Original article:

Neck dissection for head and neck malignancies: A Malaysian 13 years review

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Abstract

Introduction and Objective: Neck dissection (ND) is a surgical procedure performed in treating head and neck cancer patients with cervical neck metastasis. The aim of neck dissection is to achieveloco-regional control thus optimizing the cancer's cure rate. Various complications may potentially occur following this surgery. The main objective of this study is to evaluate the incidence of complications following neck dissection. ***Materials & Methods****:* This is a 13 years retrospective descriptive case notes analysis conducted in UKMMC (University Kebangsaan Malaysia Medical Centre), a tertiary centre in Malaysia. Neck dissection surgeries that were performed between January 2000tillDecember 2012 were recruited for data analyses. ***Results:*** A total of 233 neck dissections were performed in our centre over 13 years period from January 2000 until December 2012. Of these, 27 cases were excluded due to unavailability of data and therefore a total of 206 cases were recruited for data analyses.The types of neck dissection performed include Extended Radical ND (n=7), Radical ND (n=40), Modified Radical ND (n=88) and Selective ND (n=71). Majority of neck dissection was performed for malignant oral cavity tumours (47.1%). Out of 206 cases, 57 (27.7%) developed wound complications, 48 (23.3%) cases had nerve complications with marginal mandibular nerve was most commonly injured (13%) and 20 (9.7%) cases had vascular and lymphatic complications mainly involving the thoracic duct (5.3%). The incidence of residual or recurrent neck disease was observed in 41 cases (20%). Pre-operative clinical assesment of cervical neck node metastatic status has a high sensivity of 89.7% but low specificity of 47.5%. ***Conclusion:*** Various complications may potentially occur following neck dissection. Awareness of these possible complications could minimize the incidence of complication following this surgery. This current study observed a strong association between the type of neck dissection performed with the incidence of wound, nerve and vascularcomplications following neck dissection surgery.

Keywords: Complications; Neck Dissection; Head and Neck Neoplasms

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Introduction: Neck dissection (ND) is a surgical procedure performed in treating head and neck cancer patients with or without cervical nodal neck metastasis. The main aim of the surgery is to achieveloco-regional control of the head and neck malignant tumours thus optimizing the prognosis and the cancer's cure rate. Neck dissection surgery involves removal of all or groups of lymph nodes and

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fibro-fatty tissues from specific area of the neck with or without removal of non-lymphatic structures such as the sternocleidomastoid muscle (SCM), internal jugular vein (IJV) and spinal accessory nerve (SAN). Various types of neck dissection surgeries are commonly performed worldwide which include extended Radical Neck Dissection (eRND), Radical Neck Dissection (RND), Modified Radical Neck Dissection (MRND) and Selective Neck Dissection (SND)[1]

Various complications may potentially occur following this surgery including wound, nerve and vascular complications due to the delicate and complex anatomical structures of the neck region. Previous studies done have documented the complication rate following neck dissection surgery to range between 5% - 15%[2]. Although neck dissection is a common surgery performed by any otorhinolaryngologists or head and neck surgeons in Malaysia,there is no available local study that comprehensively review and analyse the complications of this surgery. A great amount of lessons could be learnt from this study that will subsequently open a window of opportunity for quality improvement in the surgical practice to avoid potential complications thus reducing morbidity and mortality rate among our patients who had underwent this surgery.

Materials and Methods

All patients with head and neck malignancies who underwent any type of neck dissection surgery performed by our Otorhinolaryngology -Head and Neck Surgical (ORL-HNS) team in UKMMC (a tertiary centre)within the period of 13 years from 1st January 2000 until 31st December 2012 were included in this study. The patients' individual case notes were reviewed retrospectively and analysed. Data collection were performed from June 2013 until June 2014 upon approval by the local ethics committee.

Each neck dissection surgery is considered as one sample for this study. Demographic data of the patients, type of neck dissection, primary tumours for which neck dissection surgeries were performed and complications following neck dissection surgeries were recorded. Complications of neck dissection surgery that were analysed in this study include wound, nerve and vascular complications. Additionally, the rate and survival analysis of cases with residual and recurrence neck diseases were studied. The sensitivity and specificity of pre-operative clinical staging of the neck node were also analysed. Residual and recurrence neck diseases is defined as the re-occurrence of cervical neck metastatic lymphadenopathy within the first 6 months or after 6 months respectively following neck dissection surgery. Immediate onset complication is defined as complications that occur within the first 24 hours period following the surgery. Earlyonset complication is defined as complications that occur or detected beyond 24 hours until day 7 of post-operative period and late-onset complication is defined as complications that occur or detected after day 7 of post-operative period. All data were computed and analysed using SPSS version 21.0 for Windows. Chi-square test and Kaplan-Meier survival rate analysis were performed in this study. A p-value of $p<0.05$ is considered statistically significant in this study.

