

Clinical Significance of Recurrent Laryngeal Nerve Exposure During Esophagogastric Anastomosis of the Neck

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OBJECTIVE To investigate the clinical value in a comparison between intraoperative exposure and non-exposure of the recurrent laryngeal nerve (RLN) of the neck during left neck esophagogastric anastomosis following resection of carcinomas of the middle and inferior-segment esophagus.

METHODS From January 2003 to April 2009, 237 patients were selected to undergo resection of esophageal squamous carcinoma via posteroexternal incision of the left chest plus gastroesophageal anastomosis at the left neck incision. The 237 cases were divided into 2 groups: 115 of the total cases were in group A (the study group), cases of resections with neck RLN exposure. Of the patients in this group, 64 were male and 51 female, with a mean age of 49 ranging from 31 to 73 years. Another 122 cases were in group B (the control group), cases of resections without neck RLN exposure. In this group, 51 of the patients were male and 71 female, with a mean age of 45 ranging from 33 to 75 years. In the 2 groups, there were 9 cases in total with symptoms induced by RLN injury.

RESULTS Hoarseness, choking cough when drinking, and difficult expectoration were found in 1 of the cases (1/115) in group A (0.087%), while there were 8 cases (8/122) presenting with these symptoms in group B (6.5%). There is statistical significance in the differences of RLN injury between the 2 groups ($P < 0.05$).

CONCLUSION Analysis of study cases of esophageal carcinoma resection with left-neck esophagogastric anastomosis in the 2 groups indicated that the exposure of the RLN in group A resulted in an obviously lower rate of neck RLN injury after the surgery, compared to group B, where the RLN was not exposed. Exposure can lead to the avoidance of complications induced by RLN injury, such as dysarthria and choking cough when eating. As a result, satisfactory expectoration, which would diminish the incidence of pulmonary complications, can be reached allowing the patients to recover as early as possible. The results of our study suggest that the exposure of the RLN during the left-neck esophagogastric anastomosis has significant clinical value, and that this approach can be recommended with confidence.

KEY WORDS: esophageal neoplasm, surgical anastomosis, recurrent laryngeal nerve.

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Introduction

Esophageal carcinoma (EC) may originate from multiple sources and has the potential for submucosal metastasis^[1], with a tendency for upward infiltrative growth^[2]. Following accepted standards for EC tumor resection (a margin of resection 5 cm away from tumor), the rate of positive resection margins has been reported as 9.1%^[3]. Some authors^[4,5] believe that recurrence in the stoma represents a negative correlation to the length of the involved esophagus removed in surgery. If the upper resection margin is 10 cm away from the tumor, it may decrease the incidence of residual cancer. The excision of EC and esophagogastric anastomosis in the neck is in conformity with the principles for wide excision of EC, so as to avoid the high incidence of recurrence in the stoma (4.2%–31.3%) following surgery^[6]. Also, the procedure of anastomosis in the neck is simple and convenient, only involving moving the site of anastomosis up by 2 or 3 cm compared with the site of thoracic anastomosis. Further, the surgical site can be well-exposed^[7]. Stomal fistulas frequently occur in the neck after surgery; however, most fistulas are resolved by drainage and change of dressing. Usually, fasting is not necessary for patients with fistulas, and the postoperative mortality rate is low^[8]. In addition, gastroesophageal mucosamucosa anastomosis can be used, so as to decrease the incidence of anastomotic stenosis^[9]. Gastroesophageal anastomosis in the neck, as an important step in the surgery for removing cancer located in the middle and inferior-segment esophagus (MISE), has become increasingly popular, but it may cause RLN injury to some extent. From January 2003 to April 2009, resection of EC located in the MISE was performed in 237 cases in our hospital. In a preoperatively randomized grouping, 115 of the 237 cases who would receive surgery with exposure of the RLN were assigned to the study group (group A), and the other 122 cases were assigned to the control group (group B) in which exposure of the RLN would not be performed. Gastroesophagostomy in the left neck was performed in the 2 groups. Statistical analysis of RLN injury in the 2 groups was carried out, in order to explain the clinical advantage of RLN exposure during the surgical procedure.

