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HEAD AND NECK

Medially placed vagus nerve in relation to common carotid artery: a pointer to a non-recurrent laryngeal nerve

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Abstract The aim of this study was to highlight a medialized vagus in relation to common carotid artery as an operative marker to a non-recurrent laryngeal nerve during thyroid surgeries. Three patients who underwent thyroidectomy, in who per operative diagnosis of right non-recurrent laryngeal nerve was made and the findings were confirmed radiologically by demonstration of aberrant subclavian artery were included in the study. A medially placed vagus nerve in relation to common carotid artery was the common observation in all the 3 patients. With no operative marker to identify a non-recurrent laryngeal nerve, it is more prone to injury during thyroidectomies. Vagus nerve which was constantly seen medial to the common carotid artery in all our three patients can be used as an operative marker to a non-recurrent laryngeal nerve.

Keywords Recurrent laryngeal nerve · Thyroidectomy · Carotid artery

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Introduction

Non-recurrent laryngeal nerve (NRLN) is a rarity, with a reported incidence of 0.2–1.6 % on right side and (0.04 %) on the left side [1, 2]. Rarity of the condition and lack of definitive clinical symptom, signs or an operative marker to highlight it, makes it more prone to accidental injury during thyroid surgery in comparison to a normal course recurrent laryngeal nerve (RLN). Except for a few patients who present with dysphagia (dysphagia lusoria), NRLN is usually asymptomatic. Radiological demonstration of the associated aortic arch anomalies like a right aberrant subclavian artery or situs inversus can be useful to predict an NRLN, but not feasible due to its rare occurrence. Hence, meticulous dissection and identification of the NRLN is the only guaranteed approach against nerve injury during surgery. With no specific symptoms or operative markers for an NRLN, this article is aimed to highlight the importance of a medially placed vagus nerve in relation to common carotid artery as an operative marker to identify an NRLN.

Patients and methods

Three patients, who underwent thyroid surgery in our hospital and in whom an intraoperative diagnosis of NRLN was made, were included in our study. Informed consent for surgery was obtained from all our patients included in the study. The study was approved by the institutional ethical committee. We routinely adopt a lateral to medial approach during thyroidectomy. A standardized and systematic method of identification of the RLN was followed in all our cases. After cervicotomy, the medial border of sternocleidomastoid muscle was delineated and the internal jugular vein was exposed, the middle thyroid vein when

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present was cut and ligated, the strap muscles were either cut or retracted. No other structure coursing transversely is divided until the RLN is identified. Using blunt dissection, the fascia between the common carotid artery (CCA) and the thyroid gland was opened, the CCA was traced down till it becomes the innominate artery and retracted laterally to expose the tracheo-esophageal groove. By this manoeuver, we identify the RLN in the Beahr's triangle. Branches of inferior thyroid artery were selectively ligated, anterior and posterior branches of superior thyroid pedicle were dissected and ligated close to the thyroid gland.

Case 1

A 35-year-old woman presented to our department with right-sided thyroid nodule and ipsilateral multiple cervical lymph node swellings. Patient had no symptoms of dysphagia. FNAC was consistent with papillary carcinoma thyroid. She underwent total thyroidectomy, central compartment clearance and modified radical neck dissection on the right side. Right RLN was not found as expected and a medially placed vagus nerve in relation to common carotid was encountered (Fig. 1a). As we traced the vagus superiorly, a type 2 NRLN was identified. Postoperative period was uneventful and postoperative MR angiography revealed a right aberrant subclavian artery reconfirming our intraoperative finding (Fig. 1b).

Case 2

A 50-year-old woman presented to the department with right side solitary thyroid nodule. Patient had no symptoms of dysphagia. FNAC was consistent with nodular goiter, patient underwent right hemithyroidectomy. As was in the other 2 cases, the vagus was medially placed and type 2 NRLN was encountered (Fig. 2a). Postoperative period was uneventful and post- operative CECT revealed a right aberrant subclavian artery (Fig. 2b).

