Laryngoscopy-based scoring system for the diagnosis of vocal fold leukoplakia: A preliminary study

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Abstract

Objective: To propose a scoring system based on laryngoscopic characteristics for the differential diagnosis of benign and malignant vocal cord leukoplakia. Design: Retrospective study. Setting: Tertiary hospitals Participants: Laryngoscopic images from 200 cases of vocal cord leukoplakia were retrospectively analyzed. The morphologies of vocal cord leukoplakia under laryngoscopy were evaluated by two laryngologists. Main outcome measures: The laryngoscopic signs of benign and malignant vocal cord leukoplakia were compared, and statistically significant features were assigned and accumulated to establish the leukoplakia finding score (LFS). Results: A total of five indicators (size, thickness, texture, hyperemia, and anterior commissure involvement) associated with malignant vocal cord leukoplakia were included to construct the LFS, with a possible range of 0–10 points. The diagnosis of malignant vocal cord leukoplakia as a score of [?]6 points was the most efficient. The sensitivity, specificity, and accuracy of the LFS were 93.8%, 83.6%, and 86.0%, respectively. The consistency in the LFS obtained by different laryngologists was strong (kappa=0.809). Conclusion: This scoring system based on laryngoscopic characteristics has high diagnostic value for distinguishing benign and malignant vocal cord leukoplakia.

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Key Words: Laryngoscopy, diagnosis, vocal cord leukoplakia, scoring

key points:

- Vocal cord leukoplakia is a key precancerous lesion and has the potential for malignant transformation.
- Conventional flexible laryngoscopy is the main means to diagnose vocal cord leukoplakia.
- The morphology of vocal cord leukoplakia under conventional laryngoscopy has a certain correspondence with its pathological properties.
- Leukoplakia finding score (LFS) based on laryngoscopic characteristics has high diagnostic value for distinguishing benign and malignant vocal cord leukoplakia.
- Hyperemia of vocal cord leukoplakia is the most important predictor of malignancy.

1 INTRODUCTION

Vocal cord leukoplakia is a descriptive clinical diagnosis with different pathological manifestations, including inflammatory changes or squamous hyperplasia, dysplasia of different grades, carcinoma *in situ* , or even carcinogenesis.[1] Vocal cord leukoplakia is a key precancerous lesion observed in laryngeal carcinoma. Weller *et al.* [2] performed a meta-analysis on the risk for the transformation of laryngeal dysplasia into a malignant laryngeal tumor and found that the malignant transformation rate of laryngeal mild/moderate dysplasia was 10.6%, and that of severe dysplasia/carcinoma *in situ* was 30.4%. Therefore, exploring the relationship between the appearance of vocal cord leukoplakia and the degree of dysplasia is the key to determining treatment strategies, prognosis and follow-up approaches. Making this distinction would help to avoid the excessive treatment of benign lesions and the misdiagnosis and mistreatment of lesions with high malignant potential.

Vocal cord leukoplakia often causes hoarseness, patients usually visit a doctor early in the course of the disease. Some studies have shown that narrow band imaging (NBI) laryngoscopy and strobolaryngoscopy are helpful for the differential diagnosis of benign and malignant vocal cord leukoplakia.[3] Nevertheless, white light imaging (WLI) laryngoscopy, which allows the observation of morphological characteristics of the vocal cord surface, remains the most common examination used for vocal cord leukoplakia diagnosis. Although some studies exist on the scoring[4] and classification[5] of vocal cord leukoplakia by WLI, these studies have limitations and do not include all the morphological characteristics related to malignant transformation. Therefore, there are still deficiencies in the differential diagnosis of benign and malignant vocal cord leukoplakia. This study was designed to comprehensively summarize the morphological characteristics associated with malignant leukoplakia and propose a new, simple, and effective leukoplakia finding score (LFS) for the diagnosis of vocal cord leukoplakia to improve the accuracy of the preliminary judgment by WLI laryngoscopy before treatment.

