

ORIGINAL ARTICLE

Bamboo Nodes of Vocal Fold — A Clinical Study of 14 Cases

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Key words: bamboo nodes; autoimmune disease; hoarseness; voice abuse; conservative treatment

Objective Bamboo node (BN) of vocal folds is a rare disease which is mostly associated with autoimmune diseases and always involves women as reported in literature. The purpose of this study is to investigate the clinical characteristics and the treatments in a series of BN cases.

Methods We retrospectively collected and reviewed clinical information of all patients who presented bamboo nodes by fiberoptic laryngoscopy from 2011 to 2020 in our hospital, including the demographic information, clinical symptoms, associated autoimmune diseases, voice abuse, treatments, and outcomes. Patients were followed up periodically at clinics with fiberoptic laryngoscopy and/or voice recovery evaluation using the self-assessed voice visual analog scale (VAS).

Results Totally 14 patients were diagnosed with BN and were included in the study. BN involved both women (8/14, 57.1%) and men (6/14, 42.9%). Bilateral lesions were found in 13 patients (92.9%). The most common symptom of BN was hoarseness (100%). Ten (71.4%) of 14 patients experienced voice abuse. Thirteen (92.9%) of them were concomitant with autoimmunity disease, and received medication therapy for the underlying autoimmune diseases; one patient received anti-acid treatment for the gastroesophageal reflux disease. Voice rests were performed in all patients. Voice recovered completely in 3 cases (21.4%), improved remarkably in 8 cases (57.1%), improved slightly in 1 case (7.1%), and no improvement in 2 cases (14.3%).

Conclusions BNs are mostly associated with autoimmune disease and vocal abuse. It may occur in both females and males. Conservative treatment for the underlying autoimmune diseases and vocal rest are beneficial to voice recovery in most of the patients, and can be used as the first choice of treatment.

BAMBOO nodes (BNs) of vocal folds are characterized by unique creamy transverse submucosal bands on the surface of the middle third vocal folds. BN is a rare

condition that globally there have been only 85 cases reported in the literature.^[1-23] Most are sporadic cases, large series of BN cases are very few. BN were mostly associated with autoimmune diseases and always suffered by women according to the literature.^[20,23] In the current study, we retrospectively investigate the symptoms, characteristics and treatments of 14 BN cases for the purpose to enrich the understanding of this rare disease. To our knowledge, this is the third largest series of BN reported in the literature.

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PATIENTS AND METHODS

Clinical setting and data collection

This retrospective clinical study was approved by the institutional review board, and patient's consent were waived. We retrospectively collected all the patients that were diagnosed as BN by fiberoptic laryngoscopy from June 2011 to October 2020 at the department of otorhinolaryngology of Peking Union Medical College Hospital.

The clinical data we collected included sex, age at diagnosis, symptoms, occupation, voice abuse (speaking more than 4 hours per day), comorbidities, treatment, and outcomes of voice at follow-up from the clinical charts of their medical records. Visual analog scale (VAS) was used at diagnosis and after treatment to assess the severity of hoarseness and voice recovery by the patients themselves. The voice was scored as 10 for the most severe hoarseness or dysphonia, and 0 for the normal voice. Patients who were detected with BN by fiberoptic laryngoscopy but had no previous history of autoimmune disease, or were not suffering from an autoimmune disease, were referred to experienced rheumatologists for further evaluation for systematic autoimmune diseases.

Treatment and follow-up

Patients with concomitant autoimmune disease received immune treatment in the department of rheumatology and clinical immunology. Meanwhile, all the patients were prescribed voice rest by the otorhinolaryngologist. Patient who wanted to achieve quick effectiveness by surgery received immunosuppressant combined with microphonosurgery. Patient with no autoimmune disease was treated according to the underlying disease. All patients were followed-up periodically at the out-patient clinics by fiberoptic laryngoscopy on the rheumatologist's or the otolaryngologist's advice.

Data analysis

Demographic and clinical features are described and presented as numbers and percentages. Continuous variables are presented as the mean and standard deviation or the median depending on the type of distribution. Sex, age, time with hoarseness (months), occupation, vocal abuse, comorbidities, medical treatments, voice rest, follow-up (months), and outcome of voices at the last visit were recorded.