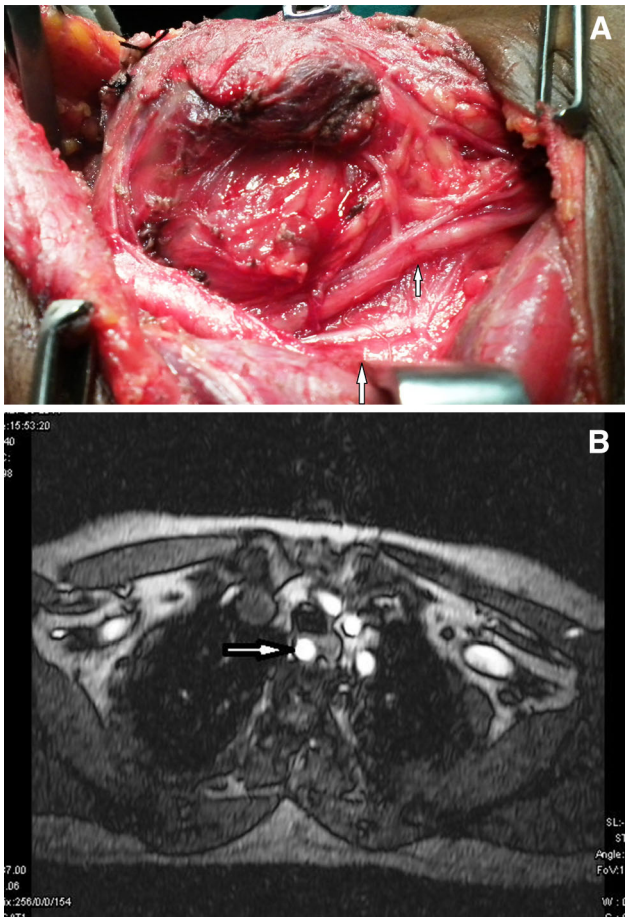

Fig. 1 **a** (Case 1) Intraoperative photograph of a medially placed right vagus nerve in relation to CCA with type II NRLN (*small arrow* vagus nerve with NRLN, *big arrow* CCA). **b** (Case 1) Postoperative MRA demonstrating a right aberrant subclavian artery (*arrow*)

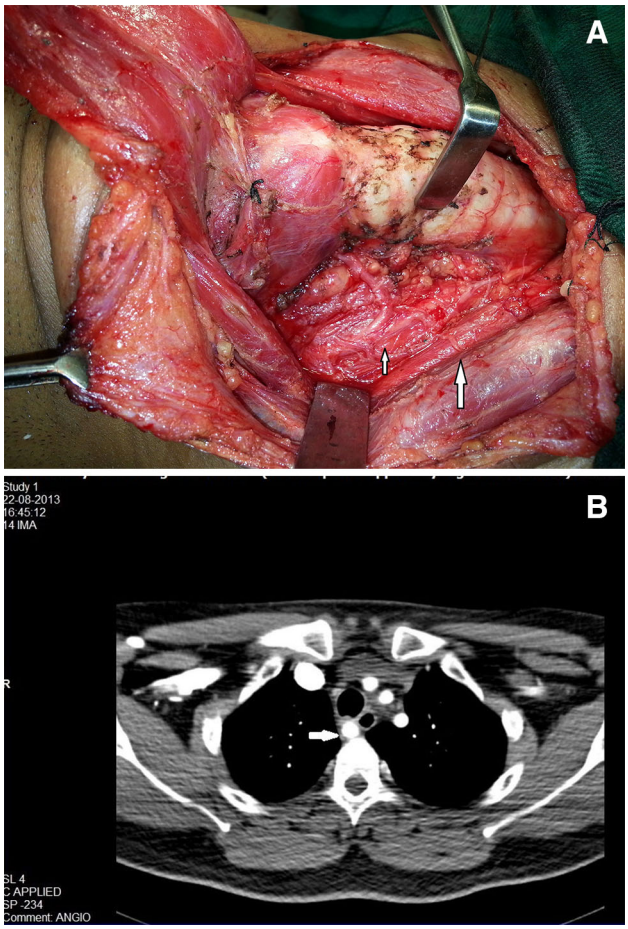

Fig. 2 **a** (Case 2) Intraoperative photograph of a medially placed right vagus nerve in relation to CCA with type II NRLN (*small arrow* vagus nerve with NRLN, *big arrow* CCA). **b** (Case 2) Postoperative CT scan demonstrating a right aberrant subclavian artery (*arrow*)

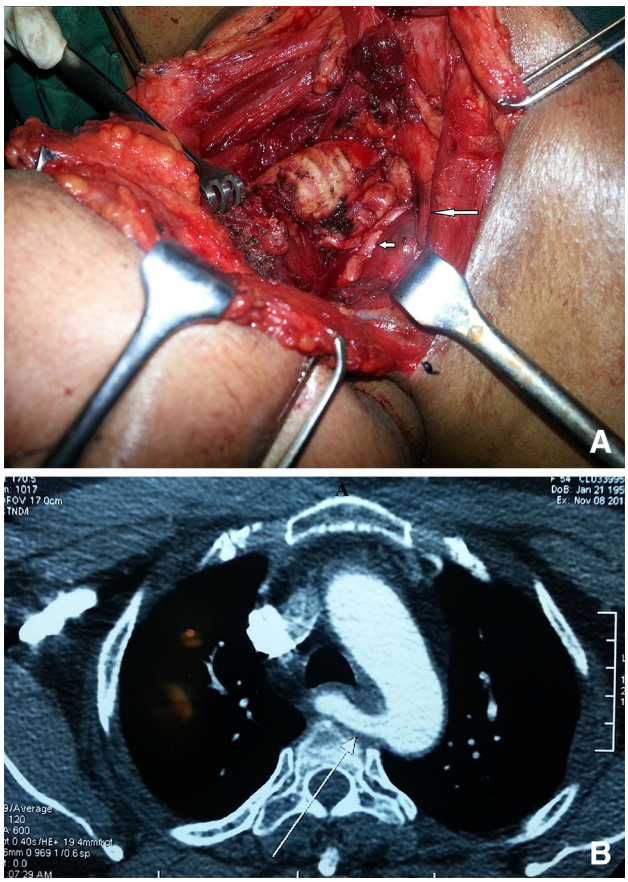

Fig. 3 **a** (Case 3) Intraoperative photograph of a medially placed right vagus nerve in relation to CCA with type II NRLN (*small arrow* vagus nerve with NRLN, *big arrow* CCA). **b** (Case 3) Postoperative MRA demonstrating a right aberrant subclavian artery (*arrow*)

