Elective Neck Dissection during Surgery for Advanced Glottic Carcinoma with a Clinically Negative Neck: Analysis of Lymph Node Yield and Early Post-Surgical Outcomes.

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Abstract

Background: Identification of occult nodal metastasis is an important determinant for staging and prognosis, particularly for adjuvant treatment modalities in head and neck cancer. **Objectives:** to analyze the lymph node yield after elective (selective neck dissection level II-IV) for advanced glottic carcinoma with clinically negative neck and correlate this with early post-surgical outcomes. **Patient and methods:** This is a case series study conducted on thirty (30) consecutive candidates for total laryngectomy at Otolaryngology departments of both Benha and Tanta University hospitals. Elective bilateral selective neck dissection SND (II-IV) was done in 18 patients (60%).Unilateral SND (II-IV) was done 12 patients (40%). **Results:** The mean for level II was 9.1, for level III: 11.5 and for level IV: 6.2. The mean nodal yield of SND (II–IV) is 47.7 LNs (range 12-99). There is high significance association between lymph node yield and age **(*p* value=0.001)** and with the need of postoperative radiotherapy **(*p* value =0.031)**. Intraoperative complication; internal jugular vein injured in one case (3.33%). There is significant association between postoperative complications and patient's age **(*p* value = 0.032)**, preoperative tracheostomy **(*p* value =0.002)**, side of neck dissection **(*p* value =0.004)**, positive lymph nodes in level II dissection **(*p* value =0.005)** and overall total size of the tumor **(*p* value =0.033)** when overall total tumor size exceeds 20 cm^3. **Conclusion:** Lymph node yield and ratio directly influence the prognosis and postoperative outcomes and could be considered in staging of those patients.

Key words: Neck dissection, laryngeal carcinoma, lymph node yield.

Introduction

In the setting of laryngeal squamous cell carcinoma, cervical node management is a key component of overall treatment plans. Although neck dissection is mandatory in presence of clinically involved lymph nodes, in the absence of such involvement is still subject to debate. This dilemma has been disputed for decades and remains unresolved **(1)**.

Identification of occult cervical metastasis is an important prognostic determinant for staging and prognosis, particularly for adjuvant treatment modalities in head and neck cancer. Although elective treatment of occult neck disease remains controversial, several investigators have emphasized increased survival in patients undergoing elective neck dissection compared with the "wait and see" approach **(2)**.

Demonstrations of the patterns of lymphatic drainage **(3)** and risk assessment for each lymph node (LN) level of harboring metastases has led clinicians to perform a less comprehensive surgical procedure, i.e. selective neck dissection (SND) and super-selective neck dissection (SSND) for designated neck levels in early stages or sentinel node biopsy (SNB) in clinically LN-negative necks **(4).** SND procedures have lower morbidity and have shown similar neck recurrence rates to modified radical neck dissection (MRND) **(5)**.

Historically the nodal yield was described in 'Anatomy of the human lymphatic system', which describes a nodal yield of up to 260 for the head and neck region, i.e. 130 per neck side **(6)**.

A quantitative study of lymph nodes retrieved following neck dissections in cadavers and reviewed the literature on clinical neck dissection specimens **(7)**. This study showed that average number of level II-IV SND on cadavers was 19 while in clinical SND II-IV was 11 lymph nodes. That study provided in part the basis for the recommendations by AJCC.

There are still no accurate tools available for the prediction of the presence of cervical metastasis in patients with clinically negative cervical lymph nodes. Although advances in radiological diagnostic techniques have led to a significant improvement in the accuracy of the preoperative diagnosis of occult neck metastases, there are still significant limitations, owing to the lack of specificity and sensitivity of morphologic findings, and these problems are unlikely to be resolved by imaging modalities **(8)**.

Lymph node yield (LNY) is defined as the number of lymph nodes retrieved after neck dissection, whereas lymph node ratio (LNR) is defined as the ratio of pathologically positive lymph nodes out of the total number of retrieved lymph nodes after neck dissection **(9)**.

Patients and Methods

This is a case series study conducted on thirty consecutive candidates for total laryngectomy at the Otolaryngology departments of both Benha and Tanta University hospitals from December, 2018 to November, 2019. Patients submitted for surgical management for advanced glottic carcinoma with clinically negative neck and having none of the exclusion criteria mentioned below. The study was approved by the medical ethics committee. The details of surgery ,with possible complications as well as a brief of our research were explained to all patients included in this study and a written informed consent form was obtained.

