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Incidence of recurrent laryngeal nerve injury following esophagectomy in esophageal cancer patients

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Abstract---Objective: To determine the incidence of recurrent laryngeal nerve injury (RLNI) in patients with esophageal cancer who have undergone esophagectomy. Materials and Methods: This was a prospective observational study that was conducted at the Department of Cardiothoracic Surgery in Hayat Medical Complex, Peshawar. Non-probability consecutive sampling technique was used to select 62 patients with esophageal carcinoma. Patients with benign lesions, preoperative hoarseness of voice, or macroscopically advanced locoregional disease on preoperative evaluation were excluded. The study recorded data on age, gender, type of surgical procedure, and injury to the recurrent laryngeal nerve (RLN). The association of RLN injury with age, gender, and type of surgery was evaluated using the chi-square test. Results: The study participants had a mean age of 34.97 ± 9.96 years. Males accounted for 35 (56.45%) of the patients, while females accounted for 27 (43.55%). The study found that 6

(9.68%) participants had RLN injury. There was a statistically significant association between age and RLN injury (p=0.018). RLN injury was more common in the older age groups, with 5 (83.33%) cases occurring in the 41-58 years age group and 1 (16.67%) case in the 26-40 years age group. Conclusion: Recurrent laryngeal nerve injury is not an uncommon complication of esophagectomy in patients with esophageal cancer.

Keywords---recurrent laryngeal, nerve injury, esophagectomy, esophageal, cancer patients.

Introduction

Esophageal cancer is a highly invasive and deadly form of cancer, with a 5-year survival rate of 15-25% worldwide. [1] It is the eighth most common malignant tumor and the sixth most common cause of death. Esophageal squamous cell carcinoma is known to have a high rate of metastasis to the recurrent laryngeal nerve and adjacent lymph nodes.[2] Myriad of treatment options exist for esophageal cancer but the prognosis is still poor. [3] Standard care for this typically includes surgery, chemotherapy, and radiation therapy. Depending on the stage of the cancer, a combination of these treatments may be used. Other treatments, such as targeted therapy and immunotherapy, may also be used.[4, 5] The recurrent laryngeal nerves (RLN) are responsible for controlling the muscles of the larynx and help in phonation. They run in the tracheoesophageal grooves on both sides of the neck, with the right recurrent nerve turning around the subclavian artery and running cranially, and the left recurrent nerve turning around the aortic arch and running up through the thoracic cavity before entering the cervical fields.[6] During surgery the esophagus in the neck region is commonly pulled up from the left side, and a anatomosis between the esophagus and the stomach is established. The injury to RLN can occur due to surgical procedures, like use of electrocautery, stretching, or being compressed. This can also be caused by post-operative swelling or formation of hematoma.[7]

The occurrence of RLNP after esophagectomy varies widely, with reports of incidence ranging from 2 to 59%.[8, 9] Another study showed the incidence of RLN injury is 8.6%.[8] The differences in outcomes have been linked to factors such as the amount of lymph node removal during surgery, the surgical method used (either two-stage or three-stage), the size and stage of tumor, and the methods used to diagnose injury of RLN.[9] This study was conducted to determine the incidence of RLN injury(RLNI) during esophagectomy in patients with resectable esophageal carcinoma. RLNI is a serious condition that can lead to increased morbidity, so prevention of damage to the RLN and early diagnosis are essential for successful treatment. The results of this study will help to alert the clinicians for the safety and efficacy of esophagectomy procedures and to prevent the RLNI.

Material and Methods

This prospective observational study was conducted at department of Cardiothoracic Surgery, Hayat Medical complex, Peshawar from 1st January 2022

to 30th January 2023. The participants were selected using non-probability consecutive sampling technique. The sample size was 62 calculated by WHO calculator at 7% margin of errors and 95% confident level using previous frequency of RLN injury to 8.6%.[8] The approval letter was obtained from the concerned hospital. A thorough explanation of the study was provided to all participants, and verbal consent was obtained from each of them. The study included confirmed cases of esophageal carcinoma based on histopathological examination, regardless of age, gender, and Pakistani nationals. However, patients with benign lesions, preoperative hoarseness of voice, or macroscopically advanced locoregional disease on preoperative evaluation were excluded.