Materials and Methods

Clinical data

Within 6 years and 3 months, from 2003 to 2009, esophagectomy for EC resection in the MISE was performed in the 237 patients, with a posterolateral incision on the left thorax and gastroesophagostomy in the left neck. The patients undergoing esophagectomy were divided into 2 groups, i.e. 115 of them in group A in which RLN exposure was performed, and the other 122 in group B in which RLN exposure was not performed. In group

A, 64 of the 115 patients were male and the other 51 female, with a mean age of 49, ranging from 31 to 73 years. In group B, 51 of the 122 patients were male and 71 female, with a mean age of 45, ranging from 33 to 75 years.

Surgical procedures

Posterolateral incision of the left thorax was performed in the 2 groups. In group A, after exposure of the RLN in the left neck, the stomach was lifted to the left neck via the left thoracic apex for the gastroesophagostomy. In group B, the stomach was pulled up to the cervical-segment esophagus through the thoracic cavity and was then anastomosed to the esophagus where the malignancy had been removed.

Exposure of the RLN in the left neck: The cornu inferius cartilaginis thyroideae, suspensory ligament of the thyroid gland, the inferior thyroid ligament, and the tracheoesophageal groove can be regarded as the pathway that the RLN traverses^[10]. A 6-cm incision at the anterior border of the left sternocleidomastoid muscle (SCMM) was performed, conventionally, with the inferior extremity of the incision to the sternal incisure; dissected layer by layer to expose the SCMM; dissociated from the anterior border of SCMM; and then pulled outwards from the muscle to touch its left common carotid artery. Then, the left thyroid was dissociated and exposed in order to invert it and in order to protect the left inferior thyroid artery (LITA) from improper ligation or cutting, so that the blood supply to the thyroid was not discontinued. Next, the left RLN was sought in the left RLN triangular area which was composed of the LITA, left common carotid, and tracheoesophageal groove. If it was difficult to expose the RLN, the LITA could be ligated and disconnected, and then the inversion of the thyroid and dissociation of the thyroid gland were still performed.

Since the site of RLN here was quite stationary and easy to find, the surgeon should search the RLN by way of from above down at the cornu inferius cartilaginis thyroideae 0.5 cm away from the larynx. Then downward dissociation to the superior aperture of the thorax was performed after localization of the RLN. Electric coagulation and electro-tome for these manipulations were avoided here as far as possible, in order to prevent nerve injury. The resected tumor specimens in every case were diagnosed as squamous cell carcinoma upon pathologic examination.

Results

When the neck RLN was injured, signs, such as hoarseness and adynamic coughing occurred immediately after the patients returned to consciousness. Laryngoscopy showed that vocal cord paralysis or dyskinesia occurred in 8 cases in group B and 1 in group A.

The χ^2 test was used for statistical analysis, and statis-

tical analysis was completed using the SPSS 11.5 package. The *P* value of < 0.05 was considered as statistically significant (Table 1).

Table 1. Comparison of postoperative RLN injury among the 237 cases.

Surgery types	<i>n</i>	No. of cases with RLN injury (%)	χ^2	<i>P</i>
Group A	115	1 (0.087)	5.24	< 0.05
Group B	122	8 (6.56)		

Table 1 indicates that hoarseness induced by RLN injury occurred in 1 case in group A (0.087%), which is significantly lower than that in group B (8 cases) (6.56%).

Discussion

Surgical resection of EC can result in some complications. Since the early 1960s, RLN injury has been listed as 1 of the 6 most severe complications caused by EC surgery in China. These complications include stomal fistula, pulmonary inflammation, empyema, chylothorax, surgical site infection or dehiscence, and RLN injury. Since that time, the types of complications have changed, as surgeons have learned through experience and from performing more and more surgery. The changes in postoperative complications include a further decrease in the incidence of RLN injury, whereas the symptoms, such as aortic hemorrhage and other cardiac complications have increased. Therefore, RLN injury has not been listed as a severe complication for this procedure^[11], but does still remain as one of the complications

Surgical resection is still the primary treatment for EC. Over the past 20 years, there has been an increase of carotid arterial anastomosis in cases with a reconstruction of the gastrointestinal tract. As a result, neck RLN injury may still occur^[12,13].