Inclusion criteria:

- Patients with advanced glottic carcinoma (T3, T4).
- Patients with clinically and radiological negative neck (N0 neck).
- No distant metastases (M0).
- Surgically fit patients.
- Patients accepting to participate in this study.

Exclusion criteria:

- Clinically positive neck (N1 or more).
- Evidence of distant metastases (M1).
- Medical or Anesthetic problems.
- Severe hypo-proteinemia and severe anemia.
- Patients refusing surgery.
- Patients refusing to participate in this study.

Preoperative preparation done through detailed history and complete ENT and head and neck examination. Computed Tomography (CT) scan with intravenous contrast injection was done to all patients. Magnetic Resonance Imaging (MRI) was done in selected cases. Full preoperative laboratory investigations were done for all patients Direct Laryngoscopy (D.L) under general anesthesia was done to all patients to determine the extent of the tumor and for tumor mapping and to take biopsies for histopathological examination. Metastatic workup was done for all patients in the form of pelvi-abdominal ultrasound, digital chest x-ray, CT scan of the brain and bone scan.

Three of our patients (10%) had preoperative radiotherapy one of them received chemo-radiation (CRT).

The operation is done under general anesthesia. Preoperative tracheotomy: a tracheostomy has already been done in 8 patients, then the anesthetist was asked to assist patient ventilation through the tracheostomy tube. Perioperative antibiotics: peri-operative antibiotics before putting knife to skin.

Surgical treatment consisted of total laryngectomy for all patients. Elective bilateral neck dissection SND (II-IV) done in 18 patients (60%). Unilateral SND (II-IV) done 12 patients (40%). Hemi-thyroidectomy was done in 26 patients (86.7%) while total thyroidectomy was performed in 4 patients (13.3%) (2 with multinodular goiter and other 2 cases to exclude direct tumor extension). Level VI was dissected in 6 patients (20%) with evidence of tumor subglottic extension. Resection of upper tracheal rings was performed in 2 patients and resection of part of pyriform sinus was done in 2 patients to ensure enough safety margins of tumor resection.

Specimens were labeled and sent for meticulous histopathological examination to define lymph node yield for presence of malignant cells.

Postoperative care in the form of analgesics, chest physiotherapy, removal of suction drains when < 50 ml drainage per 24 hrs. and initiation of oral feeding after testing with saline and betadine or colored fluid after one week and removal of nasogastric tube.

All patients were followed up every day for 2 weeks then every 2 weeks for 3 months then every 3 months for one year. All patients were followed up for the following:

- Rate of wound healing as well as the complications of wound healing.
- Pharyngeocutanous fistula (PCF).
- Time of weaning from nasogastric tube and starting oral feeding.
- Neurological complications including shoulder dysfunction.
- Any evidence of local or regional recurrence.

All early postoperative complications were monitored and documented for duration of 2 years postoperatively.

Data were analyzed using SPSS software, version 22.0 (IBM, Armonk, NY, USA) for Windows. Categorical data were presented as number and percentages, McNemar’s and Fisher’s exact tests were used to analyze them. Quantitative data were tested for

normality using Shapiro-Wilks test assuming normality at P >0.05. Normally distributed variables were expressed as mean ±standard deviation and analyzed by Student "t" test for 2 independent groups. P ≤0.05 was considered significant.

Results

Total number of patients in the study group =30 (N=30). 28 (93.3 %) were male patients and 2 (6.7 %) were female patients. Mean age was 63.7±9.8 years. 27 patients (90%) were smokers although 3 patients (10%) were non-smokers.

All patients had Hoarseness of voice. 4 patients (13.3%) had dyspnea and 13 patients (43.3%) had dyspnea and stridor and 8 of them underwent tracheostomy for airway obstruction. None of the patients had dysphagia nor hemoptysis before presentation.

During preoperative internal laryngeal examination (Indirect Laryngoscopy), 26 patients had unilateral vocal fold paralysis (86.7%) and 4 patients (13.3%) had bilateral vocal fold paralysis. 14 patients (46.7 %) showed supraglottic extension while 10 patients (33.3%) were suggestive of subglottic extension. None of them showed pyriform sinus nor valeculla or tongue base tumor extension.

