

## 声门闭合不全的病因及诊疗研究进展

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**摘要:** 声门闭合不全是指声带在无占位性病变的情况下出现双侧声带不能完全闭合, 导致气体“漏出”, 主要表现为持续性声音嘶哑、发声无力、气息音, 部分患者可出现呛咳、吞咽困难甚至误吸等症状。声门闭合不全的病因包括结构性发声障碍如声带沟、声带瘢痕等, 以及调节性发声障碍如声带麻痹、发声疲劳等。临床常用嗓音生活质量相关量表、喉镜检查、嗓音声学分析及电声门图、空气动力学指标等作为评估工具, 对疑诊为声带麻痹的患者则采用喉肌电图。声门闭合不全的治疗旨在减小发声时的声门间隙, 改善患者的嗓音质量。本文梳理声门闭合不全的常见病因及其治疗方式, 总结其最新的诊疗进展, 为临床术者提供参考。

**关键词:** 声门闭合不全; 病因; 诊断; 声带麻痹

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### Etiology and treatment advances in glottic insufficiency

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**Abstract:** Glottic insufficiency refers to the incomplete closure of the bilateral vocal cords in the absence of space-occupying lesions, resulting in air "leakage." The primary manifestations include persistent hoarseness, weak phonation, and a breathy voice. Some patients may also exhibit symptoms such as choking, dysphagia, and even aspiration. The etiologies of glottic insufficiency encompass structural voice disorders, such as vocal fold sulcus and vocal fold scarring, as well as regulatory voice disorders, such as vocal fold paralysis and phonatory fatigue. Clinically, assessment tools often include the voice-related quality of life scale, laryngoscopy, acoustic analysis of the voice, electroglottography, and aerodynamic measurements. For patients suspected of having vocal fold paralysis, laryngeal electromyography is employed. The treatment of glottic insufficiency aims to reduce the glottic gap during phonation, thereby improving the patient's voice quality. This paper reviews the common causes and treatment methods for glottic insufficiency, summarizes the latest advancements in diagnosis and treatment, and provides a reference for clinicians.

**Key words:** Glottic insufficiency; Etiology; Diagnosis; Vocal cord paralysis

声门闭合不全又称“声门闭合不良”, 指在发声过程中由于声带闭合不完全导致空气不适当逸出引起声嘶、呛咳等症状<sup>[1]</sup>。声门闭合不全的病因复

杂, 包括结构性发声障碍如声带沟、声带瘢痕等, 以及调节性发声障碍如声带麻痹、肌紧张性发声障碍、青春期发声障碍等疾病<sup>[2]</sup>。多见于用嗓较多的人

群,如教师、歌手和销售、网络主播等,嘶哑的嗓音让他们难以正常交流及工作、社交。声门闭合不全是临床常见的嗓音疾病,但由于临床术者对本病病因及治疗措施缺乏深入的理解,临床诊疗中容易引起漏诊及误诊。本文在国内首次对声门闭合不全的病因及诊疗进展进行综述,为临床术者提供诊疗思路。

## 1 病因

导致声门闭合不全的疾病众多,结构性发声障碍如声带沟及声带手术造成的组织缺损、声带瘢痕、声带萎缩等破坏声带解剖结构的疾病是引起声门关闭不全的重要病因。医源性伤害如长期及不适当的气管插管导致杓状软骨内侧黏膜损伤<sup>[3]</sup>,或喉外伤引起的环杓关节固定、脱位等也是声门闭合不全的病因。神经源性发声障碍是声门闭合不全最主要的病因之一,主要包括单侧或双侧声带麻痹及痉挛性发声障碍。其他失调性发声障碍如肌紧张性发声障碍、喉肌无力、发声疲劳、青春期发声障碍、年龄相关声带病变(老年喉)等都可造成声门闭合不全。此外,粉尘环境与吸烟饮酒等不良生活习惯也可引起声门关闭不全。

## 2 评估

声门关闭不全的评估需综合患者的病史、症状、体征,结合喉镜、嗓音生活质量相关量表、空气动力学测量、喉肌电图等辅助检查综合评估患者病情。

### 2.1 喉镜检查

电子喉镜检查可以观察到声带形态及咽喉部黏膜状态,但不能准确评估声带的运动功能,对声门闭合不全患者诊断和评估具有局限性。频闪喉镜可以观察到声带振动方式、振动幅度、黏膜波特点、振动对称性、周期性、闭合相特征及两侧声带垂直高度差异等,可以逐帧评估声门闭合情况<sup>[4-5]</sup>。不同病因导致的声门闭合不全频闪喉镜下的特征有显著差异。