2 MATERIALS AND METHODS

2.1 Study subjects

Patients with hoarseness as their chief complaint undergoing laryngoscopy from January 2009 to December 2020 were selected. Patients with vocal cord leukoplakia were included. All patients had a definite pathological diagnosis. The exclusion criteria were as follows: (1) patients with obvious cauliflower or ulcerative masses, polyps, cysts, Reinke's edema, and papilloma on the surface of vocal cords; (2) lesions without definite pathological diagnosis; (3) patients with low-quality laryngoscope images that did not meet the requirements for morphological assessment; and (4) patients with lidocaine allergy, severe uncontrolled dyspnea, unstable angina, uncontrolled hemorrhagic disease, or the inability to understand and sign informed

consent. This study was approved by the Medical Ethics Committee of the hospital. All patients provided written informed consent before the examination.

2.2 Examination methods of vocal cord leukoplakia

In this study, the EVIS LUCERA 260 system and **BF-260 electronic endoscope by Olympus were used to observe vocal cord leukoplakia.** The examinations of all patients were performed by one experienced laryngologist who did not participate in the subsequent evaluation. Patients were examined in the supine position. The laryngoscope was inserted through the nasal cavity to observe the nasopharynx, oropharynx, hypopharynx, and larynx. When vocal cord leukoplakia was observed, the laryngeal mucosa was sprayed with 2% lidocaine for surface anesthesia. Representative images were collected before biopsy of the vocal cord leukoplakia. The biopsy specimens were preserved in 10% formalin and submitted for pathological examination.

2.3 Images analysis

The laryngoscope images of vocal cord leukoplakia were independently evaluated by two experienced laryngologists who were not informed of the pathological diagnosis or other clinically relevant information. The two laryngologists recorded the characteristics of vocal cord leukoplakia by laryngoscopy, including size, thickness, texture, hyperemia, boundary, and whether anterior commissure and bilateral vocal cords were involved. Their consensus was used as the final diagnosis result. Such characteristics were defined as follows: (1) size (unilateral vocal cord leukoplakia covering more than half of the total area of the vocal cord was defined as large leukoplakia; otherwise, the definition was small leukoplakia); (2) thickness (leukoplakia was considered thick if obviously exceeding the height of the vocal cord surface and the blood vessels beneath the lesion were not visible; otherwise, it was considered thin); (3) texture (leukoplakia with a rough and uneven surface, which may manifest as papillary, verrucous, granular, or scattered nodules was defined as irregular, whereas if the surface of the lesion was flat and smooth, and the thickness of each part was almost equal, it was judged to be regular); (4) hyperemia (mucosal erythema or dilated blood vessels seen on or around the leukoplakia were considered hyperemia); (5) boundary (if the boundary between the lesion and the surrounding normal mucosa was clear, neat, and sharp, the lesion boundary was considered clear, whereas if the boundary was disordered, fuzzy, and rough, the lesion boundary was deemed unclear); (6) whether anterior commissure was involved; (7) whether bilateral vocal cords were involved; (8) the general classification of vocal cord leukoplakia under a laryngoscope as proposed by Zhang *et al.* [5] The groups in this classification system were as follows: (1) flat and smooth type; (2) bulge and smooth type; and (3) bulge and rough type.

2.4 The pathological classification of vocal cord leukoplakia

The pathological results after biopsy or surgery are the gold standard for the final diagnosis of vocal cord leukoplakia. According to the World Health Organization classification criteria (2005),[6] vocal cord leukoplakia is classified into benign and malignant types: benign leukoplakia, which includes inflammation, simple hyperplasia, mild dysplasia, and moderate dysplasia, and malignant leukoplakia, which includes severe dysplasia, carcinoma *in situ* , and invasive carcinoma.

2.5 Statistical analysis

The statistical software SPSS 20.0 was used for statistical analyses. The χ^2 test was used for univariate analysis. Multivariate logistic regression analysis was used for multivariate analysis. According to the results of the univariate and multivariate analyses, characteristics with statistically significant differences were compiled to establish the LFS system. The best critical score was determined in combination with the receiver operating characteristic (ROC) curve and clinical practice. The kappa statistic was calculated to evaluate the reading consistency between the two laryngologists (kappa <0.2 indicates poor consistency; 0.2–0.4, fair consistency; 0.4–0.6, moderate consistency; 0.6–0.8, relatively strong consistency; and 0.8–1.0, very strong consistency). Differences were considered statistically significant at $P < 0.05$.