The outcomes of treatment for BN were evaluated

by voice recovery at follow up. Voice improvement was assessed as the percentage of VAS score change after treatment, and categorized as recover completely (VAS score reduced to 0), remarkably (VAS score improving >80%), slightly (VAS score improving 30-80%), and no improvement (VAS score improving <30%).

RESULTS

A total of 14 consecutive cases with BN in our clinics were included in our study. Among them, 8 were female (57.1%) and 6 were male (42.9%), the ratio of female to male was 1.3. The mean age at diagnosis of BN was 39.3 ± 14.9 years old (range, 19 - 69 years old). The mean time of follow-up was 27.6 ± 28.9 months (range, 6-106 months). The details of diagnosis, treatment, and outcomes of 14 BN cases were presented in **Table 1**.

The frequent symptoms were hoarseness (14/14, 100%), vocal fatigue (5/14, 35.7%), voice breaks (3/14, 21.4%), unstable voice and dysphonia without dyspnea (1/14, 7.1%). Voice abuse was found in 10 (71.4%) of 14 patients.

Of all 14 patients, creamy submucosal transverse bands were found on the middle third of the vocal cords, perpendicular to the free vocal cord edge, as discovered by fiberoptic laryngoscopy (**Fig. 1**). Bilateral vocal cords were involved in 13 cases (92.9%), unilateral cord involved in 1 case. In all cases, the vocal folds of both sides moved normally.

Prior autoimmune diseases were found in 12 (85.7%) patients. Of the other 2 patients who were referred to rheumatologist for autoimmune workup, one was finally diagnosed with primary Sjögren syndrome, the other was a male patient who experienced hoarseness for 3 months. The latter had a history of gastric ulcer with gastroesophageal reflux disease and smoking history for 38 years; he was finally excluded from autoimmune disease after 24-month follow-up.

Therefore, 13 (92.9%) patients of BN were concomitant with isolated or multiple autoimmune diseases, including mixed connective tissue disease (MCTD) in 4 cases, systemic lupus erythematosus (SLE) in 3 cases, Sjögren's syndrome (SS) in 2 cases, dermatomyositis (DM) in 2 cases, Anti-Jo-1 antisynthetase syndrome (AS) in 1 case, IgG 4 related disease (IgG 4 RD) in 1 case, and rheumatoid arthritis (RA) in 1 case.

Regarding the treatment, the 13 patients with concomitant autoimmune disease received immune

treatment: oral steroids alone in 4 cases; oral steroids combined with immunosuppressant in 5 cases; oral steroids, immunosuppressant combined with anti-acid in 1 case; oral steroids, immunosuppressant combined with microphonosurgery in 2 cases, which had been reported previously;^[17,19] traditional Chinese medicine alone in 1 case because of being afraid of side effect of immunosuppressant. No patient received intra-lesion steroid injections. For the patient without autoimmune disease, reducing smoking for 24 months and anti-acid treatment for 3 months were prescribed. Meanwhile, voice rest were prescribed for all 14 patients.

At follow-up, voice recovered completely in 3 (21.4%) cases, voice improved remarkably in 8 (57.1%) cases, improved slightly in 1 case. There were 2 cases whose voice had no improvement. They both used voice intensively and did not follow doctor's advice; one of them took traditional Chinese medicine for worrying about the potential side effects of steroid.

Laryngoscopy performed in all patients at follow up revealed that lesions of vocal fold decreased in size remarkably in 4 (28.6%) patients, and in 1 patient who received treatment of prednisone and immunosuppressant for 5.5 years, the bamboo nodes disappeared, as reported previously.^[19] Of the rest 7 cases, no significant change was observed in lesion size. Generally, the smaller the lesion size, the better the voice.

DISCUSSION

Bamboo nodes of vocal folds is an infrequent disease of vocal fold, which was firstly described by Hosako *et al.* in 1993.^[1] It is a rare condition and reported mainly as sporadic case. The details of reported cases in the literature have been summarized in **Table 2**. There have been only 4 case series, comprising 19, 15, 11, 10 cases respectively so far. Our study reports 14 cases of BN, which is the third largest case series of

Table 1. Demographic and clinical features of 14 cases with bamboo nodes of vocal folds.