声带沟患者可见单侧或双侧声带膜部表面或游离缘有深浅不一的纵型凹陷,且不超过声带突,声带振动时黏膜波减弱甚至消失,发声时声门可见梭型或漏斗型关闭不全<sup>[6]</sup>;单侧声带麻痹患者频闪喉镜可见声门闭合不全,患侧黏膜波减少、间歇性声带不对称及声带肌张力缺失<sup>[7]</sup>;老年喉则可见室带内收、弓形声带、黏膜菲薄的特征<sup>[8]</sup>;肌紧张性发声障碍患者频闪喉镜可见喉的前后压缩、侧向压缩和室带代偿<sup>[9]</sup>,也可表现为声门过度闭合<sup>[10]</sup>;内收型痉挛性发声障碍患者在发声时声带过度内收,声门闭合时间延长,甚至出现咽壁、舌根的震颤<sup>[11]</sup>。

### 2.2 电声门图

电声门图(electroglottography, EGG)可检测声带在振动时声门区的电阻抗变化,描记出声门开放与闭合曲线。声带麻痹时声门在振动周期中关闭较晚、开放较早,波形呈现闭合相延长或开放相缩短<sup>[12]</sup>。声门闭合不全时发声期间声带接触面积减小,则 EGG 信号幅度则上升,波形尖且饱满,振动周期规律性也降低。

### 2.3 嗓音生活质量相关量表

嗓音生活质量相关量表是评估患者嗓音状况比较简单易行的一种方法,已成为评估嗓音疾病的重要方式,在临床上应用较广的是嗓音相关生活质量量表(voice-related quality of life, V-RQOL)与嗓音障碍指数量表(voice handicap index, VHI)、嗓音症状分级量表以及嗓音疲劳指数,以上量表可用于单侧声带麻痹及发声疲劳、青春期发声障碍等调节性发声障碍导致的声门关闭不全患者,为临床术者提供患者初步的嗓音信息。声门功能指数(glottal function index, GFI)能准确评估声门功能障碍的程度,目前多用于评估声门闭合不全患者治疗前后声门闭合改善情况<sup>[13]</sup>。

### 2.4 空气动力学指标

空气动力学指标如最长发声时间(maximum phonation time, MPT)、气流速度、声门下压和气道阻力可以客观评估声门闭合功能。评估声门闭合不全严重程度常用最长发声时间,单侧声带麻痹患者的最长发声时间较正常人明显缩短,一项纳入 17 例单侧声带麻痹患者的研究显示其平均 MPT 为 $(6.1 \pm 4.5)$ s<sup>[14]</sup>。Jen 等<sup>[15]</sup>通过对比 13 名单侧声带麻痹患者和 21 名正常人发声阈值流量(phonation threshold flow, PTF)及发声阈值压力(phonation threshold pressure, PTP),认为将 PTP 和 PTF 作为评估单侧声带麻痹声门闭合的潜在诊断指标具有可行性,并为诊断声门闭合不全的辅助工具,也可为声门闭合不全的治疗转归提供参考。

### 2.5 嗓音声学分析

嗓音声学分析常用线性分析参数、非线性动力学分析以及复合参数定量分析嗓音声学特征,判断嗓音障碍的程度。声门闭合不全时声带振动稳定性差,此时基频、频率微扰、振幅微扰多升高。倒频谱分析作为最新的声学测量指标之一,被一些研究者认为是评估语音质量的可靠指标,包括倒频谱峰突出度、倒频谱峰突出标准差等检测项目,由于声门闭合不全可产生气息声,倒频谱峰突出度测量值较正常人低<sup>[16]</sup>。

## 2.6 喉肌电图

喉肌电图通过测试喉肌及其支配神经肌电的活动判断声带运动障碍的性质,用于诊断神经损伤及神经肌肉障碍,查明声门关闭不全的病因。喉肌电图通常用于检查环甲肌、甲杓肌、环杓后肌及环杓侧肌。检查过程中观察到自发性病理活动、多相运动单位电位、神经性干扰模式,则提示神经损伤。声带麻痹的患者肌电呈电静息或出现失神经电位如纤颤电位、正锐波等,环杓关节脱位患者肌电正常或肌电波幅减弱<sup>[17]</sup>。痉挛性发声障碍患者发“/i/”时,常出现群化呈束状放电和抑制。表面肌电图作为非侵入性的检查可以通过皮肤表面的电极来检测肌肉活动时电信号,但不可评估深部肌肉活动,对肌紧张性发声障碍具有诊断价值<sup>[18]</sup>。