Results

Demographics

A total of 233 neck dissection surgeries were performed in our centre over the13 years period from January 2000 until December 2012. However, only 206 cases were available for data collection and analysis. The remainder 27 (11.6%) cases were unavailable and therefore, have been excluded from this study. A total of 138 (67%) of neck dissection were performed for male patients and 68 (33%) for female patients. The age of our study population ranged between 20 till 84 years old with mean age of 55.97±28.03 years old. Majority of neck dissection surgeries were performed in Chinese patients (48.5%) followed by Malay (35.4%), Indian (12.1%) and other ethnicities (3.9%). Neck dissection performed on the right side of the neck accounts for 51.5% (n=106) and 48.5% (n=100) for the left side.

Table 1 shows the type of neck dissection surgeries performed in our centre during the study period. MRND comprised the majority of our neck dissection (42.7%) followed by SND (34.5%), RND (19.4%) and Extended RND (3.4%). Type 3MRND (n=33) comprised the majority of MRND sub-types followed by MRND Type 1, MRND Type 2, MRND with IJV preservation, MRND with SCM preservation and MRND with SCM and IJV preservation. Supraomohyoid SND were performed in majority of our patients which comprised of 24.7% (n=51) of the cases followed by lateral SND and posterolateral SND.

Malignant tumours of the oral cavity were the commonest primary site of head and neck malignant tumour for which neck dissection surgeries were performed. This comprised of 47.1% (n=97)followed by malignant tumours of the larynx (17%) and

oropharynx (7.8%). Other malignant tumours include tumours of nasopharynx, hypopharynx, parotid gland, sinonasal, submandibular gland, thyroid gland and temporal bone (Table 2). Additionally, neck dissections were performed in 1.9% (n=4) of occult primary with cervical neck lymphadenopathy.

Table 1: Type of Neck Dissection Surgeries Performed

		No.(n)	Percentage (%)
NECK DISSECTION TYPE	Extended Radical Neck Dissection	7	3.4
	Radical Neck Dissection	40	19.4
	Modified Radical Neck Dissection -Type 1 (23) -Type 2 (22) -Type 3 (33) - with IJV preservation (6) - with SCM preservation (2) - with SCM & IJV preservation (2)	88	42.7
	Selective Neck Dissection -Supraomohyoid SND (51) -Lateral SND (18) -Posterolateral SND (2)	71	34.5
	Total	**206**	**100.0**

Table 2: Site of Primary Tumours

		No (n)	Percentage(%)
SITE OF PRIMARY TUMOUR	Oral Cavity	97	47.1
	Larynx	35	17.0
	Oropharynx	16	7.8
	Nasopharynx	14	6.8
	Hypopharynx	10	4.9
	Parotid	10	4.9
	Sinonasal	6	2.9
	Thyroid	4	1.9
	Occult Primary	4	1.9
	Submandibular Gland	3	1.5
	Temporal Bone	2	1.0
	Others	5	2.4
Total		**206**	**100.0**

Table 3: Histopathological Diagnosis (HPE)of Primary Tumours

		No. (n)	Percentage(%)
HPE OF PRIMARY TUMOUR	Adenocarcinoma	2	1.0
	Adenoid cystic carcinoma	4	1.8
	Alveolar rhabdomyosarcoma	2	1.0
	Anaplastic carcinoma	1	0.5
	Basal cell carcinoma	1	0.5
	Carcinoma ex-pleomorphic adenoma	2	1.0
	Clear cell carcinoma	2	1.0
	Embryonal rhabdomyosarcoma	1	0.5
	Fibrosarcoma	1	0.5
	Lymphoepithelial carcinoma	1	0.5
	Mucoepidermoid carcinoma	1	0.5
	Nasopharyngeal carcinoma	13	6.3
	Papillary thyroid carcinoma	4	1.8
	SCC	165	80.1
	-Well-differentiated (98)		
	-Moderately-differentiated (40)		
	-Poorly-differentiated(13)		
	-Undifferentiated (7)		
	-Undetermined (7)		
	Sinonasal undifferentiated carcinoma (SNUC)	1	0.5
	Spindle cell sarcoma	2	1.0
	Transitional cell carcinoma	1	0.5
	Verrucuous carcinoma	2	1.0
	TOTAL	**206**	**100.0**

In our series, the majority of neck dissections were performed in advance stage 3 and stage 4 tumours which comprised of 81.5% (n=168). Elective neck dissection surgeries for N0 neck were performed in 58 of the cases (28.1%).

Squamous Cell Carcinoma (SCC) was the commonest histopathological diagnosis of malignant primary tumours in our series for which neck dissections were performed. This comprised of 165 (80.1%) of the cases. Among all SCCs, well-differentiated SCC was the commonest sub-type of SCC in head and neck malignancies in our study population (Table 3).

Wound Complications

Wound complications were observed in 57 (27.7%) of our neck dissection surgeries. The commonest wound complication observed in our study was infected neck wound with or without abscess. This was observed in 42 cases (20.4%). Wound breakdown following neck dissection was observed in 35 cases (17.0%). Of which, 11 (5.3%) of the wound breakdown was at 3-point junction. Wound breakdown in previously irradiated neck accounts for 14% (n=8) of the cases. The other wound complications observed in our study include keloidand hypertrophic scar, neck contracture, neck hematoma, neck seroma and suture granuloma (Table 4).The majority of these cases(14.1%)presented with late-onsetwound complications occurring more than 7 days of the post-operative period while 13.1% presented within the first 7 days.