3 RESULTS

3.1 Clinical and pathological characteristics

Of the 163 patients with vocal cord leukoplakia included in this study, 158 (96.9%) were male and 5 (3.1%) were female, and the median age was 59 (26–86) years. There were 126 cases of unilateral onset of vocal cord leukoplakia and 37 cases of bilateral onset, totaling 200 lateral lesions. Among the 200 lateral lesions, there were 152 (76.0%) cases of benign leukoplakia and 48 (24.0%) cases of malignant leukoplakia (Table 1).

3.2 The differences in laryngoscopic characteristics between benign and malignant vocal cord leukoplakia

The univariate analysis showed significant differences in the size, thickness, texture, hyperemia, anterior commissure involvement, and Zhang classification between benign and malignant vocal cord leukoplakia ($P < 0.05$). The results of the multivariate regression analysis showed that thickness, hyperemia and anterior commissure involvement were independent risk factors ($P < 0.05$). See Table 2 for detailed information.

3.3 Establishment of the LFS system based on laryngoscopic characteristics and a comparison with other methods

According to the regression analysis, the effect of hyperemia was the most obvious factor (OR=38.278), followed by the involvement of anterior commissure (OR=5.314) and thick leukoplakia (OR=4.556). We established a vocal cord LFS system with a possible range of 0-10 points (see Table 3 for details). To facilitate calculation and memorization, according to the regression coefficient, four points were assigned to hyperemia, two points to the involvement of anterior commissure and thickness, and one point to two indicators (size and texture) correlated with benign and malignant leukoplakia (Score=4×hyperemia + 2×involvement of anterior commissure + 2×thickness + 1×size + 1×texture). The total scores of the benign vocal cord leukoplakia group and malignant vocal cord leukoplakia group were calculated according to the above scoring system, and the ROC curve was generated. The area under the ROC curve (AUC) for the diagnosis of benign and malignant vocal cord leukoplakia by the scoring system was 0.946 (95% CI: 0.916-0.976, P =0.000). In addition, according to the calculation formula (Score=0.060×age +2.609×texture +1.307×hyperemia) for assessing benign and malignant vocal cord leukoplakia reported by Fang *et al* .[4], the AUC was 0.880 (95% CI: 0.821-0.939, P =0.000); the AUC according to the classification of leukoplakia reported by Zhang *et al* .[5] was 0.742 (95% CI: 0.664-0.820,P =0.000). The AUC of the LFS was significantly better than that of the Fang score ($P = 0.0143$) and Zhang classification (P<0.0001) (Figure 1).

3.4 Diagnostic efficiency of the LFS system

Five indicators were included in the scoring system designed in this study. The Youden index of all points was calculated according to the sensitivity and specificity of each cutoff point determined by the ROC curve, and the maximum Youden index ([?]6 points) was taken as the reference cutoff point (Table 4). The lesion tended to be malignant when the score was [?]6 points, while the lesion tended to be benign when the score was <6 points. The efficiency of the cutoff value of [?]6 points for the diagnosis of benign and malignant vocal cord leukoplakia was the highest. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy rates were 93.8%, 83.6%, 64.3%, 97.7%, and 86.0%, respectively.

3.5 Consistent analysis of vocal cord LFS

Figure 2 shows the independent scoring results of the two laryngologists for 200 cases of vocal cord leukoplakia. The kappa coefficient value between their scores was 0.809, showing very strong consistency.

4 DISCUSSION

Vocal cord leukoplakia has the potential for malignant transformation.[7] Laryngoscopy is the main means to diagnose vocal cord leukoplakia. The accurate diagnosis of the malignant possibility of vocal cord leukoplakia is closely related to the clinical experience of laryngologists. Previous research showed that the NBI laryngoscopy could help to improve the diagnostic accuracy by observing the morphology of microvessels on the mucosal surface.[8] However, since the NBI laryngoscopy has not been fully popularized clinically, making accurate judgments also require training.[9] Most laryngologists still observe vocal cord leukoplakia by WLI

laryngoscopy. Therefore, it is of greater clinical significance to improve the diagnostic accuracy of vocal cord leukoplakia under WLI laryngoscopy.

