Non-recurrent Laryngeal Nerve Identified During Robotic Thyroidectomy in a Patient with Papillary Thyroid Carcinoma

Sang Yull Kang, Seon Kwang Kim, Hyun Jo Youn, Sung Hoo Jung

Department of Surgery and Research Institute of Clinical Medicine of Chonbuk National University—Biomedical Research Institute of Chonbuk National University Hospital, Chonbuk National University Medical School, Jeonju, Korea

A non-recurrent laryngeal nerve is a rare anatomical variant that entails considerable risk for iatrogenic injury during thyroid surgery. We encountered a patient with a non-recurrent laryngeal nerve that went unnoticed on preoperative imaging but was discovered incidentally during robotic thyroidectomy. A 44 year old woman presented at our department with papillary thyroid microcarcinoma, diagnosed by ultrasonography-guided fine needle aspiration cytology. During robotic right thyroidectomy and central lymph node dissection, we could not detect any structure resembling the recurrent laryngeal nerve around the inferior thyroid artery. Thus, we suspected the existence of a non-recurrent laryngeal nerve, and successfully identified a nerve entering the larynx directly from the vagus nerve without recurring. A three-dimensional high magnification view via a robotic endoscope can aid thyroid surgeons to safely identify and preserve a non-recurrent laryngeal nerve.

Key Words: Recurrent laryngeal nerve, Robotics, Thyroidectomy, Papillary thyroid carcinoma

INTRODUCTION

One of the most important complications of thyroidectomy is vocal cord palsy resulting from recurrent laryngeal nerve (RLN) injury. The incidence of transient vocal cord palsy is reported to be 0 ~ 6%, and that of permanent vocal cord palsy is < 1%.(1) However, because hoarseness may diminish social and psychological quality of life, thyroid surgeons should be careful to identify and preserve the RLN to prevent this complication.

A non-recurrent laryngeal nerve (NRLN) is a rare anatomical variant that enters the larynx directly off the vagus nerve. This abnormal route of the NRLN is very susceptible to injury during thyroidectomy. A NRLN is embryologically associated with an aberrant right-sided subclavian artery and situs inversus on the left side.(2) Thus, several imaging studies, including ultrasonography (US) and computed tomography (CT) may provide clues about the existence of NRLN before thyroidectomy.

Use of a robotic system for thyroid surgery has cosmetic advantage and enables a more precise operation than those of a conventional thyroidectomy. It is possible to performed robotic thyroidectomy comfortably and safely as experience is accumulates in patients with low-risk papillary thyroid carcinoma (PTC).(3)

We experienced a case of NRLN that went unnoticed on preoperative imaging but was successfully identified via a three-dimensional (3D), high magnification view of a robotic endoscope. This is the first report of a NRLN identified during robotic thyroidectomy in Korea.
CASE REPORT

A 44-year-old woman visited our department to operate PTC in the right thyroid gland. She was diagnosed with PTC through US-guided fine needle aspiration cytology at a private clinic. She had no medical or family history of thyroid disease. Her general condition was good, and the physical examination was non-specific. Laboratory findings, including thyroid function tests, showed that all parameters were within normal limits.

Preoperative US revealed a 0.5×0.4 cm sized, taller than wide, hypoechoic nodule in mid-pole of the right thyroid gland (Fig. 1A). Neck CT also revealed a 0.6 cm hypodense nodule in the right thyroid gland and no metastatic lymph node in either cervical chain (Fig. 1B). Routinely, we check the presence of aberrant subclavian artery on neck CT. However, we missed the anomaly and no comment was made about the aberrant right subclavian artery on preoperative images.

