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Laryngeal nerve morbidity in 1.273 central node dissections for thyroid cancer

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A B S T R A C T

Aim: We assess the prevalence and mechanism of recurrent laryngeal nerve (RLN) injury in central neck dissection (CND) for thyroid cancer.
Methods: CND with intraoperative neural monitoring was outlined in 1.273 nerves at risk (NAR). RLN lesions were stratified according to: timing (during thyroidectomy versus CND), segmental vs. diffuse injury, mechanism, severity, location, number of lymph nodes dissected and metastastatic. EMG parameters were recorded.
Results: 49/1.273NAR (3,8%) documented RLN palsy. 25 nerves were injured during thyroidectomy, 8 while CND. In 16 no precise moment or mechanism of injury was identified. A disrupted point could be identified in 19/25 (76%) and 7/8 (87%) respectively for thyroidectomy and CND steps. Diffuse injury, occurred in 24% and 12,5% respectively for thyroidectomy and CND. Nerves were injured in the all cervical nerve course without any major location for incidence for CND; for thyroidectomy most nerves were injured in the last 1 cm course. Traction (36%) was the leading cause of RLN injury for thyroidectomy. For solely CND, traction, entrapment and thermal injuries were equally frequent. Permanent vs. transient injuries were respectively 8% (4/49) and 92% (n.45/49), overall. Permanent lesions were equally distributed.
Conclusions: During CND, RLN palsy still occurs with routine exposure of the nerve even combined with IONM. The incidence of nerve lesions during thyroidectomy is higher than that of CND.

1. Introduction

Therapeutic central neck dissection (CND) for patients with clinically involved lymph nodes accompanies thyroidectomy to provide disease clearance [1].

Prophylactic CND (ipsilateral or bilateral) is considered in papillary thyroid carcinoma (PTC) with clinically uninvolved nodes (cN0) who have advanced tumors (T3 or T4), involved lateral nodes (cN1b), rather to plan further therapy [1].

Recurrent laryngeal nerve (RLN) injury is increased in cancer surgery [1,2]. Lesion occurs at rates of up to 8% temporary and 1–2% permanent palsy [2]. Metastatic lymph nodes make RLN dissection more difficult [3–8].

Intraoperative neuromonitoring (IONM) has been advocated to elucidate the causes of RLN injury during thyroidectomy and result from transection, clamping, stretching, thermal and ligature entrapment [9–12].

This study prospectively delineates the prevalence, location and mechanism of RLN injury exclusively during CND.

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2. Materials and methods

2.1. Patients

Protocol was approved by the Institutional Review Board of China-Japan Union Hospital, Jilin University, Division of Thyroid Surgery, Changchun (China). Written informed consent was obtained from each patient. Thyroidectomy without CND, "berry picking" dissection, pre-operatively paralyzed RLN, re-do procedure, lateral dissection exposing only the vagus nerve were excluded.

2.2. Technique of CND

Guideline regarding the terminology of CND defines all perithyroidal, paratracheal soft tissue and lymph nodes with borders extending superiorly to hyoid bone, inferiorly to innominate artery, laterally to common carotid arteries [1,13]. The technique applied is identical and the procedure adopted provides as first step isolated thyroidectomy, subsequently, as a second step, the CND is accomplished. That is, CND dissection specimen is not excised en bloc during thyroidectomy. CND is accomplished caudal to cranial. The surgical technique for prophylactic nodal dissection includes ipsilateral CND. Depending on the surgical strategy, surgeon might go back and forth between the thyroidectomy and CND components of the operation. Efforts were given to precisely describe when IONM signal loss occurred during a specific portion of operation.

2.3. Technique of IONM

Procedures were offered with intermitted IONM. IONM (NIM-Response 2.0 and lately 3.0 Systems, Medtronic, Jacksonville, Florida, USA) was performed according to standards of equipment, set-up, induction and maintenance anesthesia, EMG tube positioning verification, EMG definitions [3,14]. Surface electrodes integrated with endotracheal tube were used. Nerves were stimulated using a monopolar electrode at 1 mA, 100 ms impulse duration and 4 Hz frequency [3]. Supplementary Table S1 summarizes the standardized IONM protocol technique. Vagal nerve and RLN were checked repeatedly at each step of CND according to the needs of the surgeon and to elucidate where and how the RLN was injured (Table S1). An unchanged signal is defined when V2.0, R2.0 signals, R2.1 signals, and V2.1 signals were obtained successfully with the same stimulation level during the CND, and no apparent change existed between the comparisons [3,14] (Table S1).

