease with contemporary imaging techniques and its impact on salvage laryngectomy. We also report survival outcomes and complication rates.

## Materials and methods

### Setting

We performed a retrospective analysis of a prospectively maintained laryngectomy database in two large tertiary teaching hospitals. Patients undergoing salvage total laryngectomy for recurrent or persistent laryngeal SCC that was previously treated with non-surgical radiotherapy based protocols were included.

### Inclusion and exclusion criteria

All patients treated with salvage total laryngectomy after non-surgical treatment for recurrent or persistent locally advanced laryngeal SCC were included. We excluded patients that: did not have previous non-surgical treatment, had histology other than SCC, had second primary cancers (defined as tumours originating in different locations than the primary tumour), had undergone laryngectomy procedures for cervical oesophageal cancer and had undergone laryngectomy for non-functional larynx.

### Data collection

Data regarding peri-operative variables were collected using both electronic and paper notes. The same applied to histological and speech and language therapy records. All patients undergoing salvage total laryngectomy for persistent or recurrent locally advanced laryngeal SCC after radiotherapy, chemoradiotherapy or bioradiotherapy from January 2004 until December 2018 at Guy's and St Thomas' Hospital and from January 2008 until December 2018 at St George's Hospital were included.

Staging was performed following the International Union Against Cancer and American Joint Commission on Cancer staging system. Demographic data, clinical and pathological tumour-node-metastasis categorisation, extent of neck dissection and primary surgery, and reconstruction and complication rates were recorded. We classified all post-surgical complications in accordance with the Clavien–Dindo classification system for complications in head and neck surgery.<sup>16</sup> We classified grades I–II as minor and III–V as major. Occult neck disease was described as the percentage of patients that, having been classified as rN<sub>0</sub>, were upstaged to ypN+ after histological analysis.

### Surgical protocols

The standard approach in both hospitals was to perform bilateral elective neck dissection for every crN<sub>0</sub> patient from the beginning of the study period. As evidence published by one of the centres questioned the role of elective neck dissection<sup>17</sup> and with the reported high accuracy of PET scans,<sup>18</sup> one of the centres decided to select whether or not to perform elective neck dissection on an individual basis from 2014. All patients underwent level VI neck dissection.

### Pre-operative evaluation

The management of all patients was discussed in a head and neck multidisciplinary meeting. Primary site salvage surgery included salvage total laryngectomy. Pre-operative staging was performed radiologically including computed tomography (CT) or PET scan as well as endoscopic evaluation under general anaesthetic. Computed tomography and PET-CT reports were classified as negative, positive or equivocal. Mild or no fluoro-deoxy-glucose (FDG) uptake in enlarged nodes or

mild FDG uptake in normal-sized nodes was considered to be an equivocal response. Equivocal was counted as positive for test accuracy analysis. Of note, patients with level VI positive lymph nodes were not counted as positive for the purposes of this study, which is assessing the lateral neck.

As a service evaluation project, the NHS Health Research Authority decision tool determined this project to be a service evaluation; therefore, it did not require ethical approval. The project was approved with reference number AUDI000897 at St George's Hospital and project number 12083 at Guy's and St Thomas' Hospital.

### Statistical analysis

Data collection, data collation and confusion matrices were carried out in Microsoft Excel® spreadsheet software. Statistical analysis was carried out using RStudio development environment software (version 1.4.1103; Boston, USA, with R version 4.0.3). Kaplan–Meier analysis was carried out using the 'survival' and 'survminer' packages. Categorical variables were analysed by Fisher's exact test (*t*-category *vs* occult neck disease) or Wald confidence limits (location *vs* occult neck disease, and disease-free interval *vs* occult neck disease) from the 'epiR' package. The log rank test was used for univariate survival analyses ('survival' and 'survminer' packages).

## Results

### Patients and disease

A total of 106 patients were included in the final analysis. **Table 1** describes the demographic data, location of the tumour, initial staging treatment received and treatment response. Most patients included had tumours located in the glottis (66 per cent) and were treated with radiotherapy alone.

