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Bilateral vocal cord palsy after total thyroidectomy—A new treatment—Case reports

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ABSTRACT

INTRODUCTION: Dyspnea due to bilateral vocal cord palsy after total thyroidectomy (BVCPATT) is a life-threatening complication; nevertheless, we try to avoid tracheotomy.**METHODS:** Using normalized glottal area (NGA), we retrospectively studied 14 patients with BVCPATT. Nine patients without dyspnea were treated conservatively, while five with dyspnea received immediate bilevel positive air-way pressure (BiPAP) treatment. Both right and left recurrent nerves were grossly intact during surgery.**RESULTS:** The mean NGA during inspiration of five patients with dyspnea was less than that of nine patients without (6.21 ± 1.57 (mean \pm standard deviation) vs. 20.5 ± 9.5 ; $p = 0.001$). The mean age of patients with dyspnea was more than that of patients without (61.6 ± 15.6 vs. 38 ± 10.2 ; $p = 0.007$). Five patients with dyspnea that occurred at 0–8 days post operation recovered within 3–17 days after BiPAP.**CONCLUSION:** Dyspnea occurred in patients with BVCPATT who were relatively older. The mean NGA during inspiration in patients with dyspnea was less than that in patients without. BiPAP might be a new treatment for dyspnea.© 2017 The Authors. Published by Elsevier Ltd on behalf of IJS Publishing Group Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Thyroid surgery is a common clinical procedure. Technical advancements have reduced the mortality rate associated with thyroid surgery to nearly zero. The incidence of bilateral vocal cord palsy (BVCP) after total thyroidectomy (BVCPATT) has been reported to be as low as 0.4–14% [1–3]. BVCPATT can lead to severe life-threatening complications.

2. Patients and methods

A retrospective review of medical charts was performed for 1707 patients who had undergone thyroid surgery at our institution between January 2011 and March 2016. The surgeries only included total thyroidectomy with or without lymph node dissection. BVCPATT identified by laryngoscopic examinations was reported in the 14 patients who were recruited into the study. The study consisted of sex, age, body mass index (BMI), using intra-operative neuromonitoring (IONM), loss of blood during surgery and operation time. Their final diagnoses included papillary cancer

(N = 6), multi-nodular goiter (N = 5), and hyperthyroidism (N = 3). Of all patients in the study group, 10 underwent total thyroidectomy, and two required redoing surgery; three underwent total thyroidectomy in combination with central lymph node dissection, and one required redoing surgery; and one underwent total thyroidectomy in combination with modified radical neck dissection and required redoing surgery. (Table 1).

Routinely, intravenous dexamethason 8 mg was given before the induction of anesthesia. IONM was selectively used for 554 patients who agreed to pay the fees for the service. Loss of signal at the level of Berry's ligament, the inferior thyroid artery of recurrent laryngeal, or at the vagal nerve, was classified as a type I loss-of-signal, while loss of signal at the entrance of the recurrent laryngeal nerve into the larynx was classified as a type II [4]. For patients who underwent surgery without IONM, the integrity of the recurrent laryngeal nerves was visually confirmed.

Patients who underwent surgery using IONM were routinely referred for consultation to an ear, nose, and throat (ENT) specialist for a laryngoscopic examination at discharge. Consultation to an ENT specialist was also obtained for patients who underwent surgery not using IONM, but who developed hoarseness or choking soon after surgery. We used ImageJ software (National Institutes of Health) to perform automated extraction of the glottal area. The distance between the anterior commissure and the vocal process

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Table 1
Characteristics of 14 patients with bilateral vocal cord palsy after total thyroidectomy.

	Total No = 14	With dyspnea No = 5	Without dyspnea No = 9	p
Age	46.4 ± 16.6	61.6 ± 15.6	38 ± 10.2	0.007 ^a
Sex (F:M)	13:01	05:00	08:01	>0.999 ^b
BMI (kg/m ²)	22 ± 4.1	22.4 ± 3.7	21.8 ± 4.5	0.6996 ^a
IONM (yes:no)	08:06	03:02	05:04	>0.999 ^b
Operation time (min)	221 ± 37	202 ± 17	231 ± 42	0.190 ^a
Blood loss during surgery(cc)	31 ± 13.8	34 ± 15.2	28.9 ± 13.6	0.606 ^a
Redo surgery (yes:no)	04:10	02:03	02:07	0.580 ^b
Procedures:				
Total thyroidectomy	10	5	5	
Total thyroidectomy +LNs dissection	4	0	4 (3:central LNs, 1:lateral LNs)	0.221 ^b
Removed thyroid:				
Rt (gm)	12.4 ± 5.4	9.7 ± 3.6	13.6 ± 5.8	0.260 ^a
Lt (gm)	17.3 ± 15.7	16.7 ± 4.2	17.5 ± 19.1	0.240 ^a
Papillary cancer (yes:no)	06:08	01:04	05:04	0.301 ^b

Rt = right side, Lt = left side.
BMI = body mass index.
IONM = intraoperative neuromonitoring.
LNs = lymph nodes.