Case 3

A 24-year-old male patient presented to our department with diffuse thyroid swelling. Patient had no symptoms of dysphagia. FNAC was consistent with papillary carcinoma thyroid and patient underwent total thyroidectomy and central compartment clearance. Intraoperatively, we again encountered a medially placed vagus nerve (Fig. 3a) and an empty RLN triangle on the right side. On tracing the vagus superiorly, we encountered a type 2 NRLN. Postoperative period was uneventful and postoperative contrast-enhanced CT scan revealed a right aberrant subclavian artery confirming our intraoperative finding (Fig. 3b).

Results

In all our 3 cases, the RLN triangle was empty. It was our observation on Case 1, that the vagus nerve was unusually placed medial to common carotid artery. This became our operative marker in the other 2 cases reported. A medially placed vagus nerve in relation to common carotid artery was the common observation in all the 3 patients.

Discussion

Stedman, in 1823, first made the report of the NRLN during an autopsy. Berlin, in 1935, was the first to report this anomaly on the left side. But it was not until 1932 that Pemberton reported the surgical risk of this condition, after accidental dissection of the nerve [1].

NRLN is always secondary to an aortic arch anomaly. On the right side, obliteration of fifth and sixth aortic arches allows the nerve to anchor around the fourth aortic arch which forms part of the right subclavian artery, the fourth aortic arch normally drags the nerve into the thorax during its descent. Abnormal involution of this fourth arch allows a direct origin of an aberrant subclavian artery from the arch of aorta which in turn leads to the formation of an NRLN. On the left side it is associated with dextrocardia [3].

Based on the course of the nerve, NRLN is classified into two types (type I and II) [2, 3].

Type I arises directly from the cervical vagus and runs along the superior thyroid pedicle. Type II travels along the inferior thyroid artery. Most common among these is type 2 accounting for 34–84 % of cases. There is a 1–2 % risk of injury to RLN in thyroid surgeries. In case of an NRLN, this risk gets compounded to 13–75 % and type I NRLN is more prone to injuries [1, 2].

Pre-operative diagnosis of NRLN is a rarity. Less than 6 % of patients are suspected to have this anomaly, based only on clinical symptoms. Dysphagia lusoria, secondary to an aberrant subclavian artery is the only clinical indicator of a right NRLN. It is not a reliable symptom as less than 5 % of patients with an NRLN suffer from dysphagia [4]. At times it is hard to determine whether dysphagia is due to an aberrant vessel or the thyroid swelling [5]. A left NRLN is always suspected in patients with situs inversus. Imaging to demonstrate the aberrant vessel may become imperative when the clinical suspicion is high. Various imaging modalities like chest X-ray, barium swallow, CT scan, digital subtraction angiography and MR angiography are used to demonstrate the vascular anomalies. This is used as an indirect evidence to the presence of NRLN but the rarity of this condition makes routine use of these investigations less relevant [3].

Hence, meticulous dissection and identification of the nerve, be it NRLN or RLN is the safest method. Various techniques are used in the identification of a RLN like operative markers that include the inferior edge of thyroid cartilage, Zuckerkandl's tubercle, so also the use of intraoperative neuromonitors or the manual palpation of the

RLN in the tracheo-esophageal groove [5]. With no such markers available for NRLN, it is more prone to injury specially to an unsuspecting surgeon. There is a high chance of injury(13 %) in case of an NRLN when compared to a normal coursed RLN (1.8 %) during routine thyroid surgeries, more so in type 1 NRLN, the risk increases to 70 % [1, 2].

The RLN has several variations, identification of a RLN in the triangle during surgery is one of the safest methods and failure to identify the RLN should always raise a suspicion of an NRLN. During thyroidectomy, one normally does not encounter the vagus nerve as it is situated posterolateral to the internal jugular vein and common carotid artery. It was our observation in case 1 that the vagus nerve on the right side was quite medially placed to the common carotid artery and the same was confirmed in the other two cases reported. In fact the identification of a medialized vagus nerve was our marker to an NRLN. Medialization, can be explained by the traction on the vagus by the short length of NRLN when the larynx is shifted medially [6].

We also opine, in agreement with the observation by Toniato et al. [6] that a medially placed vagus nerve can serve as an operative marker to an NRLN.

Conclusion

Identification and meticulous dissection of NRLN is the only method to prevent injury to the nerve during surgery. A medially placed vagus nerve should alert the surgeon of a possible non-recurrent laryngeal nerve and can serve as an operative marker to an NRLN, especially on the right side.

Conflict of interest The authors declare no conflict of interest and have no a financial relationship with the organization where the study was done.

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