Imaging of the studied patients showed preserved laryngeal framework in 13 (43.3%) while it was invaded in the other 13 patients (43.3 %) with radiological evidence of extra laryngeal spread in 8 patients (26.7%). Pre-epiglottic space was invaded in 16 patients (53.3%). Paraglottic space was invaded by the tumor in all cases. None of the patients showed radiological evidence of nodal tumor invasion.

Total number of harvested lymph nodes level by level (*N*=48) as 18 patients had bilateral SND shown in table (1). Lymph node yield (level by level) is shown in table (2). We noted Only 2 cases were positive for 2 regions (level II: 2/17, level IV: 2/4). All positive patients were positive for one side only (no one was positive bilateral).

Table (1) : Total number of harvested lymph nodes level by level (*N*=48).

Parameter	level II*(n=48)*	level III*(n=48)*	level IV*(n=48)*	level VI*(n=6)*
Total NO. of LNs	435	554	405	37
Range	3 to 31	4 to 31	3 to 31	4 to 8
average	9.1	11.5	8.4	6.2
median	8	10	7	6
SD	5.04	5.98	5.92	1.6
Mode	7	10	4	6

Table (2) : Lymph node yield (level by level).

Variable		No. (*n*=48)	% (100%)
Level II LN involvement	**Negative**	44	91.7
(LN no. ranged from 3-23)	**Positive (1/17)**	2	4.2
	(2/17)	2	4.2
Level III LN involvement	**Negative**	46	95.8
(LN no. ranged from 4-31)	**Positive (1/15)**	2	4.2
Level IV LN involvement	**Negative**	46	95.8
(range of LN no. 3-31)	**Positive (2/4)**	2	4.2

Table (3) : Overall size and grade of the tumors of the studied patients

Variable		No. (N=30)	% (100%)
Size of the tumor (cm^3)*	**<10**	9	30.0
(D_1*D_2*D_3)	**10-20**	18	60.0
	>20	3	10.0
Grade	**Grade I**	4	13.3
	Grade II	11	36.7
	Grade III	15	50.0

. ***D**; Dimension.

Table (4) : Total lymph node yield and LN ratio among the studied patients.

	LNY	LNR
No.	30	30
Mean	47.7	0.009
Std. Deviation	24.6	0.02
Median	42.0	0.0
Minimum	12.0	0.0
Maximum	99.0	0.073

We have found highly significance association between lymph node yield and age **(*p* value=0.001)** shown in table (5).

Table (5) : Correlation between age and LNY, LNR.* **rho**: Spearman's rank correlation coefficient

With	Age (yrs)	
	rho*	***P***
LNY	0.597	=0.001 (HS)
LNR	0.233	0.27 (NS)

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We have found significant correlation between LNY and preoperative tracheostomy**(*p* value = 0.004)** but no correlation between LNY and gender, smoking, preoperative radiotherapy. Also, there is significant correlation between LNR and preoperative tracheostomy **(*p* value =0.002)** and gender (range in males was 0-0.073) **(*p* value =0.017)** but no correlation between LNR and smoking, preoperative radiotherapy as shown in table (6)

Table (6) : Correlation between LNY & LNR and (sex, smoking, preoperative tracheostomy and preoperative radiotherapy).

Variable		*n.*	LNY		Z_{MWU} test	P	LNR		Z_{MWU} test	*P*
			Median	Range			Median	Range		
Sex	**Female**	2	61	59-63	1.16*	0.24 (NS)	0.016	0.06-0.017	**2.38**	**0.017 (S)**
	Male	28	39	12-99			0.0	0-0.073		
Smoking	**No**	3	63	59-72	1.63	0.104 (NS)	0.015	0-0.017	1.68	0.09 (NS)
	Yes	27	38	12-99			0.0	0.0-0.073		
Preoperative tracheostomy	**No**	22	35.0	12-99	2.2502	0.133 (NS)	0.0	0.0-0.0	**3.424**	**0.001 (HS)**
	Yes	8	57.0	32-74			0.0	0.0-0.073		
Preoperative radiotherapy	**No**	27	44.0	12-99	0.69	0.49 (NS)	0.0	0.0-0.073	0.79	0.42 (NS)
	Yes	3	32.0	29-55			0.0	0.0-0.073		

*Kruskal wallis test was used.

Table (7) : Correlation between LNY, LNR and tumor size.* **rho**: Spearman's rank correlation coefficient.