^a Mann-Whitney U test.
^b Fisher's exact test.

was defined the gottal length. We divided the glottal area in pixels by the glottal length to determine the normalized glottal area (NGA) [5]. One of the researchers categorized vocal cords as limited movement or complete palsy. The institutional review board reviewed and approved this retrospective study (201600587B0), and informed consent was obtained from the patients. This case report was compliant with the SCARE guidelines [6].

Patients with respiratory stridor after surgery were closely observed in the respiratory care unit (RCU), and patients with dyspnea received bilevel positive air-way pressure (BiPAP) immediately. For BiPAP, the tidal volume was set to 5–10 cc/kg, the positive inspiratory pressure to 10–15 cm H₂O, the positive end expiratory pressure to 5–8 cmH₂O, and the inspired oxygen fraction (FiO₂) to 20%–35%. Oxygen saturation, measured by blood gas analysis (SaO₂) and by pulse oximeter (SpO₂), was kept above 95%, and the partial pressure of oxygen, measured by blood gas analysis (PaO₂), was maintained at 75–100 mmHg. BiPAP was removed once the dyspnea had resolved.

Statistical analyses were performed using Mann-Whitney U and Fisher's exact tests as necessary. Parametric data were presented as mean ± standard deviation (SD). Analyses were performed using SPSS Statistics for Windows, Version 20.0 (Chicago). P-values less than 0.05 were considered statistically significant.

3. Results

BVCPATT was identified in 14 (0.8%) in post-operative laryngoscopic examinations. Their symptoms included hoarseness (14 patients), choking (12), stridor (6), and dyspnea (5). Patients with dyspnea were older than those without dyspnea (61.6 ± 15.6 vs. 38 ± 10.2 years, respectively; *p* = 0.007). Sex was not significantly different between the two groups; neither was BMI, operation time, loss of blood during surgery, redoing surgery, cervical lymph node dissection, cancer or benign goiter, and weight of the removed thyroid glands (Table 1). The average post-operative day (POD) at the start of hoarseness in patients with dyspnea (0.4 ± 0.55 day) was shorter than that in patients without dyspnea (1.67 ± 1.66 day) (*p* = 0.042). Loss of signal, either type I or type II, was observed in three patients with dyspnea and four patients without. However, intact signals on both sides were found only in one patient without

dyspnea due to laryngeal trauma, and were never found in patients with dyspnea. IONM was used during surgery for eight patients, while only nerve exposure was used for the remaining six patients. The two groups were not significantly different regarding the use of IONM during surgery. The average NGA during inspiration in the five patients with dyspnea (6.21 ± 1.57) was less than that in the nine patients without dyspnea (20.5 ± 9.5) (*p* = 0.001) (Table 2). The start of hoarseness was identified at POD of less than one in all five patients with dyspnea; among them, two patients developed dyspnea immediately after extubation. Laryngoscopic examinations by the anesthesiologist showed that the vocal cords of the two patients with immediate dyspnea were in the median position. These five patients were placed on BiPAP due to dyspnea at POD 8, 1, 0, 0 and 8 respectively, and their normalize glottal areas were 7.26, 8.44, <5, <5 and 5.33 respectively. After receiving BiPAP for 7, 9, 6, 3 and 17 days respectively, all five patients recovered from dyspnea and were discharged at POD 17, 9, 10, 5 and 25 respectively, and none required tracheotomy. The NGA of two patients with immediate dyspnea after extubation increased from a median position of approximately 5.0–16.2 and 9.9 in six and three days respectively, after receiving BiPAP (Table 3). After using BiPAP, only one patient with dyspnea developed acute gastric dilatation and the other one had contact dermatitis due to BiPAP masks. All patients tolerated soft food well during the course of BiPAP

The hoarseness and choking had resolved in all 14 patients by three to 15 weeks after surgery, and none had permanent vocal cord palsy. The average hospitalization after surgery was more in patients with dyspnea (12.6 ± 6.8 days) compared to those without dyspnea (4.6 ± 0.4 days) (*p* = 0.012). The duration for recovery from hoarseness did not differ significantly between the patients with dyspnea (8.0 ± 3.9 weeks) and those without dyspnea (5.7 ± 2.8 weeks) (*p* = 0.147).