We have observed a significant correlation between the type of neck dissection surgeries performed with the incidence of wound complications with p-value of $P<0.05$ tested using Chi-square test (Table 5).

Nerve Complications

Nerve complications were observed in 48 (23.3%) of our cases. The majority (50%) of the nerve injuries were only detected during the early post-operative period. 37.5% of the nerve injuries detected during the intra-operative period and only 8.3% of the injuries were detected beyond day 7 of post-operative period. Marginal mandibular (MM)

nervewas the commonest nerve injured during neck dissection which comprised of 27 (13.1%) of all cases. This was followed by great auricular nerve (2.3%) and spinal accessory nerve (1.9%) injury. Other nerve complications observed in our study include hypoglossal nerve (1.5%), lingual nerve (1.0%), mental nerve (1.0%), recurrent laryngeal nerve (1.0%), superior laryngeal nerve (0.5%), buccal nerve (0.5%) and sympathetic chain (0.5%). This is shown in Table 4.

In marginal mandibular nerve injury, 9 out of 27 cases of was detected intra-operatively andthe remainder 18 cases were only detected during the post-operative period. Most injuries that occurred intra-operatively were due to accidental injury to the nerves. In our study population, no attempt of immediate intra-operative repair of marginal mandibular nerve was performed. All patients were treated conservatively during the post-operative period.

We had observed a strong correlation between the type of neck dissection surgeries with the incidence of nerve complications based on the Chi-Square test with a p-value of $p<0.05$ as shown in Table 5.

Vascular Complications

The incidence of vascular and lymphatic complications following neck dissection was 9.7% (n=20)of the cases as shown in Table 4. The majority of vascular/lymphatic complications was left thoracic duct injury which comprised of 11 cases (5.3%). Of these, 4 thoracic duct injuries occurred following RND, and 7 occurred following MRND. Left thoracic duct injuries that were detected intra-operatively were 6 cases and the remainder 5 cases were detected during the post-operative period.

Injury to the internal jugular vein (IJV) comprised of 5 cases (2.4%). Three of these cases were detected intra-operatively and were successfully repaired. The other 2 cases had immediate neck exploration at 2 hours and 24 hours post-operatively due to rapidly enlarging neck hematoma occurring secondary to slipped right IJV ligature and right IJV injury respectively. Both vessels were repaired successfully during the neck exploration.

Internal carotid artery (ICA) injury was seen in 2 cases (1.0%). One of these patients had accidental tear of the left ICA and was repaired successfully. The other patient had injury to the right ICA and passed away on the operating table due to massive blood loss. Injury to the external carotid artery (ECA) and transverse cervical artery comprised of 0.5% of our cases. Both vessels were successfully repaired intra-operatively. We had also observed a strong association between the type of neck dissection surgeries performed and the incidence of vascular complications in our study with p-value of $p<0.05$ as shown in Table 5.

Table 4: Complications of Neck Dissection Surgery

Complications of neck dissection		No(n)	Percentage (%)
Wound complications	Infected wound only	3	1.5
	Infected wound with abscess	4	1.9
	Infected wound with abscess and wound breakdown	4	1.9
	Infected wound with abscess and wound breakdown, at 3-pt junction	1	0.5
	Infected wound without abscess with wound breakdown	20	9.7
	Infected wound without abscess with wound breakdown, at 3-pt junction	10	4.9
	Keloid / hypertrophic scar	3	1.5
	Neck contracture	4	1.9
	Neck hematoma	6	2.9
	Neck seroma	1	0.5
	Suture granuloma	1	0.5
	Total	**57**	**27.7**
Nerve complications	Buccal nerve	1	0.5
	Greater auricular nerve	5	2.3
	Hypoglossal nerve	3	1.5
	Lingual nerve	2	1.0
	Marginal mandibular nerve	27	13.1
	Mental nerve	2	1.0
	Spinal accessory nerve	4	1.9
	Superior laryngeal nerve	1	0.5
	Sympathetic chain	1	0.5
	Recurrent laryngeal nerve	2	1.0
	Total	**48**	**23.3**
Vascular complications	External carotid artery	1	0.5
	Internal carotid artery	2	1.0
	Internal jugular vein	5	2.3
	Thoracic duct	11	5.4
	Transverse cervical artery	1	0.5
	Total	**20**	**9.7**

Table 5: Relationship of Wound, Nerve and Vascular/Lymphatic Complications with Types of Neck Dissection (Chi-Square test)

	Types of Nd	Yes (n) / (%)	No (n) / (%)	X2	P-value
Wound complications	Extended rnd	4 (57.1)	3 (42.9)	**12.91**	**0.004836**
	Rnd	11 (27.5)	29 (72.5)		
	Mrnd	32 (36.3)	56 (63.6)		
	Snd	10 (14.1)	61 (85.9)		

	Types of nd	Yes (n) (%)	No (n) (%)	X2	P-value
Nerve complications	Extended rnd	6 (85.7)	1 (14.3)	**20.67**	**0.0001232**
	Rnd	13 (32.5)	27 (67.5)		
	Mrnd	19 (21.6)	69 (78.4)		
	Snd	10 (14.1)	61 (85.9)		