Although the gross appearance of vocal cord leukoplakia with different pathological properties is sometimes approximately similar, some researchers have tried to use WLI laryngoscopy for the scoring and classification of vocal cord leukoplakia to evaluate the possibility of malignancy and guide treatment. Representative scoring systems are the leukoplakia scoring system proposed by Fang *et al.* [4] and the classification proposed by Zhang*et al.* [5] Fang *et al.* results showed that age, lesion heterogeneity, and hyperemia were independent factors for predicting malignant vocal cord leukoplakia. Afterward, the formula (score = 0.060 x age + 2.609 x texture + 1.307 x hyperemia) was proposed on the basis of the regression coefficient. This score is of some clinical value for predicting the malignancy of vocal cord leukoplakia (AUC = 0.86). Zhang *et al.* classified vocal cord leukoplakia into three types according to roughness. Further studies by this team showed that the classification of vocal cord leukoplakia into the low-risk and high-risk groups had a certain auxiliary effect (AUC = 0.863) and helped to guide the choice of clinical treatment.[10,11] In this classification system, type I mostly suggests low-risk leukoplakia, whereas type III mainly suggests high-risk vocal cord leukoplakia. However, the differential diagnosis of type II leukoplakia is not accurate, mainly because this classification was only based on texture and ignored other factors. Some studies have shown that under WLI laryngoscopy, the existence of hyperemia[12] and vascular stippling[13] are closely related to atypical hyperplasia and malignancy. Although Fang's scoring system considered texture and hyperemia, it is not widely applied in clinical practice. The main reason is that the formula of this scoring method is difficult to remember, and in addition, there is also a lack of consideration of other factors associated with malignant vocal cord leukoplakia (such as color, size, and symmetry), which leads to an average diagnostic efficiency (sensitivity 80.4%, specificity 81.5%).[4]

In order to improve the accuracy and objectivity of the evaluation of the nature of vocal cord leukoplakia by laryngoscopy, all morphological factors associated with benign and malignant leukoplakia were included in this study by referring to the grading method of reflux finding score (RFS) in the diagnosis of laryngopharyngeal reflux.[14]Scores were assigned according to the regression coefficient. The regression analysis showed that hyperemia was the most important factor. For easy memorization, 4 points were assigned to hyperemia, 2 points to the involvement of anterior commissure and thickness, and 1 point was assigned to size and texture. The final range of the score was 0–10 points. This scoring system showed a very strong consistency between the two laryngologists (kappa = 0.809). The AUC of this LFS for the diagnosis of benign and malignant vocal cord leukoplakia was 0.946, which was higher than that of the Fang score (AUC=0.880) and Zhang classification (AUC=0.742). The reference cutoff point for diagnosing malignant vocal cord leukoplakia was [?]6 points. The sensitivity, specificity, and accuracy of this scoring method were 93.8%, 83.6%, and 86.0%, respectively. It can be seen from this study that hyperemia of vocal cord leukoplakia is the most important predictor of malignancy (it has a maximum weight of 4 points in the scoring system); thus, this feature should be a focus of evaluation during laryngoscopy. This characteristic of WLI laryngoscopy that corresponds to the performance of NBI laryngoscopy is tortuous dilated microvessels, which is the main observation point of NBI laryngoscopy used to judge the nature of the lesions.[15] To accurately judge whether vocal cord leukoplakia is hyperemic, it is critical to observe as close as possible to the vocal cord surface during laryngoscopy and pay attention to the edge of the leukoplakia. In addition, the involvement of the anterior commissure is closely related to the malignant transformation of vocal cord leukoplakia (assignment of 2 points), which has not been reported in other studies. It is necessary to report the relationship between vocal cord leukoplakia and the anterior commissure to provide accurate clinical information for subsequent minimally invasive surgical treatment.