### Accuracy of pre-operative tests and occult neck disease

A total of 48 patients (45.3 per cent) had their recurrence investigated with PET-CT scan. All patients underwent a pre-operative CT scan. The accuracy of CT and PET-CT is summarised in **Table 2**. The PET-CT showed a very high specificity and negative predictive value (94.6 per cent and 94.8 per cent, respectively; **Tables 2, 3 and 4**).

Regarding the 92 patients classified as N<sub>0</sub> after clinical and radiological evaluation of persistence or recurrence, the rate of occult neck disease was 11.1 per cent. Most of the cases where occult neck disease was identified were rT<sub>4</sub>, whereas none of the cases diagnosed as rT<sub>1</sub> had occult neck disease (rT<sub>1–3</sub> *vs* rT<sub>4</sub>, relative risk: 2.27 (95 per cent confidence interval = 1.03–5)). **Table 3** shows the distribution of occult neck disease according to rT-stage and initial T-stage, initial N-stage and location and shows that the most relevant factor affecting the risk of occult neck disease is rT<sub>4</sub>. No differences were identified either according to location, initial T-stage or disease-free interval (less than six months *vs* six months or more). The results are summarised in **Table 4**.

### Lymph node distribution, neck dissection and survival impact

Neck dissection was performed in 70 patients (58 had bilateral neck dissection and 12 had unilateral neck dissection), and 36 patients did not have neck dissection. Prevalence of

**Table 1.** Summary of demographic data, tumour location and staging at diagnosis, initial treatment and treatment response

Parameter	Value
Gender ( <i>n</i> (%))	
– Male	97 (84.9)
– Female	9 (15.1)
Age (mean ± SD; years)	64.14 (9.81)
Tumour location ( <i>n</i> (%))	
– Supraglottis	29 (27.4)
– Glottis	70 (66)
– Subglottis	1 (0.9)
– Hypopharynx	6 (5.7)
Initial T-stage ( <i>n</i> (%))	
– 1	35 (33)
– 2	39 (36.8)
– 3	30 (28.3)
– 4	2 (1.9)
Initial N-stage ( <i>n</i> (%))	
– 0	90 (84.9)
– 1	6 (5.7)
– 2a	0 (0)
– 2b	7 (6.6)
– 2c	3 (2.8)
– 3	0 (0)
Initial staging ( <i>n</i> (%))	
– I	33 (31.1)
– II	33 (31.1)
– III	28 (26.4)
– IV	12 (11.4)
Initial treatment ( <i>n</i> (%))	
– Radiotherapy alone	73 (68.9)
– CRT	30 (28.3)
– BRT	3 (2.8)
Response to treatment ( <i>n</i> (%))	
– Persistence	76 (71.7)
– Complete response	30 (28.3)

SD = standard deviation; CRT = chemoradiotherapy; BRT = bioradiotherapy

pathologically positive lymph nodes was 16.9 per cent. Regarding lymph node distribution across the different neck levels, no patient suffered contralateral neck involvement without ipsilateral positive lymph nodes, and only one patient with lateralised cancer suffered with bilateral neck disease. No patient had level I or V neck disease involvement. Figure 1 shows the lymph node distribution pattern across the different neck levels during salvage total laryngectomy for recurrent SCC. Interestingly, patients receiving elective neck dissection did not have any survival benefit ( $p = 0.79$ ) (Figure 1).

### Survival outcomes and complications

With a mean follow up of 41.3 months (1–151 months), the 5-year overall survival and disease-specific survival were 59.7

**Table 2.** Accuracy of pre-operative tests

Parameter	Computed tomography (%)	Positron emission tomography-computed tomography (%)
Sensitivity	64.7	71.4
Specificity	80.2	94.6
Positive predictive value	40.7	55.6
Negative predictive value	91.5	94.8

per cent and 46 per cent, respectively (Figure 2). Ninety-two out of 106 patients were classified as  $N_0$  after clinical and radiological evaluation of persistence or recurrence. Salvage total laryngectomy showed good survival outcomes for this subgroup of patients with 5-year overall and disease-specific survival of 46 per cent and 72.9 per cent, respectively. Patients with complications ( $p = 0.02$ ), advanced T-stage ( $p < 0.001$ ) and positive margins ( $p = 0.005$ ) had a significant decrease in overall survival (Table 5).