## 3 治疗

声门关闭不全的病因复杂,应根据其不同病因选择适当的治疗方式,治疗目的在于减小发声时的声门间隙,改善患者的嗓音质量。

### 3.1 嗓音训练

嗓音训练可以通过正确的发声、呼吸方式或锻炼喉肌增加声门下压力,减少声门上阻力,提高声门水平的阻力,在一定程度上缓解声门闭合不全,对于肌紧张性发声障碍、发声疲劳等调节性发声障碍引起的声门关闭不全可作为首选治疗。Watts 等<sup>[19]</sup>采用伸展-呼气矫治方法治疗 10 例原发性肌紧张性发声障碍患者均有明显疗效。嗓音训练对青春期发声障碍患者同样有效,一项研究采用嗓音训练治疗 4 例变声期后假声患者,治疗后患者基频、焦虑、抑郁状态及 VHI-10 得分明显改善<sup>[20]</sup>。对于发声疲劳患者,嗓音训练中嗓音保健十分重要,适当的嗓音休息能明显改善嗓音疲劳症状<sup>[21]</sup>。神经源性发声障碍导致的声门关闭不全,嗓音训练作为辅助治疗可以改善患者声音嘶哑、发声疲劳等症状。嗓音训练在单侧声带麻痹的治疗过程中不管是早期还是术后都有疗效<sup>[22-23]</sup>。嗓音训练并不是痉挛性发声障碍的首选治疗方式,但可作为辅助治疗延长肉毒素注射周期<sup>[24]</sup>。Ziegler 等<sup>[25]</sup>瞻性随机对照试验中,接受嗓音训练后的老年喉患者语音相关的生活质量问卷评分显著提高,提示嗓音训练是老年喉的有效治疗方式。

### 3.2 手术治疗

对嗓音训练后效果不明显或症状较重的结构性嗓音疾病如声带沟及声带瘢痕或声带麻痹等可选择手术治疗。

### 3.2.1 声带注射喉成形术

声带注射成形术是将自体或异体生物材料填充至声带不同层次或声门旁间隙,以改善声门闭合状况,是治疗声带麻痹、声带萎缩、声带瘢痕及老年喉、声带沟等疾病的主要手段。临时注射剂包括羟甲基纤维素,半永久注射剂包括透明质酸、筋膜和脂肪等。新近的研究<sup>[26-28]</sup>显示脂肪注射是一种安全的治疗方式,疗效可以持续 6 个月~1 年甚至更长时间,适合长期纠正声门关闭不全,多用于单侧声带麻痹。自体筋膜注射则更适用于声带瘢痕与声带沟<sup>[29]</sup>。永久性注射剂如羟基磷灰石钙作用时间长,但可能存在不可预测的副作用如过敏反应或诱发免疫反应而导致严重气道水肿。随着科学技术发展,许多新型注射材料相继被报道,如水母胶原生物材料<sup>[30]</sup>、微粒化脱细胞真皮、脂肪干细胞胶<sup>[31]</sup>等。此外 Zou 等<sup>[32]</sup>将研制的天然多糖基的自融合水凝胶用于兔声门闭合不全模型,证明该新型填充物不仅作用长效、具有生物相容性,且可保护声带生理功能,为声门闭合不全的治疗提供了新方案。

### 3.2.2 甲状软骨成形术

1970 年 Isshiki 等<sup>[33-34]</sup>首次描述了 I 型甲状软骨成形术,该手术将甲状软骨板开窗后植入材料使声带内移,缩小声门间隙从而改善声门关闭不全。现常用硅橡胶、聚四氟乙烯、羟基磷灰石、Gore-Tex 软片、钛等作为植入物。声门裂隙较小,可采用声带注射术;声门裂隙较大,可采用 I 型甲状软骨成形术。内收型痉挛性发声障碍可选择 II 型甲状软骨成形术或甲杓肌部分切除术。Nomoto 等<sup>[35]</sup>通过比较接受 II 型甲状软骨成形术和甲杓肌部分切除术的痉挛性发声障碍患者术后 VHI-10 评分,显示 2 种手术均有效但差异无统计学意义,并且认为 II 型甲状软骨成形术可调控声门闭合程度,但无法根治痉挛性发声障碍,甲杓肌部分切除术则适用于保守治疗无效且反复发作的内收型痉挛性发声障碍。

