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ORIGINAL SCIENTIFIC REPORT

Relevance of Level IIb Neck Dissection in Patients with Head and Neck Squamous Cell Carcinomas

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Abstract

Background Cervical nodal metastasis is the most important prognostic factor in patients with head and neck cancers. Unfortunately, nodal dissection at level IIb carries a risk of damage to the spinal accessory nerve. We aimed to determine the prevalence of level IIb metastasis and the relevance of nodal dissection at level IIb in patients with head and neck squamous cell carcinomas.

Methods During neck dissection, level IIb lymph nodes obtained from 181 patients with head and neck squamous cell carcinomas were removed, processed, and histopathologically examined. All specimens were divided into two groups according to the side (affected and unaffected sides). The number of dissected lymph nodes and prevalence of level IIb metastasis in each group were then determined and compared according to the preoperative clinical N stage (cN0 and cN+).

Results The study included 158 men and 23 women with a median age of 65 years (range, 17–89 years). The prevalence of pathologically confirmed level IIb metastasis was 0% for clinically node-negative (cN0) necks on the unaffected side and 10.34% for clinically node-positive necks (cN+), with an overall prevalence of 2.4%. There was a significant association between clinically determined and pathologically confirmed node negativity at level IIb.

Conclusion Our findings suggest that level IIb neck dissection in patients with head and neck squamous cell carcinomas may be required only if preoperative examination reveals multilevel or level IIa metastasis or suspicious level IIb metastasis.

Introduction

The presence of cervical nodal metastasis is the most important prognostic factor in the management of head and neck squamous cell carcinomas (HNSCCs). Once the tumor involves the cervical nodes, the chances of survival drop by almost 50% [1]. Level II lymph nodes are high-risk nodes in cases of malignancies involving the oral cavity, oropharynx, nasopharynx, hypopharynx, and supraglottic larynx. This level is subdivided into levels IIa and IIb by the spinal accessory nerve [2]. Level IIa nodes are located anteromedial to the nerve, whereas level IIb nodes lie posterolaterally. In cases of HNSCCs with clinically node-negative (cN0) necks, standard selective neck dissection

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with preservation of the spinal accessory nerve is performed in order to remove level IIa and IIb lymph nodes [3, 4]. Level IIb dissection is, however, technically difficult due to the close proximity of important structures such as the spinal accessory nerve, internal jugular vein, internal carotid artery, and occipital artery. Nerve traction during surgery is the most common cause of injury to the spinal accessory nerve, which subsequently results in shoulder pain and functional impairment following surgery; however, metastatic changes at level IIb are rarely observed in patients with cN0 necks [5, 6].

The aim of this retrospective study was to determine whether level IIb neck dissection should be performed or avoided during the surgical treatment of HNSCCs.

Materials and methods

Patients

Patients with pathologically confirmed primary HNSCCs who underwent surgical treatment for the primary lesion and therapeutic neck dissection at our institution between 2014 and 2018 were considered eligible for this study. Factors that potentially affect lymph node metastasis, such as the clinical TN classification, clinical stage, level of lymph node involvement in pathological analysis, age, sex, primary tumor site, smoking history, alcohol use, performance status, and surgical procedure, were investigated. Patients with M positivity as per radiographic examinations were excluded. We defined unresectable cases as those with tumor infiltration to the vertebral bone or around the internal carotid artery along with metastatic tumors.

Evaluation of lymph node metastasis and level IIb involvement

For all patients, enhanced neck computed tomography scans were preoperatively evaluated for neck staging (clinically N+ or N0). Contralateral neck dissections were performed for all clinical stage IV carcinomas showing involvement of the medial line of the primary site with ipsilateral palpable metastases and radiologically suspected contralateral metastases. Following resection, the neck dissection specimens were separately stored according to the neck level (particularly, level IIa and IIb specimens were separately stored) and sent for histopathological analysis in order to determine the number and location of nodes containing metastatic disease at levels I, IIa and IIb, III, IV, and V. The preoperative clinical T and N stages determined according to the Union for International Cancer Control (UICC) system were confirmed after dissection by evaluation of the pathological reports. All specimens were divided into two groups according to the side (affected and unaffected sides). The number of dissected lymph nodes and prevalence of level IIb metastasis in each group were then determined and compared according to the preoperative clinical N stage (cN0 and cN+).