A female patient had bilateral loss-of-signal of the recurrent laryngeal nerves at the entry of the larynx (i.e. type II) and developed dyspnea immediately after extubation at POD 0. The laryngoscopic examination by the anesthesiologist identified median adduction palsy of the vocal cords, with a normalized glottal area of less than 5 (no picture). The patient received BiPAP immediately and was transferred to the RCU. After six days of BiPAP, her NGA had increased to 16.3 and 21 during inspiration

Table 2
Post-operative day (POD) at start of hoarseness, applications of IONM during surgery, laryngoscopic findings, and normalized glottal area in 14 patients with bilateral vocal cord palsy.

Total (No = 14)	With dyspnea (No = 5)	Without dyspnea (No = 9)	p
POD at start of hoarseness 1.21 ± 1.48	0.4 ± 0.55	1.67 ± 1.66	0.042 ^a
IONM	Rt:Lt	Rt:Lt	
not done	1:1 (No = 2)	4:4 (No = 4)	>0.999 ^b
type I loss of signal	0:1	3:1	
type II loss of signal	3:2 (No = 3)	1:3 (No = 5)	
Intact	0:0	1 ^c :1 ^c	
Laryngoscopic examination	Rt:Lt (No = 10)	Rt:Lt (No = 18)	
limited movement	0:1 (No = 1)	2:2 (No = 4)	0.626 ^b
Palsy	5:4 (No = 9)	7:7 (No = 14)	
Normalized glottal area 15.4 ± 10.4 during inspiration	6.21 ± 1.57	20.5 ± 9.5	0.001 ^a

IONM = intraoperative neuromonitoring.

Rt = right, Lt = left side.

Normalized glottal area = Glottal area/length between anterior commissure and vocal process.

^a Mann-Whitney U test.

^b Fisher's exact test.

^c Hematoma of right and left vocal cords.

Table 3
Post-operative day (POD) at start of hoarseness, stridor, and dyspnea; duration of BiPAP application; normalized glottal gap during inspiration before and after application of BiPAP; and complications after BiPAP application in five patients with dyspnea due to bilateral cord palsy after total thyroidectomy.

No.	Patients with dyspnea				
	1	2	3	4	5
POD at start of hoarseness	1	1	0	0	0
POD at start of stridor/dyspnea	1/8	1/1	0/0	0/0	0/8
Normalized glottal area during inspiration before BiPAP application	7.26	8.44	5 ^a	5 ^a	5.33
Days of BiPAP application	7	9	6	3	17
Normalized glottal area during inspiration after BiPAP application	not check	16.7	16.2	9.9	17.8
Complications after BiPAP application	no	no	gastric dilation	no	face dermatitis

^a In median position.