	Types of Nd	Yes (n)/ (%)	No (n) / (%)	X2	P-value
Vascular / lymphatic complications	Extended rnd	0 (0)	7 (100.0)	**11.95**	**0.007565**
	Rnd	8 (20.0)	32 (80.0)		
	Mrnd	11 (12.5)	77 (87.5)		
	Snd	1 (1.4)	70 (98.6)		

** significant P<0.05

Residual and Recurrent Neck Diseases

The rate of both loco-regional residual and recurrence neck diseases following neck dissection in our study population was 20% (n=41). The residual and recurrence neck diseases comprised of 9 (4.4%) cases and 32 (15.5%) cases respectively. The residual neck diseases were detected between 1 to 5 months following neck dissection surgeries with the mean onset of 2.4 months and median of 2 months. The incidence of residual neck diseases according to type of neck dissection include; 14.3% among those who underwent extended RND, 5.0% among the RND group, 5.7% among the MRND group and 1.4% among the SND group. All cases with residual neck diseases in our series were advance and high stage tumours of at least stage 4a.

A total of 32 (15.5%)cases had recurrence following neck dissection and completion of other modalities of treatment including radiotherapy and chemotherapy. The onset of recurrence neck diseases

ranged between 7 to 90 months with mean of 19.9 months and median of 11 months. According to the type of neck dissection, the incidence of recurrence neck diseases were observed in 27.5% of RND group, 14.8% from MRND group and 11.3% from SND group. The majority of the primary tumours in cases with recurrence neck diseases were malignant tumours of the oral cavity (n=12). Clinical staging of tumours for cases with recurrence neck diseases ranging between Stage 2 (n=7), Stage 3 (n=6), Stage 4a (n=17) and Stage 4b (n=2).

Although the cases who had underwent a more extensive neck dissection surgery had the highest percentage of residual and recurrence neck diseases, we did not find a significant correlation between the type of neck dissection and the incidence of residual or recurrence neck diseases in this study as p-value was p>0.05 based on the Chi-Square test.

Kaplan-Meier survival rate analysis test for cases with residual neck diseases demonstrated a mean overall survival rate of 60.8 months or 5.1 years (95% CI, 5.1 y) while cases without residual neck diseases has a mean survival of 144.24 months or 12.02 years (95% CI, 10.8 - 13.2 y) .

Cases with recurrence neck diseases had a mean survival rate of 80.94 months or 6.7 years (95% CI, 5.0 – 8.5 y) and cases without neck recurrence had a mean survival rate of 149.89 months or 12.5 years (95% CI, 11.3 – 13.7 y). (Figure 1 &2).

All of our patients have minimum follow-up duration of 6 months.The mean follow up period in our study population was 44.1 months (3.7 years). All patients without residual or recurrence neck diseases were presumed disease free. The survival rate in cases without any residual or recurrence neck diseases was almost 90% up to 5 years of follow-up period.

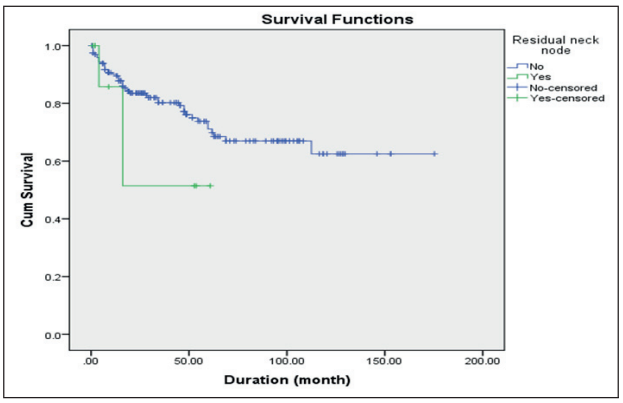

Figure 1: Compare mean duration outcome by Residual neck node (Kaplan-Meier)

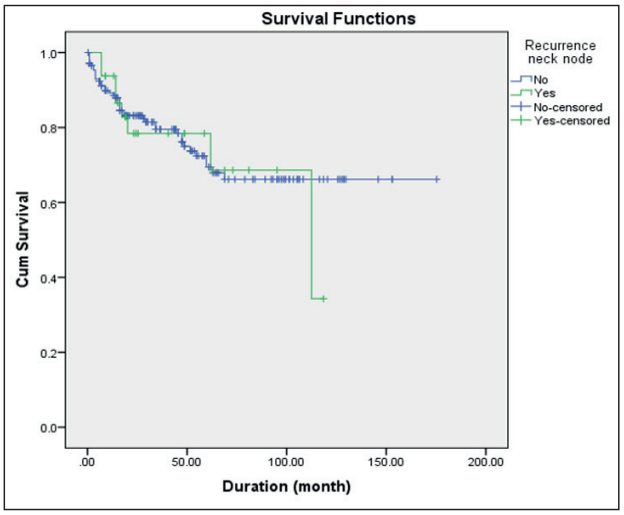

Figure 2:Compare mean duration outcome by Recurrence neck node (Kaplan-Meier)