With	**Tumor size**	
	rho*	***P***
LNY	0.271	0.14 (NS)
LNR	0.608	**<0.001 (HS)**

We have found highly significance association between lymph node ratio and tumor size **(p value <0.001)** shown in table (7).

We have found significant association between LNY and the need of postoperative radiotherapy **(*p* value =0.031)**. There is high significant correlation between LNR and Postoperative complications **(*p* value <0.001)** and Postoperative radiotherapy **(*p* value <0.001)** as shown in table (8).

Table (8): Relation between (LNY and LNR) and (tumor grade ,stage, postoperative complications and postoperative radiotherapy).

Variable		*n.*	LNY		Z_{MWU}	*P*	LNR		Z_{MWU}	*P*
			Median	Range	test		Median	Range	test	
Grade	**Grade I**	4	20.5	20-72	3.55*	0.17	0.0	0-0	3.61*	0.016
	Grade II	11	38.0	16-85		(NS)	0.0	0-0.017		(NS)
	Grade III	15	55.0	12-99			0.0	0.0-0.073		
Stage	**T3N0M0**	20	36.5	12-99	0.68	0.49	0.0	0.0-0.073	1.63	0.10
	T4aN0M0	10	44	29-74		(NS)	0.0	0.0-0.073		(NS)
Postoperative	**No**	21	34	12-99	1.58	0.11	0	0-0	4.08	<0.001
complications	**Yes**	9	55	31-74		(NS)	0.017	0.0-0.073		(HS)
Postoperative	**No**	22	33	12-99	**2.16**	**0.031**	0.0	0-0	**4.43**	**<0.001**
radiotherapy	**Yes**	8	57	44-86		**(S)**	0.02	0.0-0.073		**(HS)**

Intraoperative complications:

Vascular injury ,internal jugular vein (IJV) injured in one case (3.33%). The injury was noted intra-operatively and repaired.

Early postsurgical complications:

Postoperative complications occurred in 9 patients (30%). The most common postoperative complication among the studied patients in our study was the wound complications including hematoma, wound infection and wound dehiscence. Wound complications occurred in 6 patients (20%). Hematomas occurred in 4 patients (13.3%). In 2 patients with hematoma, patients were returned to operation theatre for re-exploration and hemostasis was achieved and no major vessel rupture was observed. The source of hematoma was attributed to the bleeding of multiple small-size vessels near the root of the neck. In another 2 patients, minor collection was noticed and managed conservatively by compression dressing. Wound infection occurred in 2 cases (6.67%) one of them showed minor wound dehiscence(3.33%) and managed conservatively.

Pharyngeocutaneous fistula (PCF) occurred in 2 patients (6.7%) in our study. One of them was treated conservatively and the other needed reoperation and underwent reconstruction with pectoralis major flap.

One patient developed chyle leak (3.3%). The leak was small, low output fistula that is <400 ml/day. They were treated with conservative treatment. The patients were kept nil by mouth and a compression dressing applied over the left supraclavicular area. The treatment was bowel rest, parental nutrition or low fat enteral formulae.

Two patients developed shoulder complications (6.7%) in the form of shoulder pain, limitation of shoulder

abduction. were managed conservatively and physiotherapy was given.

In our study, no marginal mandibular nerve nor phrenic nerve injuries were noted. Patients followed up for 24 months, no local nor nodal nor distal recurrence occurred. 6 of our patients (20%) were found to have occult neck metastasis and extra laryngeal spread on pathological examination of the specimens was found in 8 patients (26.7%). Only 2 patients (6.7%) had positive resection margins. All patients with occult metastasis and positive resection margins received postoperative radiotherapy.

Time of weaning of nasogastric tube was 10.5±3.4 days. Patient readmission within 30 days of discharge in our study occurred in 3 patients (10%) due to PCF or chyle fistula.

We have found significant association between incidence of postoperative complications and patient's age **(*p* value = 0.032)** but no similar correlation with patient's sex **(*p* value =0.083) (NS)** or smoking **(*p* value =0.21) (NS)** as shown in table (9).

Table (9): Postoperative complications according to socio-demographic characters.