Robotic right thyroidectomy and central lymph node dissection via a bilateral axillo-breast approach (BABA) was performed. We used the da Vinci surgical robot system (Intuitive Surgical, Sunnyvale, CA, USA) which consists of a 3D high magnification endoscope, multi-articulated instruments, and a hand-tremor filtering system. The robotic thyroidectomy operative technique via BABA has been described in detail by Lee et al.(3) Briefly, diluted epinephrine solution (1:200,000) was injected into the upper breast, anterior chest, and cervical area. Bilateral axillary 8 mm incision and bilateral upper circumareolar 20 mm incision were made. Trochars sized 8, 12 mm were inserted through the incisions after the flaps were raised using a tunneler and the working space was created with carbon dioxide gas insufflation at 5 mmHg of pressure. A dual-channel endoscope, 30 degree angle, was inserted through the right breast port.

Maryland forceps, ProGrasp forceps, and Harmonic Scalpel (Ethicon Endosurgery, Cincinnati, OH, USA) were inserted through the other port. A nerve monitoring device such as Medtronic was not used.

The strap muscles were divided at the cervical linea alba, and the thyroid lobes were exposed by delicately dissecting using a Harmonic Scalpel. After the isthmus was divided, the lower pole of the thyroid was dissected from the adipose tissue, and the inferior thyroid artery (ITA) was dissected to detect the RLN. Because the RLN may pass anteriorly, posteriorly, or through the branches of the ITA, the ITA is used as a surgical landmark for identifying the RLN. However, we could not detect any RLN-like structure around the ITA and suspected the possibility of a NRLN.

We rechecked the preoperative neck CT scan and found an aberrant right subclavian artery passing behind the common carotid artery and trachea (Fig. 2).

After we were convinced of the presence of the NRLN, we divided the ITA and vein for mobilization. We carefully dissected cranially along the thyroid capsule in the trachea-esophageal groove and found a nerve running parallel to the lower margin of the inferior constrictor muscle that entered the larynx beside Berry’s ligament (Fig. 3). We traced the nerve laterally and found that it merged with the vagus nerve. The nerve was compatible with a type I NRLN, as defined by Toniato et al.(2) The upper pole was drawn downward, and the superior thyroidal vessels were divided close to the thyroid gland to avoid injuring the external
branch of the superior laryngeal nerve. The thyroid gland was dissected from the trachea. Adipose tissue, including the lymph nodes around the pretracheal, paratracheal, and prelaryngeal area were dissected for the central lymph node dissection. The resected thyroid and lymph nodes were extracted through the circumareolar incision on the contralateral lesion-side in a plastic bag (LapBag; Sejong Medical, Paju, Korea). A closed suction drain was placed through the axillary incision, and the wounds were closed with subcuticular sutures. The NRLN and parathyroid glands were preserved, and no other complications occurred.

The pathological examination of the excised thyroid tissue revealed two PTCs of 0.5 cm and 0.3 cm diameters. No extrathyroidal invasion or cervical lymph node metastasis (of six lymph nodes) was detected.

She had no vocal cord palsy postoperatively, and there was no recurrence occurred during the 9-month follow-up.

**DISCUSSION**

Vocal cord palsy represents a major but avoidable complication of thyroid surgery. Therefore, visually identifying and preserving the RLN are necessary. Anatomical variations in the RLN, such as extralaryngeal branches, a distorted RLN, intertwining between branches of the RLN and ITA, and a NRLN, play an important role in the occurrence of nerve injury. The NRLN is a rare variant with an incidence of 0.3 ∼ 1.6%, and most are observed on the right side. A left-sided NRLN is extremely rare with an incidence of 0.04%.[2]

A NRLN is an anomaly resulting from an aortic arch embryological abnormality. The RLN is derived form the sixth branchial arch on both sides and originates from the vagus nerve. Structures arising from the fifth branchial arch regress during embryogenesis, and the RLN recurs around structures developing from the fourth branchial arch, which are the subclavian artery on the right side and the ligamentum arteriosum on the left side. If there is regression of the fourth arch on the right side, the right subclavian artery arises from the left side of the aorta and takes a retroesophageal course to the right axillary area. Then, the right RLN is free to migrate upward and becomes a NRLN. A left-sided NRLN is accompanied by the simultaneous occurrence of other anomalies, such as situs inversus, an aberrant subclavian artery, and an absent ductus arteriosus.[4]