Elective Neck Dissection and Diagnostic Accuracy of Pre-operative Clinical Staging of Neck Nodal Status

Elective neck dissection were performed in 58 cases (28.1%) ofclinically impalpable cervical neck lymphadenopathy (N0 neck). These elective neck dissection surgeries for N0 neck were performed prophylactically for tumours with high probability for occult nodal-metastasis especially for high grade tumours, advanced stage tumours and tumours originating at sites with rich lymphatic drainage system. The elective neck dissections for N0 neck were performed for malignant tumours of the oral cavity (n=38), oropharynx (n=4), hypopharynx (n=2), larynx (n=10), sinonasal (n=1) and other malignancies (n=1). Out of the 58 cases, 11 (19.0%) were found positive for occult nodal metastasis while 47 (81.0%) of the specimens were negative. Of the 11 positive specimens for occult nodal metastasis, 9 cases of neck dissections were for malignant tumours of the oral cavity. The remaining 2 positive specimens were for malignant tumours of the larynx. Histopathological diagnosis of all positive specimens were squamous cell carcinoma (SCC).

The pre-operative clinical assessment of the cervical neck node staging was similar to post-operative histopathological staging in 143 cases (69.4%). 11 cases (5.3%) were up-staged from clinically N0 neck (cN0) to pathologically positive N+ (pN+) neck. In addition, 52 cases (25.2%) were down-staged from clinically N+ (cN+) neck to pathologically negative N0 (pN0) neck. We have observed that pre-operative clinical staging of neck node status by clinical palpation has a high sensitivity of 89.7% but low specificity of 47.5%. The positive predictive value

(PPV) was estimated at 64.9% whereas negative predictive value (NPV) was 81.0%. The positive and negative likelihood ratioof pre-operative clinical staging in our study were 1.71 and 0.22 respectively. (Table 6)

Table 6: Diagnostic Accuracy of Pre-operative Clinical Staging of Metastatic Status of Cervical Neck Nodes

	HPE Positive Neck	HPE Negative Neck	Total
Clinically Positive Neck	96	52	148
Clinically Negative Neck	11	47	58
Total	107	99	206

Sensitivity: 96/ (96+11) = 89.7%
Specificity: 47/ (52+47) = 47.5%
Positive Predictive Value: 96/ (96+52) = 64.9%
Negative Predictive Value: 47/ (11+47) = 81.0%
Positive Likelihood Ratio: (96/107)/ (52/99) = 1.71
Negative Likelihood Ration: (11/107) / (47/99) = 0.22

Discussion: Neck dissection is a common procedure performed by almost all otorhinolaryngologists and head and neck surgeons, yet various complications may still occur due to the complex and delicate anatomical structures in the neck region. Although the potential complications from this surgery are well documented, there are no local data in our country that comprehensively document and analyse the complications following this surgery in our setting.

The mean age of our study population was 55.97 years old which was comparable with other studies who reported mean age of 45 – 56 years old[3]. Indications for specific type of neck dissection depend on the neck nodal staging (N) at the time of diagnosis. In our centre, at least a MRND surgery is performed for cases with clinically palpable cervical neck node. The decision for RND or extended RND were decided pre-operatively or intra-operatively based on the extension of the neck diseases as noted from imaging studies or during the surgery. SND is performed in selected cases with curative intent for tumours with minimal neck diseases or in clinically impalpable neck node but with primary tumour known to have high risk for occult nodal metastasis. Additionally, it is also performed for primary tumours that have crossed the midline even without clinically evident neck node or when contralateral disease is suspected[3].

The wound complication rate in our study was 27.7%. The majority of wound complications were wound infection. Infected wound was the leading cause to other complications such as abscess formation and wound breakdown. As many as 11 (5.3%) cases of wound breakdown occurred at the 3-point junction of the extended limb created during neck dissection for clearance of posterior and lower level of cervical neck lymph nodes. This is a crucial area for wound breakdown hence necessitating the need for meticulous wound closure technique and good hemostasis at this area to prevent wound breakdown. Sound knowledge of surgical anatomy and meticulous surgical techniques during surgery are extremely important factors that may prevent occurrence of wound complications. The vascular supply of the cervical skin derived from the external carotid artery superiorly and the subclavian artery inferiorly. Trifurcations or incisions parallel to carotid artery should be avoided to minimise wound breakdown[4]. Additionally, skin flaps should be elevated in the sub-platysmal plane in order to maximise the blood supply.Closure of wound should be just adequate for approximation and avoid tight closure to prevent necrosis of the wound edges[5].

The incidence of wound complications in our study was comparable to other studies. A study by R. Pellini et al (2013) on 119 patients documented the incidence of wound complications was 20.2%[6]. Their study showed that pre-operative chemo-radiation therapy and either RND or MRND with 3-point junction are recognised risk factors for major wound complications. The other contributory factors include patient factors such as co-morbidities (e.g. diabetes, hypertension, anaemia) and smoking that may impair wound healing thuslead to various wound complications. Patients' co-morbidities are beyond the scope of this study. The majority of our cases with wound complications had underwent at least a MRND (n=32), RND (n=11) and extended RND (n=4). The occurrence of wound complication was the least in SND group. A significant correlation between the types of neck dissection surgery with the incidence of wound complications was observed in this study with a p-value of $p < 0.05$. This is an important predictive factor for wound complications. From the Chi-squared test, the extensiveness of the surgery increases the possibility of wound complications. This was observed in our extended RND cases whereby 57.1% developed wound complications.