Variable		Postoperative complications (n=30)				Test of sig.	*P*
		No (n=21)		Yes (n=9)			
Age (ys)	**Mean±SD**	57.4±8.5		66.3±9.3		**St"t"=2.26**	**0.032 (S)**
	Range	48-75		53-87			
		No.	**%**	**No.**	**%**		
Sex	**Female**	0	0.0	2	100.0	**FET***	0.083 (NS)
	Male	21	75.0	7	25.0		
Smoking	**No**	1	33.3	2	66.7	**FET***	0.21 (NS)
	Yes	20	74.1	7	25.9		
Preoperative Tracheostomy	**No**	19	83.4	3	13.6	**FET***	**0.002 (S)**
	Yes	2	25%	6	75		
Side of neck dissection	**Unilateral**	12	100.0	0	0.0	**FET***	**0.004 (S)**
	Bilateral	9	50.0	9	50.0		

***FET=Fisher's Exact test.**

We have found significant association between postoperative complications and patients presented with dyspnea and stridor **(*p* value =0.002)**. 61.5% of patients with postoperative complications presented with dyspnea and stridor. There is significant association between postoperative complications and preoperative tracheostomy **(*p* value =0.002)**. 6 of the 8 patients with preoperative tracheostomy

developed postoperative complications as shown in table (9).

We have found significant association between increased postoperative complications and bilateral neck dissection **(*p* value =0.004)**. 50% of patients underwent bilateral neck dissections developed postoperative complications as shown in table (9).

We have found significant association between postoperative complications and positive lymph nodes in level II dissection **(*p* value =0.005)**. All four patients with positive lymph nodes in level II dissection developed postoperative complications in the form of shoulder complications (2 of them) and wound infection. There is also a significant association between postoperative complications and overall total size of the tumor **(*p* value =0.033)** when overall total tumor size exceeds 20 cm^3 as shown in table (10).

Table (10): Postoperative complications according to histopathological tumor grade and LNY (level by level) and total tumor size.

Variable		Postoperative complications (*n*=30)				*P*
		No (*n*=21)		Yes (*n*=9)		
		No.	%	No.	%	
Level II	Negative	21	80.8	5	19.2	**0.005**
	Positive	0	0.0	4	100.0	**(S)**
Level III	Negative	21	75.0	7	25.0	0.083
	Positive	0	0.0	2	100.0	(NS)
Level IV	Negative	21	72.4	7	25.0	0.083
	Positive	0	0.0	2	100.0	(NS)
Size	<10	9	100.0	0	0.0	**0.033**
	10-20	11	61.1	7	38.9	**(S)**
	>20	1	33.3	2	66.7	
Grade	I	4	100.0	0	0.0	0.199
	II	9	81.8	2	18.2	(NS)
	III	8	53.3	7	46.7	
	Yes	0	0.0	2	100.0	

We found no correlation between preoperative radio/chemotherapy and postoperative complications **(*p* value =1.0) (NS).**

Mortality: In our study, there were no peri-operative deaths.

Discussion

Lymph node metastasis is a crucial prognostic factor in patients with head and neck SCCA **(10)**. The presence of positive LNs (N+) is recognized as a significant

adverse prognostic factor for patient survival **(11)**.

In a review of studies **(12)** in literature about LNR asked a Question is "how the LNRs should be calculated in case of bilateral neck dissection and whether calculating the LNR should take into account the number of neck levels dissected" offering a recommendation of different cutoff points of LNR per type of neck dissection should be determined.

As the presence of occult metastasis is tumor loco-regional spread, we have calculated LNR by dividing number of positive Lymph nodes by total number of retrieved lymph nodes (unilateral or bilateral) per type of dissection included in our study SND (II-IV).

In a large cohort study **(13)** on patients underwent neck dissection for mucosal squamous cell carcinoma of head and neck identified on the national cancer database between 2004 and 2013, supported the finding in the literature that states the 18 LNs as an effective cutoff for improved overall tumor survival in neck dissection in both patients who were node negative and node positive.

Another review of clinical studies **(14)** on lymph node yield on level by level base, In the clinical SNDs the mean total nodal yields were between 8 and 39.8, while the lowest range was 1 and the highest 152. Three clinical studies provided the nodal yield on a level-by-level basis. The means for level II were 12.6, 11.2 and 11.2; for level III: 7.6, 7.6 and 7.2 and for level IV: 8.7, 7.3 and 6.9. Overall level II contained most LNs. The nodal yields of SND (II–IV) yielded between 26.4 and 30.0 nodes (range 15–43).