5 CONCLUSION

The differential diagnosis of benign and malignant vocal cord leukoplakia is challenging for laryngologists. The morphology of vocal cord leukoplakia under conventional laryngoscopy has a certain correspondence with its pathological properties, but the subjective factors are strong, and there is no clear objective standard. The establishment of this scoring method was based on the comprehensive consideration of the factors associated

with malignant vocal cord leukoplakia. This scoring system was simplified for easy memorization during office laryngoscopy, so that the vocal cord leukoplakia can be preliminarily evaluated by this scoring for the pathological properties without biopsy, avoiding unnecessary invasive injury and helping to protect the function of vocal cords. However, whether this scoring system can be well applied clinically needs to be further verified by a multicenter clinical study.

CONFLICT OF INTEREST

No conflict of interest to declare.

REFERENCES

1. Park JC, Altman KW, Prasad VMN, Broadhurst M, Akst LM. Laryngeal Leukoplakia: State of the Art Review. Otolaryngol Head Neck Surg. 2021;164(6):1153-1159.
2. Weller MD, Nankivell PC, McConkey C, Paleri V, Mehanna HM. The risk and interval to malignancy of patients with laryngeal dysplasia; a systematic review of case series and meta-analysis. Clin Otolaryngol. 2010;35(5):364-72.
3. Rzepakowska A, Sobol M, Sielska-Badurek E, Niemczyk K, Osuch-Wojcikiewicz E. Morphology, Vibratory Function, and Vascular Pattern for Predicting Malignancy in Vocal Fold Leukoplakia. J Voice. 2020;34(5):812.e9-812.e15.
4. Fang TJ, Lin WN, Lee LY, Young CK, Lee LA, Chang KP, Liao CT, Li HY, Yen TC. Classification of vocal fold leukoplakia by clinical scoring. Head Neck. 2016;38 Suppl 1:E1998-2003.
5. Zhang N, Cheng L, Chen M, Chen J, Yang Y, Xie M, Li C, Chen XL, Zhou L, Wu HT. Relationship between laryngoscopic and pathological characteristics of vocal cords leukoplakia. Acta Otolaryngol. 2017;137(11):1199-1203.
6. Barnes L, Eveson JW, Reichert PA, Sidransky D, eds, et al. Pathology and Genetics of Head and Neck Tumours. Lyon, France: IARC Press; 2005. 140 p.
7. Ali SA, Smith JD, Hogikyan ND. The White Lesion, Hyperkeratosis, and Dysplasia. Otolaryngol Clin North Am. 2019;52(4):703-712.
8. Ni XG, Zhu JQ, Zhang QQ, Zhang BG, Wang GQ. Diagnosis of vocal cord leukoplakia: The role of a novel narrow band imaging endoscopic classification. Laryngoscope. 2019;129(2):429-434.
9. Ni XG, Wang GQ, Hu FY, Xu XM, Xu L, Liu XQ, Chen XS, Liu L, Ren XL, Yang Y, Guo L, Gu YJ, Hou J, Zhang JW, Yang Y, Xing B, Ren J, Guo HQ. Clinical utility and effectiveness of a training programme in the application of a new classification of narrow-band imaging for vocal cord leukoplakia: A multicentre study. Clin Otolaryngol. 2019;44(5):729-735.
10. Li C, Zhang N, Wang S, Cheng L, Wu H, Chen J, Chen M, Shi F. A new classification of vocal fold leukoplakia by morphological appearance guiding the treatment. Acta Otolaryngol. 2018;138(6):584-589.
11. Chen M, Li C, Yang Y, Cheng L, Wu H. A morphological classification for vocal fold leukoplakia. Braz J Otorhinolaryngol. 2019;85(5):588-596.
12. Young CK, Lin WN, Lee LY, Lee LA, Hsin LJ, Liao CT, Li HY, Chen IH, Fang TJ. Laryngoscopic characteristics in vocal leukoplakia: inter-rater reliability and correlation with histology grading. Laryngoscope. 2015;125(2):E62-6.
13. Anis MM. Correlating laryngoscopic appearance of laryngeal lesions with histopathology. Laryngoscope. 2019;129(6):1308-1312.
14. Belafsky PC, Postma GN, Koufman JA. The validity and reliability of the reflux finding score (RFS). Laryngoscope. 2001;111(8):1313-7.
15. Ni XG, He S, Xu ZG, Gao L, Lu N, Yuan Z, Lai SQ, Zhang YM, Yi JL, Wang XL, Zhang L, Li XY, Wang GQ. Endoscopic diagnosis of laryngeal cancer and precancerous lesions by narrow band imaging. J Laryngol Otol. 2011;125(3):288-96.