Wound complications in previously irradiated neck was 14% (n=8) of the cases. Previous radiation therapy to the neck has a significant impact on wound healing. This finding is comparable to study by Gregory K. Sewall et al (2007) who reported the incidence of wound complications following neck dissection surgeries of 10% in post-irradiated neck for cases of head and neck SCC[4]. Out of the 42 cases, 23 (54.7%) with infected wound were successfully treated conservatively with intravenous antibiotic and daily wound dressing alone. While the other 19 (45.2%) cases requiring various forms of surgical interventions in the form of abscess drainage or surgical closure of the wound by delayed primary closure (n=11), split skin graft or full thickness skin graft (n=2) or using local regional flap (n=2).

The incidence of nerve complications in our study was 23.3% involving 48 cases. Marginal mandibular (MM) nerve was the commonest nerve injured following ND involving 27 (13.1%) cases. Other researcher described a lower incidence of MM nerve injury at 5.5% of all neck dissection sides performed[3]. The lower incidence reported in their study was probably due to a larger sample size. MM nerve injury usually occur when the upper flap is elevated or during level 1 dissection[3]. Injury to the MM nerve may cause dysfunction of depressor anguli oris muscle leading to drooping of angle of the mouth and feeding difficulties.

There were 9 out of 27 cases of MM nerve injury were detected intra-operatively. These injuries were mainly due to accidental iatrogenic injuryto the nerve. No attempts of reconstruction or repair of the injured nerve was attempted in all cases. In all the cases with MM nerve injury, 3 underwent extended RND, 9 underwent RND, 10 underwent MRND of any types and 5 underwent SND. All of the cases with MM nerve injury were managed conservatively. One of the recommended measures to maintain the integrity of MM nerve is by performing an initialskin incision at least approximately 2 finger breadth below the lower border of the mandible and then retracting the flap upwards, thus lifting the MM nerve away from the surgical flap. The flap should also be raised in correct sub-platysmal muscle plane to avoid injury to the MM nerve[5].

The second nerve that was commonly injured was great auricular nerve (n=5). The number of cases may not be a true representation and possibly higher due to lack of proper documentation. In majority of the cases, the status of the great auricular nerve during the intra-operative and post-operative period was not recorded. Although it is deemed as less important nerve functionally for many surgeons, the injury to this nerve would subject the patients to some degree discomfort and numbness of the ear lobules.

Injury to the hypoglossal nerve and lingual nerve comprised of 3 cases and 2 cases respectively. One case of hypoglossal nerve injury and 1 case of lingual nerve injury were due to accidental cut of the nerve intra-operatively. No attempts of repair were carried out intra-operatively. The remainder presented later during the post-operative period. All patients were managed conservatively. The hypoglossal nerve can be identified crossing the external carotid artery and then emerging from underneath the posterior belly of digastric on the hyoglossus muscle.This nerve can be injured during removal of submandibular gland and clearance of level I and level II lymph node[7]. Failure to identify this structure may lead to injury of this nerve.

In addition, we reported 2 cases of recurrent laryngeal nerve (n=2) and 1 case of superior laryngeal nerve injury. The case with superior laryngeal nerve injury were detected on day 9 of the post-operative period when patient complained of aspiration during oral feeding. He underwent right extended RND for Tonsil SCC. He was managed conservatively with Ryle's tube feeding and was under speech and language team follow up for swallowing rehabilitation. The 2 patients with recurrent laryngeal nerve injury were detected on day 14 and day 21 post-operatively. Both presented to our department during the follow up with hoarseness. Endoscopic examination revealed left vocal cord immobility in both cases. Both patients underwent RND for Left EAC SCC with recurrent neck metastasis and left parotid adenocarcinoma with recurrent neck metastasis respectively. Both received conservative treatment.

The incidence of sympathetic chain injury in our study was 0.5% (1 case). The patient underwent right lateral SND for papillary thyroid carcinoma with neck metastasis. The patient presented with Bernard-Horner's syndrome during the follow up in our clinic on day 7 post-operative period with ipsilateral partial ptosis, anhydrosis and miosis. Regario et al (2011) in their series had reported 3 cases of sympathetic chain injury following neck dissection[3]. The incidence of sympathetic chain injury reported was around 1%[7]. Horner's syndrome or oculosympathetic paresis is caused by injury to the cervical sympathetic nerve which is located posterior to carotid sheath underneath the pre-vertebral fascia. This nerve isat risk during neck dissection surgery especially

when the pre-vertebral fascia was breached intra-operatively during the dissection. It could also occur as a result of retraction of the carotid sheath to clear the neck nodes at respective levels[3,8].