Patients with esophageal cancer underwent staging according to the American Joint Committee on Cancer using a contrast-enhanced CT scan of the chest and abdomen. Additionally, the hypopharynx, oropharynx, and larynx were examined using an endoscope to detect any pathology or dysfunction. Esophagectomy was performed on all participants using one of the following procedures: McKeown, thoraco phreno laparotomy, or transhiatal esophagectomy. An incision was made in the neck area and the anterior margin of the sternocleidomastoid muscle was dissected. The omohyoid muscle was cut and the strap muscle was retracted. To avoid thermal injury to RLN, diathermy and electrocautery were used selectively. The middle thyroid vein and inferior thyroid artery were identified and ligated. Diathermy and electrocautery were avoided in the bed and around the RLN to prevent thermal injury. After the middle thyroid vein and inferior thyroid artery were secured, sharp dissection was performed to carefully separate the esophagus from the tracheoesophageal groove. Retractors were used to prevent direct traction on the RLN. Once the esophagus was exposed, the affected portion was removed and the remaining healthy portions were reconnected.

The patients who presented with hoarseness of voice underwent fiberoptic laryngoscopy one day after surgery to assess the condition of their vocal cords and detect any potential RLN injury. Data like age, gender, type of surgical procedure and injury to RLN was recorded. The data analysis was performed using R programming version 4.1.2. Descriptive statistics were computed for continuous variables in terms of means and standard deviations, and for categorical variables in terms of frequencies and percentages. The chi-square test was used to assess the association between RLN injury and age, gender, and surgical procedure, with a significance level set at $p < 0.05$.

Results

The study included 62 participants with confirmed carcinoma oesophagus. The mean age of the participants was 34.97±9.96 years, with an age range from 16 to 58 years. Of the participants, 35 (56.45%) were male and 27 (43.55%) were female. The most common age group was 26-40 years, with 27 (43.55%) participants, followed by 41-58 years, with 20 (32.26%) participants. The incidence of RLN injury was found in 6 (9.68%) participants (Table I). The most common type of surgical procedure was thoraco-phreno laparotomy (n=33, 53.33%), followed by McKeown (n=15, 24.19%), and the least common was trans-hiatal (n=14, 22.58%) (Fig 1). Table II presents a comparison of RLN injury by gender, age group, and type of surgical procedure. Gender was not found to be a

significant predictor of RLN injury (p=1), and there was no significant difference in RLN injury among the different types of surgical procedures (p=0.841). However, a statistically significant association was found between age and RLN injury (p=0.018). RLN injury was more common in older age groups, with 5 (83.33%) cases occurring in the 41-58 years age group and 1 (16.67%) case in the 26-40 years age group.

Table I
Frequency of gender, age group and injury of RLN

Variable	Characteristic	n(%)
Gender	female	27 (43.55)
	male	35 (56.45)
Age group	16-25	15 (24.19)
	26-40	27 (43.55)
	41-58	20 (32.26)
Injury of RLN	Absent	56 (90.32)
	Present	6 (9.68)

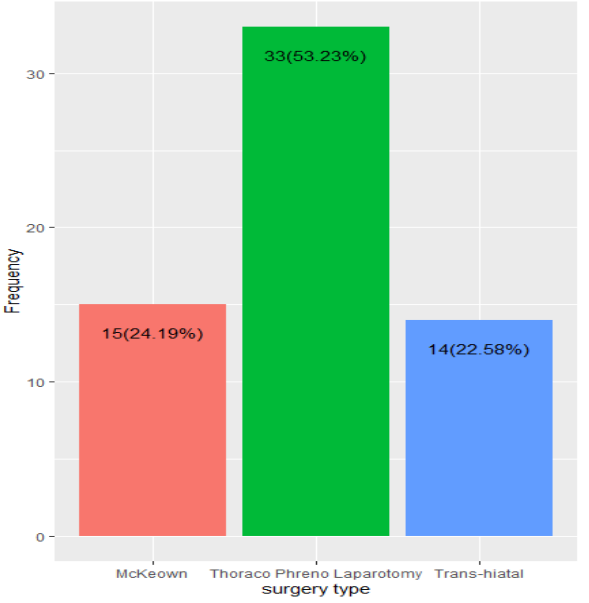

Fig 1. Type of surgical procedures

Table II
Comparison of recurrent laryngeal nerve by gender age group and surgery type

