Received: 1 October 2021 | Revised: 12 November 2021 | Accepted: 26 November 2021

DOI: 10.1002/lio2.712

ORIGINAL RESEARCH

Laryngoscope Investigative Otolaryngology

Use of a transnasal flexible laryngoscope tip for laryngeal culturing: A novel in-office technique

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Funding information
Departmental Research Fund.

Abstract

Background: In-office culture of the larynx using a flexible laryngoscope tip can help identify laryngeal pathogens in cases of laryngitis.

Objective: This retrospective case series aimed to investigate the feasibility of in-office laryngoscope tip culture to identify laryngeal pathogens and help guide medical treatment.

Methods: This case series consists of 8 patients who underwent 11 in-office laryngeal cultures using the tip of the flexible laryngoscope. Concurrent nasal cultures were performed on two patients to assess for possible nasal contamination of these laryngoscope tip cultures.

Results: Nine patients underwent laryngeal culture with laryngoscope tip in-office, with two patients undergoing repeat swabs for a total of eleven swabs. Then, 8 of 11 swabs (73%) grew methicillin-sensitive *Staphylococcus aureus*, while 1 of 11 (9.1%) swabs grew methicillin-resistant *S. aureus*. Three of eleven swabs (27%) grew Candida species. Concurrent culture was performed of the contralateral nasal cavity in two patients to assess for the possibility of nasal contamination of laryngoscope tip cultures. Concurrent contralateral nasal cultures grew distinct pathogens compared to the laryngeal cultures, suggesting that nasal contamination did not occur.

Conclusion: In-office laryngoscope tip culture allows safe identification of laryngeal pathogens in an ambulatory setting. In-office laryngoscope tip culture can help guide medical treatment of laryngeal infections.

Level of Evidence: 4

KEYWORDS
laryngeal culture, laryngitis, MRSA

1 | INTRODUCTION

Culture of the larynx is not routinely performed as an in-office diagnostic tool. Laryngeal cultures have more traditionally been obtained

Presented at: Triological Society Combined Sections Meeting 2020, January 23-25, 2020, Coronado, CA, USA.

in an operative setting and are of clinical importance in selected cases of acute and chronic infectious laryngitis.[1,2]

Laryngitis is most often traumatic but when infectious, is commonly viral and usually self-limited. Culture may be warranted if glottic or subglottic purulent secretions are visualized on laryngoscopy to identify bacterial or fungal pathogens. Susceptibilities can provide directed antibiotic/antifungal therapy, eliminating the need for empirical treatment. Pathogen identification may be especially important in immunocompromised patients with chronic laryngeal infections. Chronic laryngitis may mimic laryngeal carcinoma and may warrant culturing to rule out a benign infectious etiology before considering a biopsy.[1]

Laryngeal culture via mucosal tissue biopsy can be performed by micro-direct laryngoscopy in the operating room or through a channeled laryngoscope in clinic.[2] This approach permits culturing of pathogens found in the intraepithelial and subepithelial tissue that cannot be assessed with swabbing of the epithelial surface.[2] However, there are risks associated with biopsy of an inflamed larynx—bleeding, impaired healing, scarring, and voice changes. In the case of micro-direct laryngoscopy, patients would incur the risk associated with general anesthesia and intubation and instrumentation of the oral cavity and larynx.

In-office culture of the larynx without biopsy has been described as surface swabbing, often passing a bent cotton-tipped swab through the oral cavity with visual guidance by a non-channeled laryngoscope.[3] This technique may be difficult on patients with less favorable anatomy or gag reflex.

We present a novel in-office use of a transnasal flexible laryngoscope tip for laryngeal swab and culture.

2 | METHODS

Nine patients were seen in clinic with complaints of dysphonia. The retrospective review of these cases was approved by University of Iowa IRB (IRB#: 201903800). Flexible laryngoscopy in office demonstrated secretions suspicious for infection. Transnasal flexible laryngoscopy using an ENF-VH or ENF-V3 video flexible laryngoscope (Olympus Corporation of the Americas, Center Valley, PA) is performed in-office with standard topical nasal anesthesia (1 ml of atomized 4% lidocaine with 1% phenylephrine). The option for an additional 1 ml of transoral atomized lidocaine and phenylephrine can be offered for laryngopharyngeal anesthesia. All laryngoscopes in our clinic undergo a centralized, in-hospital sterilization prior to use. Prior to nostril insertion of the laryngoscope, the tip is "defogged" by running under hot running tap water and wiped dry with a paper towel.

The transnasal flexible laryngoscopy includes inspection for crusting, mucous secretions, erythema or edema to indicate a source to sample. The tip of the laryngoscope is then placed onto the appropriate laryngeal region with anticipated loss of visualization obscured when the tip is in contact with mucosa. The laryngoscope is removed from the larynx, through the nasal cavity and placed into a culture transport tube (BD ESwab Transport System for Aerobic, Anaerobic and Fastidious Bacteria; Becton, Dickinson and Co., Sparks, MD). The sterile cotton-tip swab within the transport system is used to manipulate sampled material from the tip of the flexible laryngoscope into the tube. An example is provided to demonstrate this swabbing technique in a patient with suspected bacterial laryngitis found to grow methicillin-sensitive *Staphylococcus aureus* (MSSA) on the swab culture (Figures 1 and 2).