Toniato et al.[2] classified type I and II NRLNs based on their course. A type I NRLN stems from the vagus nerve above the laryngotracheal junction and descends into the larynx. It mimics a branch of the superior thyroid artery. In
contrast, a type II NRLN arises from the vagus nerve below the laryngotracheal junction and runs parallel to the ITA. A type IIa NRLN runs more horizontally, whereas the type IIb has a more ascending course running inferior to the ITA trunk. This patient had a type I NRLN on the right side.

The RLN is normally protected from thyroid masses, as it passes through the tracheoesophageal groove. However, the anomalous position of a NRLN predisposes the nerve to compression by a thyroid mass. Some patients with NRLN may suffer from swallowing difficulties, hoarseness, voice changes, or a foreign body sensation. The swallowing difficulties occur because the retroesophageal subclavian artery compresses the esophagus. However, these symptoms are rare and non-specific and should be distinguished from nerve invasion by thyroid carcinoma. This patient did not have any of these symptoms.

As the NRLN is always associated with development of an embryonic arch, a preoperative diagnosis of this arterial anomaly is essential to identify the existence of a NRLN. Thus, several imaging examinations, including chest X-rays, a barium esophagogram, US, CT, and magnetic resonance angiography have been recommended. Among these examinations, a neck CT scan is very useful for predicting an aberrant subclavian artery by determining the positional relationship between the right subclavian artery and the tracheoesophagus. In this case, the preoperative neck CT scan also showed that the right aberrant subclavian artery is typically located on the dorsal side of the trachea and the right side of the esophagus. However, it went unnoticed preoperatively and was encountered incidentally during robotic thyroidectomy. The surgeon must be aware of the possibility of a NRLN and must check preoperative radiological imaging. Intraoperative neuromonitoring has also been recommended to recognize and preserve the NRLN during surgery.

Galen’s anastomosis, which occurs between the inferior and superior laryngeal nerves, may mistakenly be identified as a NRLN. Another anastomosis between the RLN and cervical sympathetic chain that mimics a false NRLN may be present. Therefore, it is important to differentiate the NRLN from these structures through a careful and meticulous dissection.

The da Vinci robotic system was developed to improve the weak points of endoscopic surgery and is a feasible, safe, and effective method for operating on patients with a PTC. The 3D high magnification endoscope magnifies the operative anatomy and vital structures, which helps preserve the RLN. In addition, the ability to multiarticulate instruments allows the surgeon to perform complex tasks in difficult areas with limited space. Although finger palpation and tactile sensation are not possible during robotic thyroidectomy, 3D high-magnification views of important surgical landmarks can help thyroid surgeons safely identify and preserve the NRLN. Therefore, a NRLN is not a contraindication for robotic thyroidectomy. Only one case report identified a NRLN during robotic thyroidectomy and this is the first report in Korea.

In conclusion, NRLN is a rare asymptomatic but important anatomical variation that is highly susceptible to damage during thyroid surgery. Preoperative radiological images, including CT, which show an aberrant subclavian artery, are useful to predict the presence of a NRLN. The precise robot thyroidectomy system is very useful to identify the NRLN. We have reported a case of NRLN that went unnoticed on a preoperative CT scan but was successfully preserved during robotic thyroidectomy in a patient with a PTC.

ACKNOWLEDGEMENTS

The authors thank the reviewers for their extremely thorough and helpful reviews and suggestions.

REFERENCES

4. Fellmer PT, Böhner H, Wolf A, Röhrer HD, Goretzki PE. A left nonrecurrent inferior laryngeal nerve in a patient with
right-sided aorta, truncus arteriosus communis, and an aberrant left innominate artery. Thyroid 2008;18:647-9.