Six patients were excluded from further analysis of complications because full data were not available. Forty-three patients (50 per cent) suffered complications (20 (23.2 per cent) minor and 23 (26.7 per cent) major); these are summarised in Table 5. The complications distribution is summarised in Table 6. Univariate analysis did not identify any relationship between the rate of complication and neck dissection ( $p = 0.21$ ), recurrent T-stage ( $p = 0.67$ ), disease-free interval ( $p = 0.52$ ) or reconstruction ( $p = 0.4$ ). Finally, we analysed which variable might influence the length of stay as this can be a more accurate measure of complications. Results are summarised in Table 6.

## Discussion

### Accuracy of pre-operative tests and occult neck disease

Salvage laryngectomy for recurrent locally advanced laryngeal SCC is related to a high rate of post-operative complications.<sup>5</sup> One of the possible contributors to this increase of complications is performing neck dissection. With the increased number of patients undergoing salvage total laryngectomy, controversy exists regarding the need for prophylactic neck dissection for clinically and radiologically neck negative ( $crN_0$ ) patients. The need to better analyse the usefulness of elective neck dissection for salvage total laryngectomy is evident with four meta-analyses trying to clarify the subject in less than two years.<sup>11–14</sup> However, only 19 studies are included, and laryngeal subsites or unilateral or bilateral neck dissection are normally not specified in those analyses. More importantly, a PET scan was not routinely in use at the time of the publication of the majority of the included studies.

Studies advocating the need for elective neck dissection do so on the basis of a high percentage of occult neck disease (as well as this being the likely last curative possible treatment and the lack of evidence for increased complications). In the  $N_0$  neck, it is recognised that neck dissection should be performed as a staging and therapeutic procedure when the risk for positive lymph nodes exceeds 20 per cent.<sup>10</sup> The rate of occult neck disease will be directly influenced by the accuracy of the pre-operative diagnostic technique utilised. Positron emission tomography-computed tomography has proved to be very useful in identifying areas of local, regional and distant metastasis in head and neck cancer. The negative predictive value of PET-CT has been reported to be especially high for local and regional

**Table 3.** Percentage of patients with occult neck disease\* according to recurrent tumour stage versus initial tumour stage, initial node stage and location of the tumour

Stage	cT <sub>1</sub> (n (%))	cT <sub>2</sub> (n (%))	cT <sub>3</sub> (n (%))	cT <sub>4</sub> (n (%))	cN <sub>0</sub> (n (%))	cN+ (n (%))	Supraglottis (n (%))	Glottis (n (%))	Total (n (%))
rT <sub>1</sub>	0/7 (0)	0/3 (0)	0/0 (0)	0/0 (0)	0/10 (0)	0/0 (0)	0/0 (0)	0/10 (0)	0/10 (0)
rT <sub>2</sub>	0/9 (0)	1/16 (6.3)	0/1 (0)	0/0 (0)	1/26 (3.8)	0/0 (0)	0/6 (0)	1/20 (5)	1/26 (3.8)
rT <sub>3</sub>	1/13 (7.7)	1/5 (20)	1/17 (5.8)	0/0 (0)	3/30 (10)	0/5 (0)	1/16 (6.3)	2/18 (11.1)	3/35 (8.6)
rT <sub>4</sub>	1/4 (25)	3/9 (33)	3/7 (42.9)	0/1 (0)	7/19 (36.8)	0/2 (0)	1/4 (25)	5/11 (45.4)	7/21 (33.3)
Total	2/33 (6.4)	5/33 (15.2)	4/25 (16)	0/1 (0)	11/85 (12.9)	0/7 (0)	2/26 (7.7)	8/59 (13.6)	11/92 (11.9)

\*Defined as rN<sub>0</sub>-ypN+ or rN<sub>0</sub> regional recurrence within one year of surgery