Statistical analysis

Fisher's exact test was used to assess intergroup comparisons of the different outcome measures. All statistical analyses were performed using Stata Software, version 12 (Stata Corp., College Station, TX, USA). A P value of ≤ 0.05 was considered statistically significant.

Results

Patients

Between 2014 and 2018, 181 patients underwent surgical treatment for the primary lesion and therapeutic neck dissection at our institution. Neck dissection was bilateral in 124 patients (68.5%) and unilateral in 57 (31.5%). There were 158 (87.3%) men and 23 (12.7%) women with a median age of 65 years (range, 17–89 years). The primary tumor sites were as follows: oropharynx, 26 (14.4%); hypopharynx, 72 (39.8%); larynx, 35 (19.3%); and oral cavity, including the tongue, 35 (19.3%). Table 1 describes the demographic and clinical characteristics of the patients according to the treatment (surgical treatment alone or surgical treatment followed by chemoradiotherapy/radiotherapy).

Preoperative TN classification and clinical stage (Table 2)

Preoperative staging was performed by chest radiography, computed tomography, and magnetic resonance imaging of the head and neck. At initial presentation, the primary tumors were classified as per the UICC staging system as follows: T1 (n = 15; 8.3%), T2 (n = 50; 27.6%), T3 (n = 40; 22.1%), and T4 (n = 76; 42.0%). Table 2 also describes the clinical N stage for all patients according to the treatment. Two (1.1%), 14 (7.7%), 39 (21.5%), and 126 (69.7%) patients exhibited stage I, stage II, stage III, and stage IV disease, respectively. None of the patients exhibited distant metastases.

Pathologically confirmed levels of lymph node involvement

For the affected side group (n = 181), pathological analysis revealed the involvement of levels I, IIa, IIb, III, IV, and V

Table 1 Demographic and clinical characteristics of patients suffering from head and neck squamous cell carcinomas who received surgical treatment which included therapeutic neck dissection

	Surgery alone (n = 99)	Surgery + postoperative CRT/RT (n = 82)	Total (n = 181)	P value
Sex				0.071
Female	17	6	23 (12.7%)	
Male	82	76	158 (87.3%)	
Age (years old)	37–87 (median = 65)	17–89 (median = 61)	17–89 (median = 65)	0.085
<60	17	24	41 (22.7%)	
60–69	40	34	74 (40.9%)	
>70	42	24	66 (36.4%)	
Primary site				0.402
Oropharynx	11	15	26 (14.4%)	
Hypopharynx	40	32	72 (39.8%)	
Larynx	18	17	35 (19.3%)	
Oral, tongue	30	18	48 (26.5%)	
Performance status				1.000
0	98	81	179 (98.9%)	
1	1	1	2 (1.1%)	
History of cancer				0.06
No	84	77	161 (89.0%)	
Yes	15	5	20 (11.0%)	
Smoking history				0.227
No	19	10	29 (16.0%)	
Yes	79	73	152 (84.0%)	
Drinking history				0.106
Yes	20	9	29 (16.0%)	
No	79	73	152 (84.0%)	

CRT chemoradiotherapy, *RT* radiotherapy

in 19 (10.5%), 95 (52.5%), 10 (5.5%), 57 (31.5%), 20 (11.0%), and four (2.2%) cases, respectively. In the unaffected side group (n = 124), levels I, IIa, IIb, III, IV, and V showed involvement in two (1.6%), 24 (19.4%), three (2.4%), 14 (11.3%), five (4.0%) and one (0.8%) case, respectively (Table 3).