2.4. Definition of loss of signal and identification of injured nerve

The following prerequisite issues are constitutive to loss of V2.1 and R2.1 signals (LOS): (a) normal VC movement at preoperative laryngeal examination; (b) initial EMG satisfactory (V1.0 and V2.0 > 500mcV); (c) no EMG response with stimulation at 1–2 mA or (d) low response <100mcV with stimulation at 1–2 mA; (e) no laryngeal twitch; (f) loss of the primary normal biphasic waveform; (g) the troubleshooting algorithm applied systematically [3,15,16]. If R2.1 and V2.1 signals were lost after complete dissection of the RLN, the disrupted point of conduction was located by the procedures that follow: the RLN was tested from the distal portion of RLN at the entry to the larynx with stimulation between 0.5 and 1 mA [3,14–16]. If a signal was obtained, then the lower portion of the nerve was tested until a response could not be elicited. Conversely, the RLN was tested from the proximal portion of the exposed nerve to the upper portion until a response was elicited. Thus, the disrupted point was located [3,14–16].

2.5. Outcomes measured

Parameters recorded on each NAR were: transient or permanent lesions, either uni- or bilateral; amplitude and latency in a standardized fashion (Table S1), the success in identifying the injured RLN, the manner in injury was identified (visual vs. IONM), circumstances that determined nerve injury [13]; location of injury; relationship between EMG parameters and number of lymph nodes resected, EMG parameters and number of positive/metastatic lymph nodes, therapeutic dissection vs. prophylactic dissection, TNM staging. RLN injuries were stratified in accordance with Chiang's classification [13].

2.6. Follow-up

Pre- and postoperative follow-up included direct laryngoscopy performed at 24 h before surgery and on the first postoperative day [17]. Dysfunction was considered permanent if persisted for >12 months [17].

2.7. Statistical analysis

Patients' data were collected in a prospective manner with a dedicated electronic Microsoft Office Access Data Base. Measurement of RLN palsy rate was based on the number of NAR. Statistical analysis was computed with SPSS, release 15.0 for Windows (SPSS Inc, Chicago-Ill, USA). The level of significance was set at P less than R.05.

3. Results

3.1. Patients

From July 2016–December 2016, 1.119 patients with PTC underwent CND. There were 237 men, 882 women; mean age 45.2 (18–82) years. 1.007 therapeutic and 112 prophylactic CNDs constituted this investigation. 154 bilateral CND and 965 ipsilateral CND were performed, covering 1.273NAR. 1.112 (99%) were PTC, 3 (0,25%) follicular, 2 (0,17%) medullary, 2 (0.17%) coexisting PTC and medullary. Mean tumor size was 22 ± 5 (4–72) mm (Table S2).

3.2. Lymph node histology

6.636 lymph nodes were extracted. 5,9 mean lymph nodes were dissected per procedure (range 0–45) (Table S2). In 58 (5,1%) CNDs, no nodes were detected. In 593 (52%) > 5 nodes were detached. 489 (43%) were pN1. There was a positive correlation between the total number of excised lymph nodes and metastases ($r = 0.183$, $P < .01$). There was a negative correlation test between the lymph nodes excised and T1a tumors ($r = -0.242$, $P < .01$), while a positive difference with T1b, T3a, T4a ($r = 0.068$, $P < .05$, $r = 0.091/0.086$, $P < .01$ respectively) (Table S2).

3.3. Normative EMG data

Complete follow-up was available for all NAR. Vagus nerve and the RLNs were correctly localized and monitored in all procedures. 1.221 (95,9%) NAR showed unchanged EMG signals after complete CND; all had normal vocal fold movement after operation. The mean ± standard deviation response amplitudes were 1.250 ± 879 μV for *V1*, 1.436 ± 749 μV for *R1*. Mean response amplitudes of *R2.1* and *V2.1* were 1.466 ± 721 μV and 1.592 ± 616 μV respectively. No false negative cases were noticed.

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