The spinal accessory nerve (SAN) is another nerve that could be injured following neck dissection surgery. Injury to the SAN could lead to shoulder dysfunction and painful shoulder syndrome[7]. We reported 4 (1.9%) cases with SAN injury. In 1 case, the SAN was accidentally injured when performing an elective left supraomohyoid SND. The other 3 cases underwent MRND type 2. The nerve paresis were detected on day 2 to 6 post-operatively when patient complained of reduced shoulder abduction on operated side. All the 4 patients were referred to physiotherapy for conservative management. In minimising accidental injury to the SAN, care should be taken when elevating the skin flaps especially in the posterior triangle of the neck as occasionally, the SAN may lie superficially. A useful surgical landmark commonly used intra-operatively to identify SAN is the Erb's point[5]. An ability to identify the Erb's point and the SAN, could prevent accidental injury to the nerve.

Our study had found a significant correlation between the type and extension of neck dissection surgery with the incidence of nerve complications. We have observed the incidence was higher among patients who underwent extended RND (85.7%) and RND (32.5%) with a p-value of $p<0.05$ from the Chi-squared test.

Injury to various vascular structures in the neck could lead to a wide array of complications from minimal hematoma to a more devastating outcome including death. The severity of complications depend on the vascular structures involved.In our study, vascular complication rate was 9.7% and majority were thoracic duct injuryinvolving 11 cases (5.3%).Of these, 4 cases underwent left RNDs and 7 cases underwent left MRNDs. All were succesfully managed either by conservative management or surgical intervention. The 6thoracic duct injuries were identified intra-operatively when performing Valsalva maneuver and were repaired immediately by over-sewing of the injured thoracic ducts. In 1 case, surgicell and tetracycline powder was used and in another case bio-glue was used following failure of over-sewing of the duct. Four out of 6 cases had successful repair of thoracic duct intra-operatively with no clinical evidence or sequel of chylous leak post-operatively. The other 2 cases continued to have chylous leak during the post-operative period but subsequently resolved with conservative treatment of low fat diet, medium chain triglyceride (MCT) diet and compressive dressing.

The remaining 5 of the 11 cases with thoracic duct injury were detected clinically and biochemically post-operatively. All of these cases were treated by low fat diet, MCT diet and compression. There was only 1 case that failed conservative treatment and required neck exploration and repair of chylous leak on post-operative day 12 and was repaired successfully. No mortality following chyle leak was observed in our series.

Chylous leak is rare. Other studies have documented the incidence of chylous leak between 1 to 2.5%and mainly involving the left side of the neck as observed in our study[3]. Chylous leak may potentially lead to devastating outcome such as malnutrition, chylous fistula, chylothorax, chylomediastinum, chylopericardium, poor wound healing and death if left untreated[9]. Khurana et al (2009) stated that most surgeons are unfamiliar with its early signs that allow prompt diagnosis and effective management. Their study reported an incidence of chylous leak of 0.5-2% following neck dissection[10]. Intra-operatively, identification of chylous leak can be aided by placing the patient in Trendelenburg position and adopting a forced Valsalva manouvre[9]. Early intra-operative detection of chylous leak allows intra-operative repair of the injury.

Management of chylous leak have been described previously in numerous literatures. Generally, it can be divided into non-surgical and surgical management. Non-surgical management include low-fat-diet (LFD) or fat-free diet (FFD), medium chain triglyceride (MCT), enteral nutrition with a specialised formula, a very low fat elemental formula and total parenteral nutrition (TPN) or any combination of the above. Enteral nutrition with specialised formula is especially effective in low-output chylous leak of less than 1 litre/day while TPN is recommended for high output leak exceeding 1 litre/day. Indication for TPN include for those patients who are not responding to enteral regimen or having increased chyle output on enteral nutrition. In addition, somatostatin analogues (e.g.: octreotide) and negative pressure wound therapy (NPWT) has also been used previously with mixed outcomes[9].

Surgical management options for chylous leak described in literatures include thoracic duct ligation (oversewing of throcacic duct), thoracic duct embolization, therapeutic lymphography or using locoregional flaps (e.g.: pectoralis major flap) and

lymphatic-venous anastomoses (LVA) microsurgical technique. The thoracic duct terminates most commonly in the left IJV although less commonly it may enter the left subclavian, left external jugular vein, left brachiocephalic vein or right IJV[9].

Internal carotid artery (ICA) injury occurred in 2 cases. One was following right RND and 1 case following left supraomohyoid SND. The first case who underwent right RND, died on the operating table following unsuccessful repair of injured ICA. The neck was previously irradiated prior to neck dissectionand there was close adherent of the tumour to the ICA. The other case had accidental tear of left ICA but was successfully repaired intra-operatively. The case of external carotid artery injury and transverse cervical artery injury were both successfully repaired during the intra-operative period.

Previous literatures had reported the incidence of carotid artery injury following neck dissection around 3 to 4% with mortality rate of 50%[7]. Our study documented 3 cases (1.5%) of both ICA and ECA injuries following neck dissection with a mortality rate of 33.3%. Only 1 patient died following the injury to the ICA.