Table 4 details the true-positive, false-negative, true-negative, and false-positive rates that were determined using pathological analysis following neck dissection. Among the 181 neck dissections on the affected side, 10 cases (7.04%) of clinical level IIb node positivity exhibited pathological node positivity. Among the 124 neck dissections on the unaffected side, three (10.34%) cases of clinical level IIb node positivity and none of the cases (0%) with clinical node negativity showed pathologically positive nodes. Regardless of the side, there was a statistically significant association between clinically determined and pathologically confirmed negativity at level IIb ($P < 0.001$). Over a median follow-up of 23.8 months, none of the patients exhibited regional failure at level IIb.

Complications of level IIb dissection

In total, 140 (77.3%) patients developed shoulder abduction disorder and mitral muscle weakness following level IIb neck dissection. These patients received postoperative rehabilitation involving shoulder joint range of motion (ROM) exercises, pulley exercises, muscle strengthening exercises, and neck stretches. In the affected side group (n = 181), 32 (23.0%), 76 (54.0%), 21 (15.0%), and 11 (8.0%) patients exhibited complete recovery, good recovery, fair recovery, and no change or deterioration, respectively, at 12 months after surgery.

Discussion

In the present study, we investigated a heterogeneous group of patients with cancers of the hypopharynx (n = 72), larynx (n = 35), oral cavity (including tongue; n = 35), and oropharynx (n = 26). Although lymphatic drainage can follow high-frequency patterns, its direction is variable,

Table 2 Clinical stage and TN classification of head and neck squamous cell carcinomas treated surgically with therapeutic neck dissection

	Surgery alone (n = 99)	Surgery + postoperative CRT/RT (n = 82)	Total (n = 181)	P value
T classification				0.147
cT1	6	9	15 (8.3%)	
cT2	34	16	50 (27.6%)	
cT3	20	20	40 (22.1%)	
cT4	39	37	76 (42.0%)	
N classification				0.002
cN0	29	9	38 (21.0%)	
cN1	28	17	45 (24.9%)	
cN2a	4	2	6 (3.3%)	
cN2b	28	34	62 (34.3%)	
cN2c	10	17	27 (14.9%)	
cN3	0	3	3 (1.6%)	
Clinical stage				<0.001
I	2	0	2 (1.1%)	
II	9	5	14 (7.7%)	
III	18	21	39 (21.5%)	
IV	78	48	126 (69.7%)	

CRT chemoradiotherapy, *RT* radiotherapy

Table 3 Pathological involvement of each dissected level or sublevel in patients with head and neck squamous cell carcinomas treated surgically with therapeutic neck dissection

	pN0	pN+
Affected side (n = 181)		
Level I	162 (89.50%)	19 (10.50%)
Level IIa	86 (47.51%)	95 (52.49%)
Level IIb	171 (94.48%)	10 (5.52%)
Level III	124 (68.51%)	57 (31.49%)
Level IV	161 (88.95%)	20 (11.05%)
Level V	177 (97.79%)	4 (2.21%)
Unaffected side (n = 124)		
Level I	122 (98.39%)	2 (1.61%)
Level IIa	121 (97.58%)	3 (2.42%)
Level IIb	10 (37.04%)	17 (62.96%)
Level III	110 (88.71%)	14 (11.29%)
Level IV	119 (95.97%)	5 (4.03%)
Level V	123 (99.19%)	1 (0.81%)

with intermittent drainage to unexpected locations. Unusual drainage patterns, particularly drainage to the contralateral side of the neck, should always be investigated because they are likely to represent a direct drainage path from the tumor. With regard to the applicability of level IIb neck dissection, all patients in the present study exhibited

Table 4 Diagnostic accuracy (confirmed by pathology) following neck dissection in patients with head and neck squamous cell carcinomas

	Pathological diagnosis		P value
	Negative	Positive	
Affected side (n = 181)			
Level I–V			0.122
cN0 neck dissection	29 (74.36%)	10 (25.64%)	
cN+ neck dissection	30 (21.13%)	112 (78.87%)	
Level IIb			<0.001
cN0 neck dissection	39 (100.0%)	0 (0.00%)	
cN+ neck dissection	132 (92.96%)	10 (7.04%)	
Unaffected side (n = 124)			
Level I–V			0.012
cN0 neck dissection	83 (87.37%)	12 (12.63%)	
cN+ neck dissection	11 (37.93%)	18 (62.07%)	
Level IIb			<0.001
cN0 neck dissection	95 (100.0%)	0 (0.00%)	
cN+ neck dissection	26 (89.66%)	3 (10.34%)	

metastases concentrated at levels II and III, which represent the first drainage stage for these tumors.