Case No.	Sex	Age (yrs)	Time with symptoms (months)	Occupation	Vocal abuse	Comorbidities	Medical treatments	Voice rest	Follow-up (months)	Outcome of voices
1	M	42	6	Engineer	+	AS	Oral pred, CTX, surgery	+	66	Recover completely
2	M	47	1	Wagon driver	-	Dermatomyositis	Oral pred, MTX, Anti-acid	+	6	Improved remarkably
3	M	55	2	Office clerk	-	RA, Urticaria	Oral pred, CTX	+	30	Improved remarkably
4	M	57	6	Actor	+	GERD, no autoimmune disease	Anti-acid	+	15	Improved slightly
5	F	21	3	Teacher	+	SLE	Oral pred, MTX	+	9	Improved remarkably
6	F	27	20	Office clerk	+	MCTD	Oral pred	+	14	Improved remarkably
7	F	28	24	Engineer	-	MCTD	Oral pred	+	12	Improved remarkably
8	F	32	12	Nurse	+	SLE	Oral pred, MMF	+	30	Improved remarkably
9	F	32	30	Housewife	+	MCTD, carcinoma of thyroid	Oral pred	-	11	No Improvement
10	F	38	36	Business woman	+	SLE	Oral pred	+	39	Recovered completely in 10 months
11	F	69	60	Housewife	+	SS+, IgG4 RD	Oral pred, CTX	+	8	Improved remarkably
12	F	19	12	Student	+	MCTD	Oral pred, tacrolimus, surgery	+	106	Recovered completely
13	M	44	5	Housewife	+	SS	Traditional Chinese medicine	-	13	No improvement
14	M	38	12	Engineer	-	Dermatomyositis	Oral pred, CTX	+	4	Improved remarkably

AS, Anti-Jo-1 antisynthetase syndrome; RA, rheumatoid arthritis; GERD, gastro-esophageal reflux disease; SLE, systemic lupus erythematosus; MCTD, mixed connective tissue disease; SS, Sjögren's syndrome; IgG4 RD, IgG4 related disease; MTX, methotrexate; CTX, cyclophosphamide; MMF, mycophenolate mofetil; Pred, prednisone.

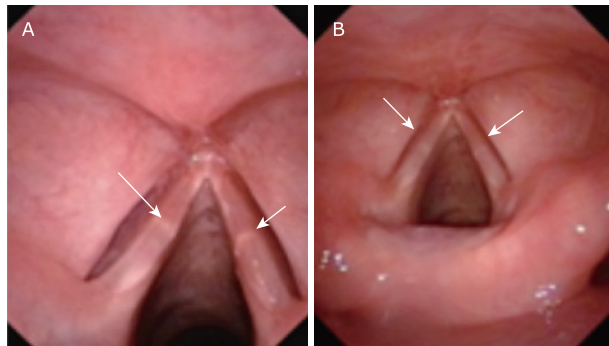


Figure 1. Fiberoptic laryngoscopy findings of a 28-year-old female patient (Case 7) with mixed connective tissue disease for 3 years and hoarseness for 24 months.

(A) White transverse submucosal bands of bilateral vocal folds (white arrow) resembling bamboo nodes, which suggested the diagnosis in 2018. (B) After conservative treatment for 1 year, decreases of the lesions in size (white arrow) were observed.

BN by far.

The diagnosis of BN of vocal cords is based on laryngoscopy, which reveals unique creamy transverse submucosal bands on the cephalic surface of the mid portion of the membranous vocal folds, isolated or multiple, and bilateral involvement of vocal folds is more frequent than unilateral involvement.^[20]

BN is usually associated with autoimmune diseases, such as SLE, RA, SS, autoimmune hepatitis, Hashimoto thyroiditis, progressive systemic sclerosis, MCTD, and AS.^[7, 20, 21, 23] In most cases, BN was recognized in patients with pre-existing autoimmune disease, occasionally before the diagnosis of the autoimmune disease. BN can be isolated with or without serologic abnormalities.^[22, 15] Among our case series, 92.9% were associated with isolated or multiple autoimmune diseases, most of which were pre-existing disorders, and one was diagnosed as SS after diagnosis of BN. The associated autoimmune diseases listed in decreasing order of frequency were MCTD, SLE, SS, DM, AS, RA and IgG 4 RD in our study. No vocal cord paralysis exists. In only one patient, the BN was not concomitant with autoimmune disease, which was confirmed by 24 month of follow-up in our study. Causes of BN other than autoimmune disease has been reported previously.^[6,15] This case needs longer follow-up and further investigations.