3 | RESULTS

Eleven laryngoscopy tip culture swabs were performed among nine patients presenting with dysphonia or hoarseness. Two of the patients (Patient # 3 and 4) had repeat swabs due to recurrent symptoms.

Then, 8 of 11 (73%) swabs grew MSSA, 3/11 (27%) grew *Candida*, and 1/11 grew methicillin-resistant *S. aureus* (MRSA) (9.1%) on culture (Table 1). The tip swabs for Patient #4 and #5 growing MSSA and *Candida*, respectively, were confirmed by in-office channeled laryngoscope culture biopsies of the larynx, showing the same susceptibilities. Among those growing MSSA, 4/8 (50%) were treated with amoxicillin/clavulanic acid and 4/8 (50%) with trimethoprim/sulfamethoxazole. The single patient growing MRSA was effectively treated with TMP-SMX. Then, 7/11 (64%) of all swab results had symptomatic improvement on follow-up with targeted antimicrobial therapy.

In addition to swab cultures of the larynx with the tip of the laryngoscope, the potential contamination of the laryngoscope tip from "defogging" prior to nasal insertion was analyzed. As described in our technique, "defogging" of the laryngoscope tip was performed by running hot water over the tip and wiped dry with a non-sterile paper towel. Immediately following "defogging" the tip was placed into a culture transport tube. This was performed three separate times. No aerobic, anaerobic or fungal pathogens grew from culturing of the laryngoscope tip following "defogging."

Additionally, two patients (#8 and #9) in this series underwent concurrent culture of the contralateral nasal cavity to assess whether nasal contamination may have influenced the result of in-office laryngeal culture. Patient #8's laryngeal aerobic culture grew mixed oral flora and few *Streptococcus dysgalactiae*, several *Prevotella* species on anaerobic culture, and fungal culture grew *Candida albicans*. The concurrent nasal cavity cultures for Patient #8 grew mixed oral flora on aerobic culture, no anaerobic organisms, and no fungal organisms. Patient #9's laryngeal aerobic culture grew few *S. aureus* (methicillin-sensitive) and rare mixed oral flora, anaerobic culture grew *Prevotella jejuni*, and fungal culture grew no fungal organisms. Patient #9's concurrent nasal aerobic culture grew *S. aureus* (methicillin-sensitive) and many mixed oral flora, anaerobic culture grew *Cutibacterium acnes* and fungal culture grew no fungal organisms.

4 | DISCUSSION

Identification of laryngeal pathogens and their susceptibilities aids in providing targeted therapy. Carpenter et al. demonstrated over half of