There are great differences in the incidence of RLN injury among patients following esophagectomy, with the incidence rate ranging from 0.14% to 7.12%^[14,15]. In recent years, the highest incidence rate of RLN injury in neck anastomosis following EC resection superior to the high midthoracic segment has reached up to 12%^[16]. The incidence rate in Japan has been reported to be very high, which might be related to the conventional neck lymphadenectomy which is popular in Japan^[17]. The physiological role of RLN is to dominate vocal cord movement. After RLN injury, hoarseness results from vocal fold abduction and loss of adduction on the involved side. Further, bucking presents when patients are on a liquid diet. This may prevent the occurrence of postoperative cough, and it may even result in aspiration pneumonia and sputum retention in patients in which the symptoms are severe and consequently make control

of pulmonary infections very difficult^[18]. Pneumonia caused by the postoperative pulmonary infection is one of most hazardous complications in thoracic surgery^[19]. Previous data have revealed a death rate of approximately 46% from pneumonia in patients receiving the conventional therapy^[20,21]. In addition, this rate could be as high as 75% in cases in which emergent incision of the trachea was performed^[21]. Severe coughing may cause a sudden disgorgment of a significant amount of endothoracic and gastric contents, and may even bring about apnea which can endanger a patient's life. Thus, protection of the RLN from injury can reduce the incidence of complications following EC surgery, and as a result, lead to a reduction in death rates.

In the cases in our study, preoperative hoarseness was not seen, and apparent external encroachment of the thoracic esophagus was not found during case selection (image analysis); therefore, this made the dissection of the thoracic esophagus easier and consequently decreased the probability of endothoracic RLN injury. Postoperative hoarseness occurred in cases in both groups. In 1 case in group A (0.087%), normal enunciation was attained 1 month after surgery. In this patient, laryngoscopy showed that the bilateral vocal cords moved normally. Therefore, intraoperative stimulation of the RLN in the neck may be the origin RLN edema seen in patients. In group B, postoperative hoarseness occurred in 8 cases (6.56%). It was confirmed by laryngoscopy that there was left vocal cord paralysis, and that compensation in the right vocal cord had developed. The injury was thus considered as a result of intraoperative dissociation of the neck RLN. The differences in RLN injury between the 2 groups were statistically significant (*P* < 0.05).

Dissociation of the thoracic esophagus and the tumor should be close to the external layer of the esophagus, and then the RLN coming from the vagus nerve stem to the side of the aortic arch should be reflected, in order to prevent damage of the vagus nerve stem on the aortic arch. Fully exposing the neck-segment RLN can decrease the risk of damage to the neck RLN in the esophagogastric anastomosis. It is similar to thyroid surgery, that when the RLN is well exposed, the incidence of neck RLN injury can be effectively lowered. Jatzko et al.^[22] reported that it was shown, in a comparison between cases with exposure of the RLN and those without, that the RLN injury rate was sharply reduced in cases with RLN exposure, revealing a significant difference between the 2 groups (*P* < 0.01). Therefore, many authors have shared the same idea that neck RLN exposure is essential for reducing the injury in the anastomosis. Our study also supports this point of view. Many Chinese authors^[23] have believed that the blood supply to the RLN should be of prime consideration, including consideration of characteristics, such as multiple vascular sources, asymmetry, introversion etc. Thorough dissociation of the entire RLN can likely result in dis-

ordered blood supply to the RLN. We believe that sufficient exposure of the neck RLN is quite important. Once RLN injury occurs, intramuscular injection of vitamin B₁ or B₁₂ can be administered intravenously, with active treatment of neck inflammation and edema and speech exercises. Dried foods are necessary when symptomatic bucking becomes severe, in addition to eating with the head up and swallowing with the head down so as to relieve the symptoms of bucking^[24]. Eating a smaller amount of food at each meal but having more than 3 meals a day is recommended. Enteral and parenteral alimentation are also essential in postoperative rehabilitation. Preventing intense coughing and active treatment for pulmonary complications, such as administration of antibiotic via ultrasonic nebulization can be performed. The treatments should be continued until compensation of function of the uninvolved vocal cord is restored, which usually takes 1 to 3 months after the surgery, while vocalization can also be improved soon after.

In summary, dissection and exposure of the RLN should be performed in the esophagogastric anastomosis in the neck, in order to prevent the injury of the RLN, and as a results, reduce some complications and death rates induced by RLN injury.

Conflict of interest statement

No potential conflicts of interest were disclosed.

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