In previous reports, BN was most frequently suffered by women.^[6,20,23] However, in our series, we recognized BNs in 6 men, with the female to male ratio of

1.3. BNs that suffered by male patient have been rarely reported in the literature.

In our BN series, the frequent symptoms were hoarseness, vocal fatigue, voice breaks and unstable voice without dyspnea, which was consistent to the previous reports.^[7,23] The mean age at diagnosis was 39 years, ranged from 19 to 69 years, which is consistent with the previous reports.^[7,20] The youngest patient as reported in the literature was a 13-year-old girl,^[15] however, we did not recognize child patient of BN in our series. This discrepancy was perhaps due to children patients usually go to the pediatric department or Children's hospital in our city, and we seldom perform laryngoscopy for children at our hospital.

The pathology of BN lesions of vocal folds had revealed the submucosal fibrinoid necrosis, granulomatous lesions, and circulating immune complexes deposited on the walls of micro-blood vessels in bamboo nodule, and hypertrophy of micro-blood vessels wall in a laminar pattern, accompanied by infiltrations of macrophages and lymphocytes.^[12,17,19]

The pathophysiologic mechanism of BN formation remains unclear. There were mainly two hypotheses: 1) autoimmune lesions, since most BNs were associated with autoimmune diseases and circulating immune complexes deposition in lesions on vocal folds; 2) microphonotrauma secondary to vocal abuse, as BN lesions are located in the mid portion of vocal folds, the site with maximal aerodynamic and muscular forces,^[12,24] and most BN patients experience voice abuse.^[23] Autoimmune diseases are associated with 92.9% of all cases in our study, and vocal abuse was found in 71.4% of our BN patients. These findings are consistent to the previous reports and support the above hypotheses.

There exists no consensus on the treatment for BN.^[20] The first-line treatment recommended by most authors is conservative treatment for both causative factors—autoimmune diseases and mechanical factor—phonotrauma, including steroids and immunosuppressive medication, and speech therapy / vocal rest.^[20,23] If dysphonia after nonsurgical approaches still bother patients, local injection of steroids and microphonosurgery are regarded as the second-line treatment.^[6,25] Recurrence of BN has been observed after surgery,^[4] therefore treatment of the underlying autoimmune disease is preferred to the surgical removal.

In our case series of BN, voice improvement was achieved in most patients by exclusive maximal

Table 2. Published cases of bamboo nodes of the vocal folds in the literature

References	Number of patients	sex	Age (yrs) ^a	Comorbidities	Treatments
Hosako <i>et al.</i> ^[1]	1	F	28	SLE	Oral steroids
Nishinarita M <i>et al.</i> ^[2]	1	F	51	AIH, UCTS	Oral steroids
Tsunoda and Soda ^[3]	1	F	52	SLE, AIH	Oral steroids
Hosako-Naito <i>et al.</i> ^[4]	4	F	34	SLE, HD, PSS, ANA+	Surgery
Murano <i>et al.</i> ^[5]	2	F	32	SLE, SS	Surgery, oral steroids
Perouse <i>et al.</i> ^[6]	19	F	NA	RA, SLE, SS, MCTD	Surgery
Ylitalo <i>et al.</i> ^[7]	11	F	37	RA, SLE, PSS, SS, MCTD, arthralgia, myalgia, proteinuria	Oral steroids, surgery
Ramos <i>et al.</i> ^[8]	5	F	35	MCTD, SLE	Oral steroids
Immerman and Sulica ^[9]	1	F	24	RA	Oral steroids
Schwemmle and Ptok ^[10]	1	F	46	MCTD	Steroid injections
Hilgert <i>et al.</i> ^[11]	3	F	37	MCTD	Speech therapy, oral steroid
Li <i>et al.</i> ^[12]	1	F	38	ANA+	Surgery
Webb and Payne ^[13]	1	F	48	RA	Oral steroids
Woo <i>et al.</i> ^[14]	2	F	48	RA, SLE	Surgery, oral steroids
Schwemmle and Ptok ^[15]	1	F	13	NO	Speech therapy, steroid injections
Bitter <i>et al.</i> ^[16]	1	F	31	SS	Speech therapy, surgery, steroid injections
Wu and Gao ^[17]	1	F	19	CTD	Oral steroids, surgery
Schwemmle <i>et al.</i> ^[18]	1	F	43	MCTD	Speech therapy, steroid injections, surgery
Fan and Chen ^[19]	1	M	46	AS	Oral steroids, surgery
Todic J <i>et al.</i> ^[20]	10	F	37	SLE, RA, SS, HD, MCTD, ANA+	Speech therapy, oral steroids, steroid injection, surgery, antacid
Kim M and Sadoughi B ^[21]	1	F	56	AS	Oral steroids
Hanai <i>et al.</i> ^[22]	1	F	27	Anti-SS-A, Anti-SS-B +	Oral steroids, surgery
Oker <i>et al.</i> ^[23]	15	F	38	SLE, RA, SS, AS, CD	Speech therapy, autoimmune treatment, steroid injection
present study	14	F8/M6	39	MCTD, SLE, SS, AS, DM, RA, IgG4 RD	Speech therapy, oral steroids, surgery, antacid