### 3.2.3 杓状软骨内移术

杓状软骨内移术是通过向前牵拉杓状软骨肌突的同时使声带位置下降从而将麻痹侧声带移向正中位,对声门间隙较大或双侧声带高度不一致的患者有帮助<sup>[36]</sup>。Watanabe 等<sup>[37]</sup>通过对比接受杓状软骨内移术的单侧声带麻痹患者术后早期及晚期 VHI 评分,认为接受杓状软骨内移术的单侧声带麻痹患者嗓音状况得到了长期改善。老年喉不仅肌纤维缺失,固有层也有变性或缺失,杓状软骨退化,环杓关节运动功能失调,杓状软骨内移术可改善患者声门闭合。

### 3.2.4 神经移植术

由于神经受损而导致的单侧声带麻痹,若保守治疗无效,还可以通过喉神经修复术治疗。喉返神经损伤是甲状腺和甲状旁腺手术常见风险,对于术中明确损伤喉返神经的患者,可立即在术中或术后进行神经修复术,术式包括直接端对端吻合术、游离神经移植吻合术等<sup>[38]</sup>。喉返神经端-端吻合术由于存在喉痉挛及声带矛盾运动的风险,故不推荐采用<sup>[39-40]</sup>。郑宏良等<sup>[41]</sup>、高颖娜等<sup>[42]</sup>通过大量研究,证明颈袢主支-喉返神经吻合术、颈袢前根-喉返神经吻合术治疗喉返神经损伤所致的单侧声带麻痹有较好疗效。

### 3.3 药物治疗

单侧声带麻痹可以全身或局部给予神经营养药物如维生素 B12、呋喃硫胺、神经生长因子等。同时改善微循环药物如尼莫地平可以通过阻断钙离子内流促进神经再生,也可用于单侧声带麻痹<sup>[43]</sup>。另外声带内注射地塞米松能预防瘢痕形成,可作为声带瘢痕的辅助治疗<sup>[44]</sup>。声带内注射碱性成纤维细胞生长因子也可治疗声带瘢痕,并且对声带萎缩、声带沟或单侧声带麻痹患者同样有效<sup>[45]</sup>。新斯的明为兴奋平滑肌及骨骼肌的拟胆碱药,能可逆性地抑制胆碱酯酶的活性,对喉肌无力引起的声门闭合不全有一定作用。目前肉毒素注射被认为是治疗痉挛性发声障碍的最佳治疗方法,肉毒素注射治疗应采取个体化原则,肉毒素多在注射后 3~4 d 起效,药效持续时间约 3~6 个月,需根据患者病情调整注射间隔期,进行多次注射治疗,注射后常见声音嘶哑、进食呛咳等不良反应,但一般症状较轻<sup>[46]</sup>。

### 3.4 中医治疗

声门闭合不全可引起声音嘶哑症状,在祖国医学中称之为“喉瘖”,声门闭合不全的中药治疗强调辨证施治,声门闭合不全多属宗气不足证,治疗应着重补气,补气开音丸效果显著<sup>[48]</sup>。刘静<sup>[47]</sup>运用解毒通络治法,方用自拟解毒通络汤治疗病毒感染引起的单侧声带麻痹患者,治疗后声嘶症状明显好转。近年临床上应用针灸治疗声门闭合不全的研究也越来越多,针灸可能通过刺激神经、协调神经肌肉功能以及促进免疫的作用来影响声门闭合。Liang 等<sup>[49]</sup>通过研究发现针刺配合嗓音训练治疗原发性肌紧张性发声障碍患者疗效明显。管培凡<sup>[50]</sup>结合中医经络及五脏学说使用攥拳提气法配合针灸治疗声门闭合不全患者,治疗后声门闭合情况明显改善。王末等<sup>[51]</sup>运用切脉针灸疗法治疗特发性声带麻痹也给我们在声门闭合不全的治疗提供了新思路。

## 4 展望

声门关闭不全作为一种常见的嗓音疾病,对患者的生活质量造成了显著影响。由于其病因复杂且症状缺乏特异性,容易造成漏诊误诊。因此综合患者的病史、体征以及一系列辅助检查,以明确病因并制定针对性的治疗策略显得至关重要。展望未来,我们有必要制定一套专门针对声门闭合不全的嗓音评估量表,对病情程度进行分级,并建立一个规范化的诊疗流程。此外近年来有大量研究提示中药及针刺治疗声门闭合不全有潜在优势,但还需多中心的随机对照研究验证其疗效。

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