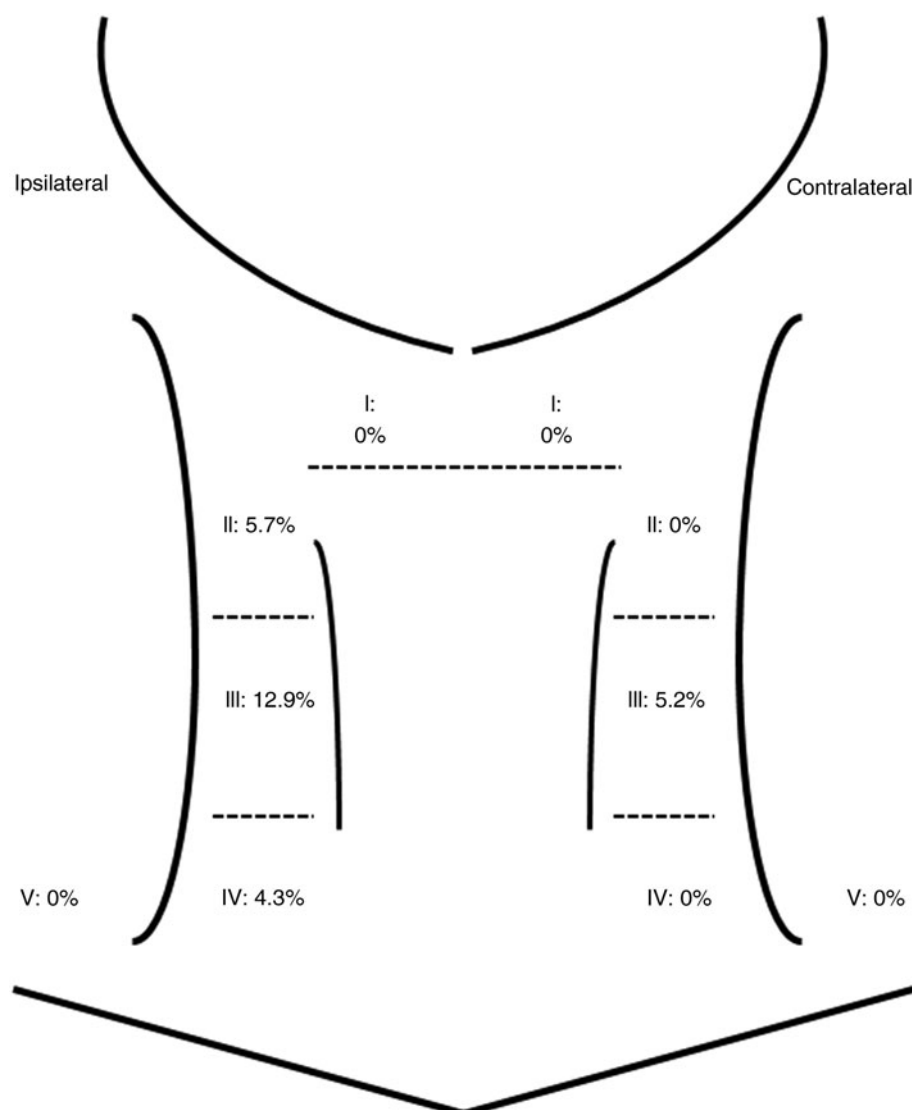
**Table 4.** Risk of occult neck disease\*

Factor	Relative risk (95 per cent CI)	P-value <sup>†</sup>
cT <sub>1</sub> vs T <sub>2-4</sub>	1.11 (0.96-1.27)	0.31
rT <sub>1-3</sub> vs rT <sub>4</sub>	2.27 (1.03-5)	<0.001
Location (supraglottis vs glottis)	1.07 (0.92-1.24)	0.72
DFI (<6 months vs ≥6 months)	1.43 (0.39-5.27)	0.72