SLE, systemic lupus erythematosus; AIH, autoimmune hepatitis; UCTS, undifferentiated connective tissue syndrome; HD, Hashimoto disease; PSS, progressive systemic sclerosis; RA, rheumatoid arthritis; SS, Sjögren syndrome; ANA, antinuclear antibody; MCTD, mixed connective tissue disease; CD, Crohn disease; DM, dermatomyositis; AS, ankylosing spondylitis; IgG4 RD, IgG4 related disease; NA, not available; NO, not specified. ^a Mean of age in a case series.

medication for autoimmune disease and vocal rest. For the 2 cases who did not achieve voice improvement after conservative treatment, the main reasons we consider lie in the insufficient vocal rest and poor adherence to the medication. The outcomes of our BN series suggest that autoimmune disorders and voice abuse are crucial for BN formation. We recommend maximization of immunosuppressive treatment in cases with autoimmune diseases; vocal rest is beneficial to the voice quality and can be used as an adjunctive therapy. Anti-acid treatment in BN case with gastro-

esophageal reflux also benefit to the voice recovery. Microphonosurgery may be considered for refractory cases.

The total recovery rate of voice remains less than a quarter. Therefore, early treatment may lead to a better outcome for BN patients. Clinically, for patients with severe hoarseness, doctors are often more aware of laryngeal disorders than the underlying diseases. This study suggest hoarseness with BN of vocal folds strongly suggest autoimmune diseases, which need to be attached importance to both otolaryngologists and

rheumatologists.

In conclusion, BN is not a disease of voice fold itself, but rather a manifestation of underlying autoimmune diseases. It may affect both women and men. Patients with BN of vocal folds should be referred to rheumatologist for further workup of autoimmune diseases. Conservative treatments for the underlying autoimmune diseases are beneficial to the patients mostly.

Conflict of interests

None.

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论著

声带竹节病 —— 14 例临床病例研究

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摘要

目的 声带竹节病系与自身免疫病相关的罕见疾病，文献报道声带竹节病仅见于女性。本研究旨在进一步探讨声带竹节病的临床特点和诊疗经验。

方法 回顾性搜集 2011 至 2020 年北京协和医院诊断为声带竹节病的全部患者及相关临床信息、伴随的自身免疫病、用声情况及治疗方法。患者定期门诊随访，行纤维喉镜随诊声带情况及采用嗓音视觉模拟量表自我评估声音恢复情况。

结果 共获得 14 例诊断为声带竹节病的患者，13 例 (92.9%) 患者双侧声带受累。女性 8 例 (57.1%)，男性患者 6 例 (42.9%)。最常见的症状为声音嘶哑 (100%，14/14)。用声过度占 71.4% (10/14)。13 例 (92.9%) 为自身免疫病患者，给予针对自身免疫病的药物治疗和嗓音休息；1 例为胃食道返流患者，接受抗酸治疗和嗓音休息。3 例 (21.4%) 患者声音完全恢复，8 例 (57.1%) 患者声音显著恢复，1 例 (7.1%) 患者轻度恢复，2 例 (14.3%) 患者声音无改善。

结论 声带竹节病与自身免疫病和用声过度有关。男女均可受累。自身免疫病的药物治疗和嗓音休息对大多数患者声音恢复有益，可作为本病的首选治疗。

关键词：声带竹节病；自身免疫病；声音嘶哑；用声过度；保守治疗