HNSCCs readily metastasize to adjacent cervical lymph nodes. The level IIb nodes primarily drain the skin over the head and neck region, nasal cavity, and nasopharynx and themselves drain into the jugular and spinal accessory nodes. The oral cavity, oropharynx, larynx, and hypopharynx are not drained by these nodes [7, 8]. The incidence of metastasis to the posterior cervical region in patients with HNSCCs is low, and few studies have documented the frequency of metastasis at level IIb [9]. The incidence of level IIb metastasis is extremely low, particularly in clinically and radiologically node-negative necks [10]. The removal of level IIb lymph nodes is associated with a high risk of spinal accessory nerve injury by traction, which can be inevitable, or interruption of the vascular supply. This kind of injury results in postoperative shoulder dysfunction [11–13]. Loss of function of the spinal accessory nerve and trapezius muscle leads to decreased use of the shoulder complex, which predisposes patients to fibrosis or adhesive capsulitis of the glenohumeral joint capsule. A significant element of the accessory nerve syndrome could be prevented if the postoperative cycle of disuse and fibrosis is prevented or interrupted [13]. Therefore, early-stage rehabilitation for these patients should be encouraged.

Sentinel node biopsy aims to facilitate exemplary surgical management of patients with early-stage disease, such as those with clinically N0 oral squamous cell carcinoma. It also allows individualized patient care with minimal

morbidity and is inexpensive relative to management by neck dissection [14].

In cases of therapeutic neck dissection, there is a strong association between the presence of level IIa metastasis and level IIb involvement; therefore, several studies recommend the preservation of level IIb if level IIa shows clinical node negativity [15, 16]. It is also worth considering that level IIb dissection in some patients can provide improved exposure for both elective and therapeutic neck dissections. In the present study, three (10.34%) cases of clinical level IIb node positivity and none of the cases (0%) with clinical node negativity on the unaffected side demonstrated pathologically positive nodes; these values were 7.04% and 0%, respectively, for the affected side. The differences were statistically significant, and there was no case of isolated or contralateral metastasis at level IIb. These findings are in accordance with those of other studies [5, 6, 12, 17–19].

The retrospective design of this study represented a major limitation as it resulted in certain inconsistencies. For example, there is inherent heterogeneity among the studies included. The inclusion and exclusion criteria, specimen processing methods, and techniques for metastasis detection were variable. Moreover, the sample size was small. Further prospective, controlled studies with larger sample sizes are required to assess the correlation between clinically determined and pathologically confirmed level IIb positivity.

Conclusion

The findings of the present study suggest that the incidence of level IIb lymph node involvement in clinically node-negative necks is low. Thus, level IIb removal can be avoided during neck dissections in patients with HNSCCs and a preoperative cN0 status in order to avoid additional morbidity. It should be noted, however, that therapeutic neck dissection should always include the removal of level IIb if the patient demonstrates clinically positive nodes at level IIa before surgery or in frozen section analysis during surgery.

Author contributions SH takes responsibility for the integrity of the content of the manuscript; GT and JO have full access to all data in the study; and SH and HM are responsible for the decision to submit for publication. AI, DM, RI, YT, TY, KM, and HM were involved in data collection and analysis. SH and HM were involved in writing the manuscript.

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Compliance with ethical standards

Conflict of interest The authors have no conflict of interest to declare.

Ethical approval This was a retrospective observational study, and the study design was approved by the medical ethics committee of Hamamatsu University Hospital (Protocol No. 16-167).

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