Variable	Characteristic	Recurrent laryngeal nerve		p-value*
		absent, N = 56[1]	present, N = 6[1]	
Gender	female	24 (42.86)	3 (50.00)	1.00
	male	32 (57.14)	3 (50.00)	

Age group	16-25	15 (26.79)	0 (0.00)	0.018
	26-40	26 (46.43)	1 (16.67)	
	41-58	15 (26.79)	5 (83.33)	
Surgery type	McKeown	13 (23.21)	2 (33.33)	0.841
	Thoraco Phreno Laparotomy	30 (53.57)	3 (50.00)	
	Trans-hiatal	13 (23.21)	1 (16.67)	

Discussion

This prospective study aimed to determine the incidence of RLN injury in patients who underwent esophagectomy. Our findings revealed an incidence of 9.68% for RLN injury. In a study conducted by Scholtemeijer et al. [10] in the Netherlands on 451 participants who underwent esophagectomy, they reported a 10% incidence of RLN injury. Another study conducted on 782 patients reported a 29.3% incidence of trauma to the RLN during esophagectomy. [11] Gockel et al. [12], in a prospective study on 404 cases of esophagectomy, reported a 14.85% paralysis of the RLN. In a study by Pertl et al., [13] the incidence of RLN paralysis was found to be 50%. The high rate of RLN injury in these studies may be attributed to esophagectomy followed by cervical anastomosis. Other studies reported a much higher prevalence of RLN injury during esophagectomy, ranging from 48% to 70%.[7, 14] The incidence of RLNP reported can vary depending on the diagnostic method used. Studies utilizing clinical assessment and indirect laryngoscopy have reported lower incidences compared to those using direct visualization of vocal cords through fiberoptic laryngoscopic evaluation, which is more sensitive in detecting RLNP. [14]

Our findings showed no significant association between gender and RLN injury. This suggests that the gender of an individual is not a significant predictor of injury to the RLN. It is important to keep in mind that a low p-value does not necessarily mean that there is a cause-and-effect relationship between the variables, but only that the relationship is statistically significant and unlikely to have occurred by chance. No previous study was traced comparing RLN among gender. In our study the incidence of RLN injury during esophagectomy is higher in older individuals compared to younger individuals. Several factors can play role. Firstly, older individuals may have more underlying medical conditions, such as cardiovascular disease or chronic obstructive pulmonary disease, that can make them more vulnerable to complications during surgery, including RLN injury.[15] Additionally, the anatomy of the larynx and esophagus may change with age, making it more difficult to identify and preserve the RLN during surgery. Furthermore, older individuals may have a decreased ability to compensate for RLN injury, leading to more significant and long-lasting consequences. Lastly, the type of esophagectomy performed may vary based on age, with older individuals potentially undergoing more invasive procedures that increase the risk of RLN injury.[16]

It is also important to recognize that recurrent laryngeal nerve injury can have significant consequences for patients, including hoarseness, difficulty speaking, and breathing problems. As such, it is important for surgeons to take steps to minimize the risk of recurrent laryngeal nerve injury during esophagectomy, such

as using nerve monitoring techniques and employing meticulous surgical technique.[17] The study has several limitations, including its relatively small sample size and the lack of incorporation of other factors that could affect the incidence of RLN injury, such as the amount of lymph node removal during surgery and the size and tumor stage of the primary tumor.

Conclusion

The study findings suggest that recurrent laryngeal nerve injury is not an uncommon complication of esophagectomy in patients with esophageal cancer. Healthcare providers should be aware of the risk factors associated with RLN injury and take preventive measures to minimize its occurrence.

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