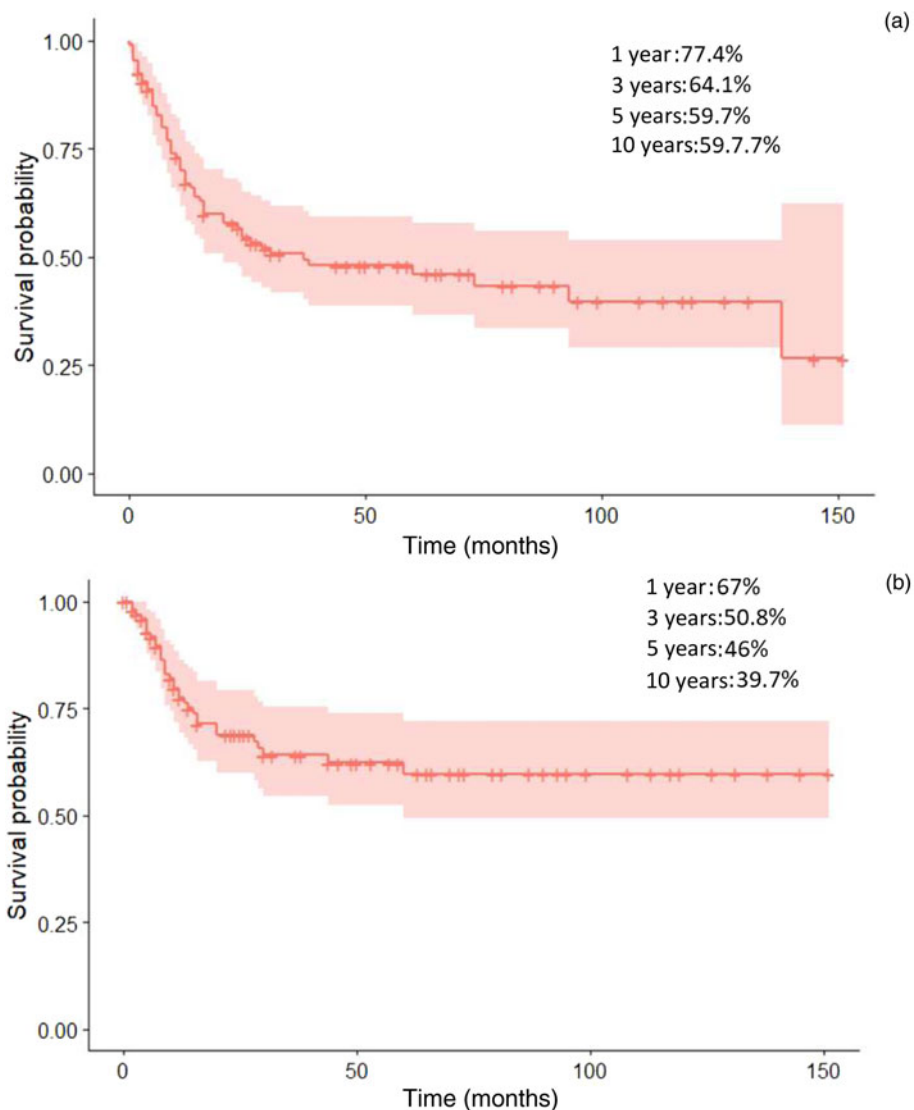
\*Defined as rN<sub>0</sub>-ypN+ or rN<sub>0</sub> regional recurrence within one year of surgery; <sup>†</sup>Fisher's exact test. CI = confidence interval; DFI = disease-free interval

recurrence after head and neck SCC treated with radiotherapy or chemoradiotherapy, with values between 93–95 per cent and 94–100 per cent, respectively.<sup>18</sup> In our cohort, the negative predictive value was 94.8 per cent, showing once again the usefulness of PET-CT in avoiding unnecessary neck dissection.

One of the first reports promoting the need for elective neck dissection was published in 1995 by Yuen *et al.*<sup>19</sup> with 126 crN<sub>0</sub> patients treated conservatively with a regional recurrence rate of 18 per cent. On further analysis, 93 patients (73.8 per cent) were classified as T<sub>4</sub>, increasing the risk of occult neck disease as demonstrated in our series. The largest series advocating the need for elective neck dissection was reported



**Fig. 1.** Lymph node distribution pattern across the different neck levels during salvage total laryngectomy for recurrent squamous cell carcinoma. The (patient's) right side represents the ipsilateral, and the (patient's) left side represents the contralateral.



**Fig. 2.** (a) Overall survival and (b) disease-specific survival.

by Birkeland *et al.* in 2016<sup>20</sup> with 203 recurrent or residual locally advanced laryngeal SCC cases classified as crN<sub>0</sub> by CT scan. A total of 406 elective neck dissections were performed with a 17 per cent risk of occult neck disease being more prevalent in T<sub>4</sub> (34 per cent) and supraglottic tumours (28 per cent). By performing bilateral neck dissection for every patient independently of the staging, this study avoids selection bias; however, re-staging prior to salvage surgery was performed with PET scan in only 21 per cent of the patients, missing the potential benefit of PET.