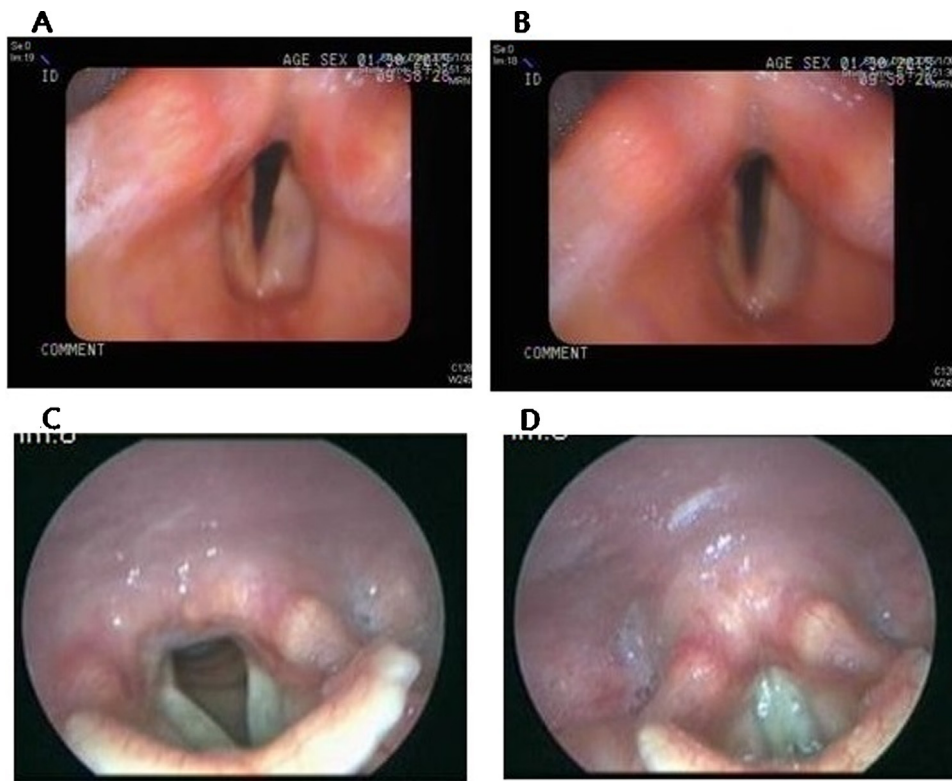
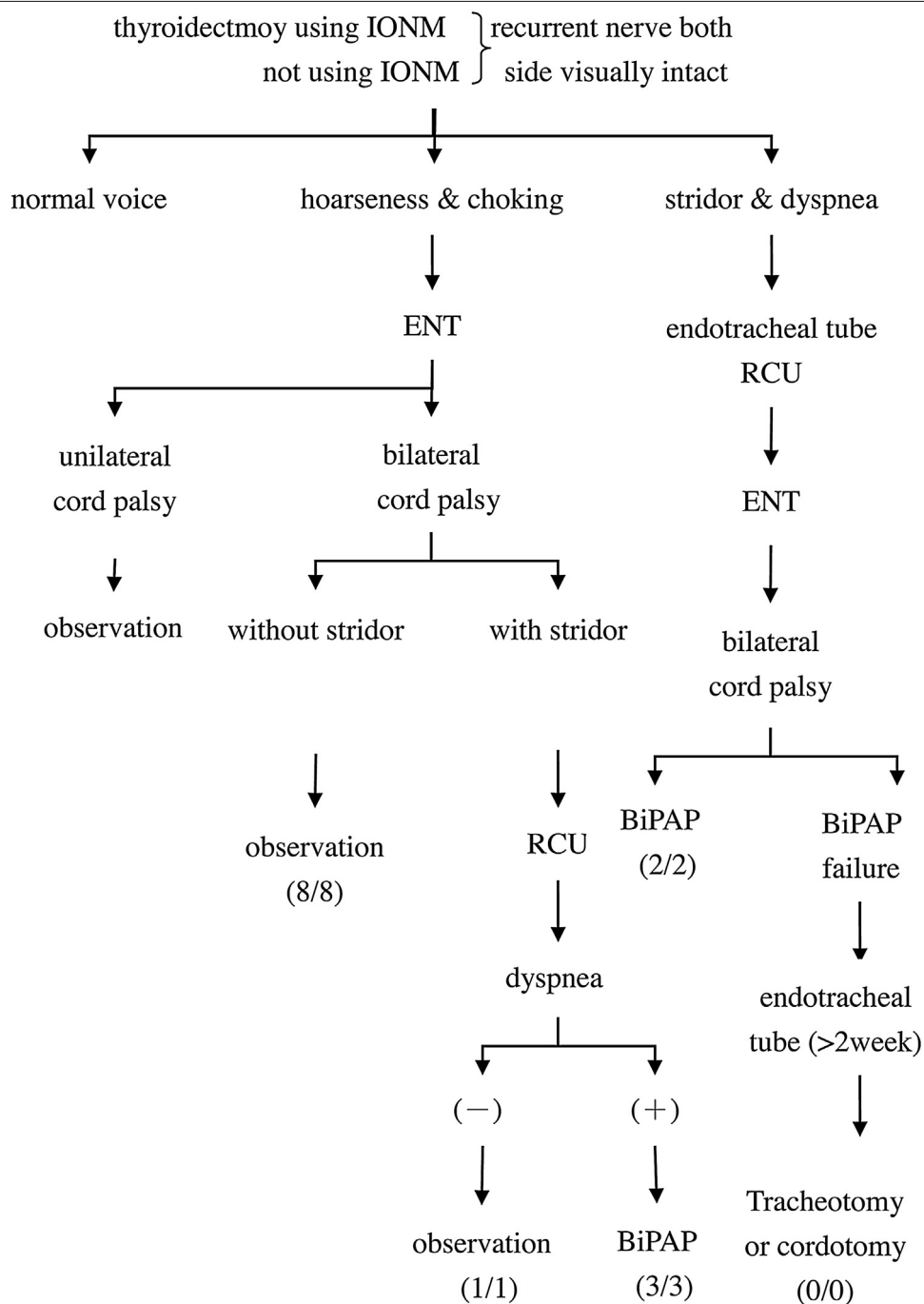