In our study, the mean for level II was 9.1, for level III: 11.5 and for level IV: 6.2. while overall level III contained most LNs. The mean nodal yield of SND (II–IV) is 47.7 LNs (range 12-99). So our mean for SND(II-IV) is significantly higher than other studies **(7)** and **(14)**. As **(7)** described an average of 19 LNs in SND II-IV dissection a 'healthy' neck side in cadavers with no sign of head and neck disease not in the clinical setting on patients with a diagnosis of a head and neck cancer. It is known that the primary cancer induce LN hypertrophy and remodeling and so **(14)** review of literature of different head and neck cancers was 26.4 (mean) for SND II-IV and not only for the laryngeal cancer.

In the past study **(15)** there was no significant correlation was found between the presence of positive nodes and gender **(*P* = 0.188)**, age group **(*P* = 0.360) ,**but we have found highly significant correlation

between LNY and age **(p=0.001)** and no correlation between LNR and age. We can explain that association between age and LNY as the nodal yield is related to the patients and anatomical variation between individuals. The mean age of the patients was (63.7±9.8) (range 48-87) and **(14)** stated that increased age of the patients is known to affect the appearance and decrease the size of the LNs.

Regarding the correlation between gender and LNR, we assume that it is due to 28 of 30 patient in our study were males.

In our study, we have found no significant correlation between lymph node yield (LNY) and preoperative tracheostomy **(*p* value = 0.133)** and sex, smoking, preoperative radiotherapy. In contrast there is high significant correlation between lymph node ratio (LNR) and preoperative tracheostomy **(*p* value =0.001)** and significant correlation with gender **(*p* value =0.017)** but no correlation between LNR and smoking, preoperative radiotherapy.

We can explain that association between age and LNY as the nodal yield is related to the patients and anatomical variation between individuals. The mean age of the patients was (63.7±9.8) (range 48-87). **(15)** stated that increased age of the patients is known to affect the appearance and decrease the size of the LNs. Regarding the correlation between gender and LNR, we assume that is due to 28 of 30 patient in our study were males.

In our study, we have found high significant correlation between LNR and tumor size **(*p* value <0.001)** and this could be assumed to advanced tumor (T stage) and tumor size resulted in more positive lymph nodes (occult metastasis).

We have found significant association between LNY and the need of postoperative radiotherapy **(*p* value =0.031).** There is high significant correlation between LNR and postoperative complications **(*p* value <0.001)** and postoperative radiotherapy **(*p* value <0.001)** .So the increase of the number of dissected lymph nodes and LNR directly influence the postsurgical treatment modality.

We agree with many studies in literature **(9), (13)**, **(15)** that both LNY and LNR are not the only important factors that directly influence the prognosis of head and neck cancers but also directly influence the postoperative outcomes especially in advanced laryngeal cancers.

However, further research is required to achieve this. The number of lymph nodes removed in selective neck dissection should be comparable to that of the corresponding

levels in radical neck dissection with strict adherence to surgical boundaries is maintained.

Regarding intraoperative complications, in our study vascular injury[internal jugular vein (IJV)] occurred in one cases (3.33%) and repaired intra-operatively. This is comparable with the results of the retrospective study in literature **(16)** internal jugular vein injured in 2 of 82 patients (2.4%).

Regarding prevalence of postoperative complication among the studied patients, in our study,21 of 30 patients (70%) did not develop any complications, while 9 (30%) experienced postoperative complication and this is comparable with the postoperative complications noted in a retrospective study **(17),** as postoperative complications occurred in 12 out of 52 patients (23.07%).

Postoperative hematomas occurred in 4 cases (13.3%) in our study and this is higher than results of previous studies **(18)** and **(16)** as hematomas occurred in (2.4%) and (1.21%) respectively. This could be attributed to advanced mean age of patients in our study(63.7±9.8) compared to 51 years in both studies and associated chronic illnesses as hypertension and atherosclerosis.

Wound infection occurred in our study in 2 cases (6.67%) and this is higher than results of other previous study **(16)** where infection occurred in only one of 82 patients (1.21%). In our study minor wound dehiscence occurred in only one case (3.33%) and managed conservatively while occurred in (4.87%) of patients in the previous study **(18)**. In another study **(16)** wound dehiscence occurred in (3.65%) of patients which required surgical revision. Both studies included patients with other head and neck cancers beside cancer larynx, other cancers that do not include opening of airway nor food way in their surgical management.