Other published series have advocated avoiding neck dissection. The series with the largest number of patients included 125 salvage total laryngectomy procedures with 98

patients undergoing neck dissection.<sup>21</sup> Although incurring a potential selection bias, especially because there is no report of the proportion of patients with node positive disease at the time of initial diagnosis, the authors concluded that according to the lack of benefit of elective neck dissection in disease-specific survival and overall survival, elective neck dissection is not recommended. A previous report in 2014 (with 52 elective neck dissections performed on 28 crN<sub>0</sub> patients) from one of the hospitals participating in this study showed that the risk of occult neck disease was 6.3 per cent.<sup>17</sup>

- Controversy exists regarding the management of the N<sub>0</sub> neck during salvage laryngectomy
- The rate of occult neck disease in recurrent laryngeal cancer is related to primary tumour staging
- Contemporary pre-operative tests have high accuracy in detecting neck nodes
- No obvious survival benefit is related to prophylactic neck dissection during salvage surgery
- Larger studies are required to better understand the indication of prophylactic neck dissection during salvage laryngectomy

**Table 5.** Clavien–Dindo complications classification distribution

Clavien–Dindo grade	Value (n (%))
0	43 (50)
1	8 (9.3)
2	12 (14)
3	19 (22.1)
4	2 (2.3)
5	2 (2.3)

**Lymph node distribution, neck dissection and survival**

The rate of occult neck disease is the most relevant variable for the indication of performing elective neck dissection.

**Table 6.** Relation between length of stay and neck dissection, recurrent tumour stage, disease-free interval and reconstruction

Parameter	Length of stay (days)	P-value*
No elective neck dissection		0.36
- Total (n)	29	
- Median (IQR range)	20 (15-37)	
Elective neck dissection		
- Total (n)	55	
- Median (IQR range)	26 (18-38)	
Recurrent T-stage		0.18
- rT <sub>1</sub> -T <sub>3</sub> (total n)	65	
- rT <sub>1</sub> -T <sub>3</sub> (median (IQR range))	22 (16-33)	
- rT <sub>4</sub> (total n)	19	
- rT <sub>4</sub> (median (IQR range))	31 (24-37)	
Disease-free interval		0.84
- <6 months (total n)	20	
- <6 months (median (IQR range))	116.5 (87.3-160.8)	
- ≥6 months (total n)	64	
- ≥6 months (median (IQR range))	111.4 (78.0-164.5)	
Reconstruction		0.87
- No (total n)	51	
- No (median (IQR range))	28 (18-32)	
- Yes (total n)	33	
- Yes (median (IQR range))	21 (16-44)	

\*Log-rank test. IQR = interquartile range

Accordingly, many authors have tried to identify the occult neck disease rate in the locally advanced SCC recurrence or persistence groups as summarised in the previous paragraphs. The next step should be, in accordance with how we do selective neck dissection in primary surgery according to primary tumour site, to be able to identify risk of metastasis in different neck levels in case of recurrence or persistence in order to tailor the surgery accordingly. To date, the only large series reporting the risk of occult neck disease in a specific neck level according to primary tumour location (but not recurrent stage)<sup>20</sup> showed that the risk of occult neck disease at levels I, IV and V for supraglottic SCC and all levels for glottic SCC (except level VI) was less than 10 per cent, whereas the risk of occult neck disease at levels II, III and VI for supraglottic SCC is more than 10 per cent even on the contralateral side. Hogg *et al.*<sup>22</sup> reported a 2 per cent risk of contralateral neck disease during salvage total laryngectomy, and therefore recommended avoiding contralateral elective neck dissection during salvage total laryngectomy. In our series, no patient had involvement of levels I or V, and only one patient with a lateralised tumour had contralateral neck disease.