Fig. 1. Type II loss-of-signal of the recurrent laryngeal nerve bilaterally was identified during surgery. The patient developed stridor and dyspnea immediately after extubation. The emergent laryngoscopic examination by the anesthesiologist showed the vocal cord to be in the median position, with an estimated normalized glottal area of less than 5 (not pictured). After six days of BiPAP, the normalized glottal area increased to 16.32 during inspiration (1A) and 21.02 during expiration (1B), and the patient recovered from dyspnea. Four weeks after surgery, a complete recovery of vocal cord functions was evident during inspiration (1C) and phonation (1D).

Table 4
Flow chart for treatment of dyspnea due to bilateral vocal cord palsy after total thyroidectomy.



ENT = ear, nose and throat specialist, BiPAP = bilevel positive air-way pressure, RCU = respiratory care unit.
(/) = successfully treated patients in our study.

and expiration, respectively (Fig. 1A, B). She was discharge at POD 10, with complete recovery of vocal cord function at four weeks after surgery, as assessed by inspiration (Fig. 1C) and phonation (Fig. 1D).

4. Discussions

BVCPATT was quite rare, with an incidence rate of about 0.80% in this study. Bilateral vocal cord palsy (BVCP) may result from various causes, including endotracheal intubation [7], laryngeal mask [8], unidentified causes [9], use of IONM [10], and thyroid surgery itself

[11,12]. In almost half the patients with dyspnea as the main symptom of BVCP, temporary tracheotomy or surgical glottis widening procedures had to be performed [13]. In this study, we found that dyspnea occurred more in old than in young patients with BVCPATT. The loss of vocal cord pliability with aging and especially with glottal insufficiency or respiratory dysfunction made elderly patients prone to dyspnea [14]. BVCP can be transitory or permanent, may occur in adduction or abduction, may be complete or incomplete and may recover from 1 day to 12 months [13,15] in idiopathic and traumatic patients, while no recovery of paralysis is shown in malignancy-associated paralysis [13]. Although

we used intravenous dexamethasone routinely before the induction of anesthesia, to diminish nerve injury during thyroidectomy [16], BVCPATT still happened. True vocal cord adduction, in median or paramedian positions, reduces the glottal gap and increases resistance to respiration [11,12]. All five patients with dyspnea recovered within 3–17 days after receiving BiPAP without endotracheal intubation or tracheotomy. Since a recovery was reported in 79–87.5% of patients with BVCPATT [3,17], we proposed that BiPAP might be used to manage BVCPATT. The use of BiPAP could increase the NGA and shorten the period of dyspnea due to transient BVCPATT, with duration of 3–17 days observed in this study. Hoarseness resolved between 3 and 15 weeks after surgery. Our proposed treatment of vocal cord palsy after thyroidectomy is shown in Table 4.

If hoarseness or choking is found after thyroidectomy, consultation to an ENT specialist should be requested for a laryngoscopic examination to confirm the vocal cord dysfunction.

Observation is recommended for patients with unilateral cord palsy and with BVCPATT without stridor. Patients with BVCPATT with stridor should be transferred to the RCU, and BiPAP is recommended for those with dyspnea.

If patients' SaO₂, SpO₂ and PaO₂ cannot be maintained by BiPAP, an endotracheal tube is necessary. If the endotracheal tube cannot be weaned within two weeks, patients are advised to have tracheotomy or cordotomy.

This is the first report so far about BiPAP for the treatment of BVCPATT. This method might be beneficial to patients and surgeons.

5. Conclusions

Dyspnea occurs in patients with BVCPATT and NGAs during inspiration are less in patients with dyspnea than in patients without. BiPAP might be a new treatment.

Conflicts of interest

No conflict of interest to disclose.

Funding

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Ethical approval

Yes.

Author contribution

Dr. Fong-Fu Chou the main author, took part in study design, data collection, data analysis and writing.

Dr. Cheng-Ming Hsu and Dr. Chi-Chin Lia took part in laryngoscopic examinations.

Dr. Yi-Chia Chan took part in data analysis and literature review.

Dr. Shun-Yu Chi took part in data collection.

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