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Prediction of nonrecurrent laryngeal nerve before thyroid surgery—experience with 1825 cases

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ARTICLE INFO

ABSTRACT

Background: Nonrecurrent laryngeal nerve (NRLN) is a rare anatomic anomaly, which often co-occurs with aberrant right subclavian artery (ARSA). With this large case series, we present our experience of predicting the presence of NRLN by the means of chest X-ray film, thoracic computed tomography (CT), and ultrasonography.
Materials and methods: A prospective, nonrandomized study has been carried out. A total of 1825 patients with various thyroid disorders scheduled for surgery were recruited between January 2006 and July 2012. All patients underwent preoperative chest X-ray examination. Those suspected with ARSA further underwent thoracic CT scan. Unsuspected patients who had NRLN revealed by surgery were analyzed with ultrasonography postoperatively.
Results: A total of 41 patients (2.25%) were suspected to have ARSA by X-ray, of those 19 (46.3%) were confirmed by thoracic CT and proven to have NRLN upon subsequent surgery. No NRLN injury was inflicted. For the remaining 22 cases, CT scan suggested a normal right subclavian artery and none had NRLN upon surgery. For the 1784 unsuspected patients, 4 (0.22%) were discovered to have NRLN upon surgery, of those one was injured. For the 19 predicted NRLN, the time used for identifying the nerve was significantly shorter than the four cases with unsuspected NRLN ($t = -15.978$; $P = 0.000$). After the operation, all these unsuspected NRLN were confirmed to have ARSA by ultrasonography.
Conclusions: Patients scheduled for thyroid surgery should be screened for ARSA upon routine chest X-ray and thyroid ultrasonography before surgery. Detection of ARSA can accurately predict the existence of NRLN; hence prevent NRLN injury during subsequent surgery.

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1. Introduction

Anatomical anomaly has been an important factor for iatrogenic injuries. Nonrecurrent laryngeal nerve (NRLN) is a rare anatomical anomaly which lacks specific clinical symptoms. Preoperative detection of NRLN can be difficult, and the nerve may be easily injured during thyroid surgery, leading to complications such as hoarseness. Soustelle *et al.* [1] have

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Table 1 — Criteria for the suspicion of ARSA[*].		
Posteroanterior radiograph	Oblique edge	An oblique edge extends to the right from the aortic knob area. The edge produced by left lung contacts with the upper surface of the vessel as it originates from the aortic arch.
	Vessel through trachea	The vessel is demonstrated through the lucent tracheal air column, with a sharp upper or upper and lower margin or as a tubular opacity without sharp margins. Recognition as a subtle tubular opacity is facilitated by identification of the slightly greater lucency above and below the area of tubular opacity that represents the vessel. The oblique edge extending to the right from the aortic knob may also be noted.
	Mass effect	A mass projected at the right clavicle medially, sometimes slightly above or below. The mass is produced by contact of the ARSA with the right lung as the vessel "turns" to proceed upward toward the apex of the chest.
Lateral radiograph	Retrotracheal opacity	Retrotracheal opacity, rather than lucency, is noted above the aortic arch. The opacity is produced by the ARSA, which is present in, and excludes lung from, the retrotracheal area. The retrotracheal opacity, measured from the inner posterior tracheal wall to the posterior extent of the opacity, shows an anteroposterior dimension of 1.0—4.0 cm (2.6 cm in average). Some of the opacity immediately behind the tracheal air column is accounted for by the posterior tracheal wall and the esophagus.
	Aortic arch obstruction	Obscuration of the aortic arch by the retrotracheal opacity above is explained by the origin of the vessel preventing the left lung from outlining the upper surface of the aortic arch. Patients who showed retrotracheal opacity, the aortic arch was not obscured. This happens when the origin of the vessel from the arch lies slightly inferior to the upper surface of the arch, thereby not preventing lung from contacting the uppermost surface of the arch.
	Posterior tracheal imprint	A focal imprint along the posterior tracheal air column may be noted. This may occur when the retroesophageal ARSA pushes the esophagus forward, and the esophagus in turn impinges on the pliable noncartilaginous posterior tracheal wall.

[*] Adapted from Henry et al. [4].

classified the NRLN into two subtypes according to their courses. Type 1 enters the larynx at the upper edge of thyroid gland, whilst type 2 traverses in close proximity with the inferior thyroid artery and enters the larynx up and horizontally (type 2a enters the throat at above the inferior thyroid artery, and type 2b below the artery), which gives an illusion of recurrence. Compared with type 1, type 2 (type 2b in particular) is more likely to be injured for its recurrent course, as this may lead to negligence of lateral anatomy of the thyroid gland.

Developmentally, NRLN is closely related with aberrant right subclavian artery (ARSA) [2]. The two malformations share similar embryonic origin and often occur together, with similar incidences of 0.3%—1.0% and 0.4%—2.3%, respectively [3]. Detection of ARSA is therefore indicative of NRLN, and this may help to reduce the chance of iatrogenic injury [4]. The aims of this study were to prospectively evaluate the incidence and identify NRLN in a large cohort of patients scheduled for thyroid surgery and retrospectively investigate the cases where NRLN has failed to be identified.

2. Materials and methods

2.1. Study design

The study has been designed as a prospective, non-randomized study. Patients scheduled for thyroid surgery was subjected to chest X-ray for the prediction of NRLN. The results were verified with computed tomography [CT]. For a small number of patients in whom an NRLN was not predicted by the previously mentioned method but revealed by subsequent surgery, ultrasonography was used to investigate the presence of NRLN retrospectively.

2.2. Patient data

A total of 1825 patients with various thyroid diseases were recruited between January 2006 and July 2012 at the Department of Thyroid and Breast Surgery, West China Hospital, Sichuan University. Reoperations or those with thyroid diseases on the left side were excluded. The patients included 327 males and 1498 females, with an average age of 48.74 y (10—87 y). No patient presented symptoms such as hoarseness or dysphagia. All patients were operated by the same group of surgeons. All procedures of this study have been approved by the Ethics Committee of West China Hospital.

2.3. Preoperative imaging

All patients underwent preoperative assessments including chest X-ray, thyroid ultrasonography, dynamic laryngoscopy, thyroid function assay, and liver and kidney functional tests. Patients suspected to have ARSA according to the criteria listed in Table 1 underwent thoracic CT to confirm the diagnosis.

2.4. Surgery

All patients underwent surgery under general anesthesia. During the operation, the NRLN was exposed through a conventional approach. The nerve was first explored via the inferior thyroid artery. Should this be unsuccessful, a path via the inferior horn of thyroid cartilage would be tried. For those with NRLN, an effort was made to expose the nerve from its entrance into the throat to the vagus nerve. The average time for identifying the nerve after identification of the inferior thyroid artery was recorded, and the difference between patients was assessed by a Student t-test, with $P < 0.05$ regarded as being statistically significant.