Injury to the internal jugular vein (IJV) comprised of 2.3% (n=5) of our cases. Of these, 3 out of 5 cases were detected intra-operatively and were successfully repaired. In one case, neck hematoma was detected at 2 hours post-operative period and emergency surgical neck re-exploration was performed and the source of bleeding was due to slipped right IJV ligature following MRND type 1. In another case, the patient presented with left neck hematoma on day 3 post-operative period. Neck exploration noted injury to the left IJV and was successfully repaired. Most of the vascular injuries are repairable if detected early with excellent outcome. Prevention of vascular injury should start from pre-operative stage of assessment with appropriate imaging and clinical assessment[5]. We observed a significant correlation between the incidence of vascular complications and the extend of neck dissection with p value of $p<0.05$.

The rate of loco-regional recurrence or residual neck disease following treatment for head and neck malignancy has been reported previously to be around 5 to 15%[11]. Comparable finding was observed in our study whereby the incidence of residual and recurrence neck diseaseswere noted to be 4.4% and 15.5% respectively. Several factors determine the occurrence of residual and recurrence neck disease which include tumour staging and grading, presence of multiple neck lymphadenopathy, presence of extracapsular spread and positive tumour margin[12].

In our study, all cases with residual neck disease were advanced high stage tumour of at least stage 4a (n=8) and stage 4b (n=1) at the time of surgery. In recurrence neck disease, themajority (78.1%) were tumours of stage 3 and above. The majority of the cases with residual and recurrence neck diseases were observed in cases who had underwent a more extensive neck dissection surgery such as extended RND, RND and MRND. The least percentage of cases with residual and recurrence neck diseases were observed in the SND group. There may be a correlation between the stage of tumour and type of neck dissection with the incidence of residual and recurrence neck disease, however Chi- Square test did not show a significant correlation with p-value of $p> 0.05$. This could possibly due to small sample size in our study. A larger sample size for future studies to better assess this association may be needed.

All of our patients were followed up until a minimum period of 6 months. Cases without any residual or recurrence neck diseases, the 5 years survival rate was almost 90% following neck dissection surgeries. This reflects the importance of loco-regional control of neck diseases in cases of metastatic head and neck malignancies. The much higher survival rate was observed in our study population without any residual or recurrence neck diseases.

Careful planning of surgery, meticulous surgical techniques and post-surgical treatment including adjuvant radiotherapy and/or chemotherapy are essential in ensuring a longer disease-free period thus preventing loco-regional residual or recurrence neck diseases that can be associated with poor prognosis[12].

The accuracy of clinical assessment of the neck node metastatic status has a sensitivity of 89.7% but specificity of 47.5%. Of all our neck dissection specimens, 96 (46.6%) cases were accurately diagnosed pre-operatively as clinically neck positive node (cN+) and 47 cases (22.8%) were accurately diagnosed as clinically N0 (cN0) neck. These were confirmed by histopathological examination.

Previous studies have reported the false positive and false negative rate in clinical assessment of the neck node to range between 20 to 51%. In our study, the false positive rate for clinical assessment of the neck node was 35.1% and the false negative rate was 18.9%. The false positive rate in our study was slightly higher than the study by Giorgios et al (2014) that reported 28.4% false positive rate of their clinical assessment[13]. In another study by Moore

et al (1986), they suggested that false-positive pre-operative assessments are more likely in patients with large tumours because of the examiner's expectation of metastatic nodes and the increased likelihood of reactive nodal hyperplasia due to local factors[14].

In our study, positive likelihood ratio of 1.71 indicates that cases with clinically positive neck (cN+) have more than 1.7-fold odds of having a pathologically positive neck node (pN+) and those with clinically N0 neck have 4 times less odds of a pathologically positive neck node (pN+) with a negative likelihood ratio of 0.22. The accuracy of pre-operative clinical assessment relied on clinical skills of the examiner, the patients' body structure, the patients' co-operativeness and history of previous surgery or radiotherapy treatment[13]

Another important finding from this study was the predictive rate for risk of occult nodal metastasis for the malignant tumours of the oral cavity. The rate for occult nodal metastasis for malignant tumours of the oral cavity was 22.5%. The knowledge on risk of occult nodal metastasis for each primary tumours is important in deciding the need for an elective neck dissection surgery for clinically N0 (cN0) neck. This knowledge will help the surgeons to decide on the best surgical management of the neck so as to maximise the loco-regional control of the tumours.

To the best of our knowledge, this study was the first of its kind to be conducted in Malaysia using our very own local data. The findings from this study could be the basis for future references of local and national data on head and neck cancer patients undergoing neck dissection surgery. Additionally, data on the various potential complications of this surgery would encourage otolaryngologists and other practising surgeons to be meticulous and mindful when performing this surgery in order to avoid unnecessary patients' morbidity and mortality.

Conclusion

Although neck dissection surgeries are performed routinely, various complications may potentially occur even in experienced hands. Good knowledge of surgical anatomy, awareness of potential complications and meticulous surgical techniques are vital in minimising complications following neck dissection surgeries. Main complications involving the wound, nerves and vascular structures were highlighted in this study. A strong association was observed between the type of neck dissection surgery and the incidence of wound, nerve and vascular complications following neck dissection.

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Conflict of interest: Declared none

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