No study performed to date has demonstrated a survival benefit when performing elective neck dissection during salvage total laryngectomy, with the same conclusion taken from our results. The only benefit attributed to elective neck dissection is a better understanding of the prognosis by confirming the pathological nodal status. Freiser *et al.* showed significant differences in terms of overall survival and disease-free survival between ypN<sub>0</sub> and ypN+ patients.<sup>21</sup>

### Survival outcomes and complications

Salvage total laryngectomy has demonstrated promising survival rates with 5-year overall survival rates ranging from 30-70 per cent depending on staging.<sup>4</sup> However, overall complication rates after salvage total laryngectomy in the literature range from 5 to 78 per cent with the most common complication being pharyngocutaneous fistula formation occurring in as many as 73 per cent of cases in salvage total laryngectomy.<sup>4</sup> For this reason, the identification of risk factors for complications that can be modified is crucial in order to decrease the risk of post-operative complications. In 2019, Lin *et al.* performed a systematic review analysing the role of elective neck dissection during salvage total laryngectomy.<sup>11</sup> Data were available for 370 patients in 5 out of 19 studies for neck dissection and associated complications. Overall, 51 per cent of patients who underwent elective neck dissection and 34 per cent who were observed suffered complications with a pooled relative risk of post-operative complications with elective neck dissection compared with observation of 1.72 ( $p = 0.07$ ; 95 per cent confidence interval = 0.96-3.10). Hamoir *et al.* reported that patients undergoing salvage total laryngectomy combined with neck dissection were more at risk of developing complications than patients undergoing primary site surgery alone or neck dissection alone.<sup>23</sup> In our series, we found no significant relation between the risk of complications and elective neck dissection ( $p = 0.21$ ).

The importance of accurately collecting post-operative complications data using a widely accepted classification system was highlighted for head and neck surgery.<sup>24</sup> Depending on the definition of a complication, a single institution can significantly modify its reported complication rates. Veen *et al.*<sup>25</sup> were able to demonstrate a dramatic increase in the total number of registered complications simply by varying small aspects of their definition midway through the same study. There is fear in the surgical community that a high complication rate equates to substandard care. As a result, incentives to document complications properly remain ambiguous. Without clear incentives, the healthcare system as a whole may be denied much needed opportunities for improvement. In order to decrease the impact of inaccurate post-operative complications documentation, we also analysed the length of stay. Although other confounders, such as social issues, can affect the results, it is expected that patients with complications are more likely to suffer longer in-patient stays. However, no differences were found between patients with or without elective neck dissection and their length of stay ( $p = 0.36$ ). It is worth mentioning that because of the high rate of complications repeatedly reported to be associated with salvage total laryngectomy, such surgical procedures should only be performed by experienced teams in order to increase experience and scientific evidence that will help to better tailor the management of this complex cohort of patients.

### Limitations

This study had limitations. First, it is a non-randomised, retrospective cohort study. Potential confounding variables and unmeasured factors, such as differences in baseline co-morbidities between patients undergoing elective neck dissection or not, may not have been identified. No randomised, controlled trial assessing the role of elective neck dissection in recurrent crN<sub>0</sub> locally advanced laryngeal SCC has been performed because of ethical reasons. However, multiple studies have

analysed it on a retrospective basis. This carries an inevitable selection bias that neck dissection is more commonly performed on advanced cases and less on early stages, with a potential effect on the final rate of occult neck disease and overall survival. Second, the inter-observer variation in detection and interpretation of cervical lymph nodes in pre-operative imaging has been minimised by including equivocal reports as positive when assessing diagnostic test accuracy. Finally, the inconsistent surgical management, starting with bilateral elective neck dissection for every patient and then moving to decisions on an individual basis (although inevitable because of the long period of data collection and the availability of new evidence) can translate into a selection bias as previously explained.

### Value of the study

This is one of the largest cohorts of salvage total laryngectomy ever analysed in a multicentre study with a very long follow up. Given these results, elective neck dissection may be unnecessary in the clinically and radiologically negative lateral neck during locally advanced laryngeal SCC salvage total laryngectomy because, when using PET-CT, the risk of occult neck disease is very low, especially in  $rT_1$ – $T_3$  disease. Furthermore, elective neck dissection does not seem to translate to any survival benefit.

### Conclusion

There is still controversy regarding the impact of neck dissection on the rate of post-operative complications after salvage total laryngectomy. However, according to the low risk of occult neck disease when using contemporary imaging techniques for the evaluation of recurrence or persistence of locally advanced laryngeal SCC (especially in early stages) as well as the lack of impact on survival, conservative management of the neck should be considered for  $crT_1$ – $T_3$   $N_0$  recurrence.

**Competing interests.** None declared

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