FIGURE 1 ROC curve of laryngoscopic characteristics in the diagnosis of vocal cord leukoplakia

FIGURE 2 Consistent analysis of LFS between the two laryngologists

TABLE 1 Pathological classification of vocal cord leukoplakia (n=200)

Pathological classification	Number of patients (%)
Benign vocal cord leukoplakia	152(76.0%)
Inflammation	46(23.0%)
Simple hyperplasia /hyperkeratosis/dyskeratosis	52(26.0%)
Mild dysplasia	34(17.0%)
Moderate dysplasia	20(10.0%)
Malignant vocal cord leukoplakia	48(24.0%)
Severe dysplasia/Carcinoma in situ	33(16.5%)
Squamous cell carcinoma	15(7.5%)
Total	200(100%)

TABLE 2 Comparison of laryngoscopic characteristics between benign and malignant vocal cord leukoplakia

Factors	Categories	Groups	Groups	Univariate analysis	Univariate analysis	Multivariate logistic regression analysis	Multivariate logistic regression analysis	Multivariate logistic regression analysis	Mu log reg sio an
		benign	malignant	χ^2 value	P value	B	Ods ratio (OR)	P value	95
Size	Small	71	10	10.137	0.001	0.760	1.421	0.233	0.6 7.4
	Large	81	38						
Thickness	Thin	73	4	24.274	0.000	1.610	4.556	0.033	1.1 21.
	Thick	79	44						
Texture	Regular	75	7	18.220	0.000	1.083	2.532	0.112	0.7 11.
	Irregular	77	41						
Hyperemia	Absence	121	3	83.319	0.000	4.407	38.278	0.000	23. 43(
	Presence	31	45						
Anterior commissura	Uninvolved	120	20	24.144	0.000	1.529	5.314	0.021	1.2 16.
	Involved	32	28						
Boundary	Clear	67	17	1.124	0.289				
	Unclear	85	31						
Site	Unilateral	61	26	2.924	0.087				
	Bilateral	91	22						
Zhang Types	Type I	71	5	30.204	0.000	0.717	1.385	0.239	0.6 6.7
	Type II	60	21						
	Type III	21	22						

TABLE 3 Vocal cord leukoplakia finding score (LFS) based on laryngoscopic characteristics

Factors	categories	Score	Definition
Hyperemia	Absence	0	There is no erythema or increased vascularity on or around the leukopla
	Presence	4	Mucosal erythema or increased vascularity can be seen on or around the
Anterior commissura	Without invasion	0	The leukoplakia is limited to one vocal cord and do not reach the anteri
	Invasion	2	The vocal cord leukoplakia extends to the anterior commissure.
Thickness	Thin	0	The leukoplakia is thin, and blood vessels beneath the lesion are visible.
	Thick	2	The leukoplakia is obviously higher than the vocal cord surface, and blo
Size	Small	0	The extent of leukoplakia is less than half of one vocal cord.
	Large	1	The extent of leukoplakia is more than half of one vocal cord.
Texture	Regular	0	The surface of vocal cord leukoplakia is smooth, flat, and homogeneous.
	Irregular	1	The surface of vocal cord leukoplakia is uneven, rough, and non-homoge

TABLE 4 The diagnostic efficacy of different scores of LFS system

Scores	Youden index	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
[?]1	0.217	100	21.7	28.7	100	40.5?¿?
2	0.322	100	32.2	31.0	100	48.5?¿?
3	0.421	100	42.1	35.3	100	56.0?¿?
4	0.546	100	54.6	41.0	100	65.0?¿?
5	0.721	95.8	76.3	56.1	98.3	81.0?¿?
6	0.774	93.8	83.6	64.3	97.7	86.0?¿?
7	0.642	68.8	95.4	82.5	90.6	89.0?¿?
8	0.522	54.2	98.0	89.7	87.1	87.5?¿?
9	0.341	35.4	98.7	89.5	82.9	83.5?¿?
10	0.326	33.3	99.3	94.1	82.5	83.5