Pharyngeocutaneous fistula (PCF) is a major cause of increased morbidity after total laryngectomy; it delays starting of adjuvant therapy, prolongs hospitalization, increases treatment costs and reduces the quality of life **(19)**.

PCF occurred in 2 patients (6.7%) in our study which is lower than other studies **(20)** and **(21)** as it occurred in (13.9%) and (15%) of patients respectively. This could be explained by higher percentage of patients received preoperative radiotherapy either as primary therapy or preoperative therapy in both studies as 62% and 29% respectively while in our study is only 10% of patients.

In our study ,one patient developed chyle leak (3.3%). The leak was small, low output fistula that is <400 ml/day. They were treated with conservative treatment and this comparable to both previous studies **(16)** and **(18)** where chyle leak developed in 2 cases (2.43%) in both studies and they were managed conservatively.

Our study shoulder complications incidence was (6.7%) which is much lower than that of **(18)** study (15.85%) but slightly higher than **(17)** study where it occurred in 3 out of 52 patients (5.76%). This variation may be due to different surgeon's expertise and skill.

In our study, no marginal mandibular nerve injury was noted compared to 6.1% in **(18)** study and 5.5% in **(17)** study. We assume that because both studies included level I dissection.

In our study, no phrenic nerve injury was noted compared to one of 82 patients (1.2%) in **(18)** study.

Patients followed up for 24 months, no local , nodal nor distal recurrence was noted. We owe this as all patients were clinically N0 and 6 patients (20%) were found to have occult neck metastasis and extra laryngeal spread on pathological examination of the specimens was found in 8 patients (26.7%). Only 2 patients (6.7%) had positive resection margins. All patients with occult metastasis and positive resection margins received postoperative radiotherapy.

In our study, patient readmission within 30 days of discharge occurred in 3 patients (10%). Patients with PCFS and chyle fistula compared to 34 of 245 patients (13.9%) were readmitted to the hospital within 30 days of discharge in **(20)** study.

In our study, time of weaning of nasogastric tube was 10.5±3.4 days and this is comparable to **(21)** study as nasogastric tube was removed on the tenth postoperative day.

We have found significant association between incidence of postoperative complications and patient's age **(*p* value = 0.032)** but no similar correlation with patient's gender **(*p* value =0.083) (NS)** or smoking **(*p* value =0.21) (NS)**. This may be explained to comorbid diseases with advanced age as diabetes and hypertension and atherosclerosis.

We have found significant association between postoperative complications and preoperative tracheostomy **(*p* value =0.002)**. We owe this to the advanced local tumor necessitated tracheostomy and presence of other comorbidities as malnutrition and chronic illnesses which delay wound healing and predispose to complications. In addition to local inflammation and fibrosis around

preoperative tracheostomy make patients more prone to postoperative complications.

This association is compatible with **(20)** study ,who found preoperative tracheotomy associated with higher postoperative wound complications and PCF and readmission to hospital. He also found an association between low preoperative albumin levels (or preoperative dietary counseling) and wound complications, and this aligns well with our findings and provides a measureable, actionable item for optimizing outcomes and reducing readmission rates. Because the preoperative nutritional status represents a potentially modifiable risk factor.

We have found significant association between postoperative complications and bilateral neck dissection **(*p* value =0.004)**. 50% of patients underwent bilateral neck dissections developed postoperative complications. Bilateral neck dissection carries more risk for development of postoperative complications due to more vigorous surgery with longer duration and more tissue manipulation and trauma.

We have found significant association between postoperative complications and positive lymph nodes in level II dissection **(*p* value =0.005)**. All four patients with positive lymph nodes in level II dissection developed postoperative complications in the form of shoulder complications (2 of them) and wound infection. This could be assumed to level II intimate relation to spinal accessory nerve.

We have found significant association between postoperative complications and overall total size of the tumor **(*p* value =0.033)** when overall total tumor size exceeds 20 cm^3. Advanced local disease T stage is more prone to develop postoperative complications.

We found no correlation between preoperative radio/chemotherapy and postoperative complications **(*p* value =1.0) (NS)**.This may be due to small number of patients (only 3 patients) who had preoperative radiotherapy in our study.

Conclusion

We confirm the importance of the lymph node yield and ratio after neck dissection for patients with advanced glottic carcinoma. Both LNY and LNR are important factors that directly influence the prognosis and postoperative outcomes and they could be considered in the staging of these patients.

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