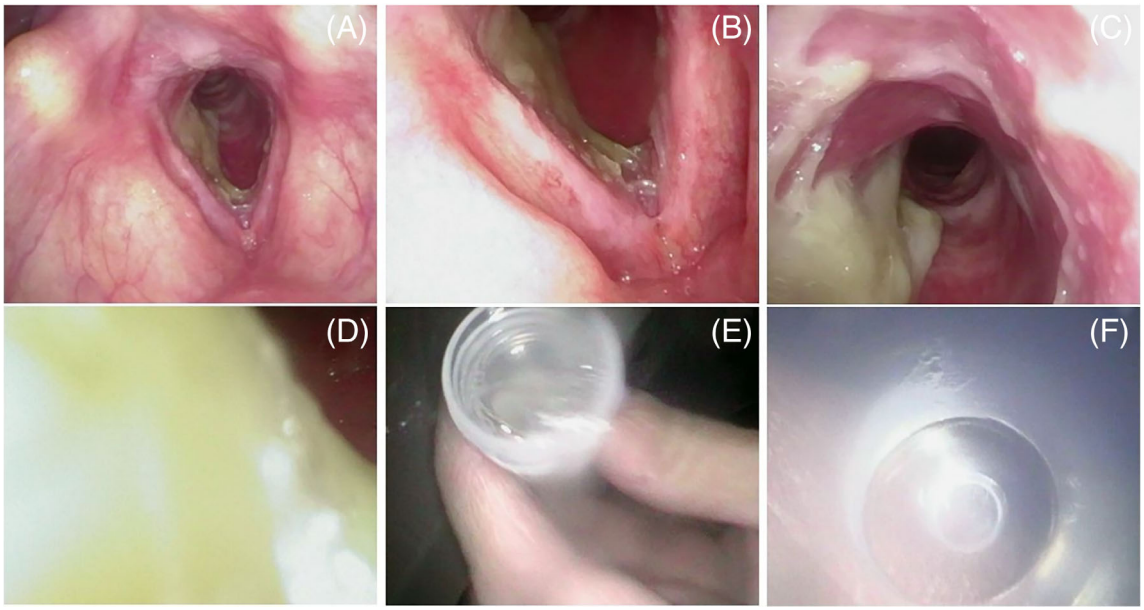

FIGURE 1 Images from transnasal flexible laryngoscope camera demonstrating glottic and subglottic culturing with the tip of the laryngoscope in a patient with suspected bacterial laryngitis. Laryngeal cultures grew methicillin-sensitive *Staphylococcus aureus*. (A) Visualization of the superior larynx with evident glottic and subglottic mucosal accumulations with erythema and edema of the vocal folds. No other laryngeal abnormalities were identified. (B,C) Advancement of the laryngoscope towards glottis into the subglottis. (D) The tip of the laryngoscope is advanced through the glottis and onto mucous collection in subglottis. The laryngoscope is then retracted from subglottis and glottis, through pharynx and removed transnasally. (E,F) The tip of the laryngoscope is placed into the culture transport tube (BD ESwab Transport System for Aerobic, Anaerobic and Fastidious Bacteria)

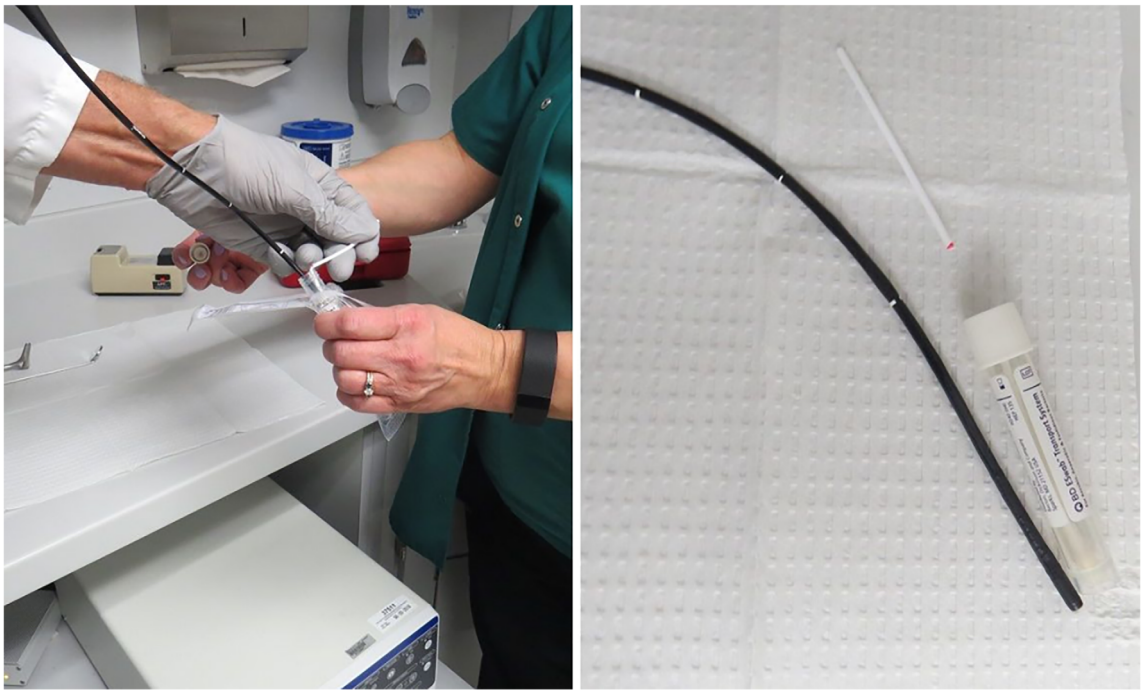

FIGURE 2 (A,B) Placement of the flexible laryngoscope tip (Olympus Flexible Video Endoscope ENF-VH/ENF-V3) into the culture tube (BD ESwab Transport System for Aerobic, Anaerobic and Fastidious Bacteria) after placement on subglottic mucous. The cotton swab can be used to manipulate sampled material from the tip of the flexible laryngoscope into the tube

TABLE 1 Culture and treatment results of transnasal flexible laryngoscope tip swabs in nine patients

Patient #	Swab site	Anaerobic culture	Fungal culture	Aerobic culture	Treatment	Symptom improvement on follow-up?	Follow-up duration (months)
1	Subglottis	No growth	*Candida albicans*	NG	Nystatin, Fluconazole	Yes	4
2	Subglottis	Rare Veillonella species	NG	MSSA	AMX/CLV	Yes	3
3	Bilateral TVF	NG	NG	MSSA	AMX/CLV	Yes	3
3 (second swab)	Posterior glottis	NG	NG	MSSA[a]	TMP-SMX	No	3
4	L aryepiglottic fold	NG	NG	MSSA	TMP-SMX	Yes	2
4 (second swab)	Posterior glottis	Rare *Cutibacterium acnes*, Mucor species	Mycobacterium chelonae, Mucor species[b]	MSSA	TMP-SMX	Yes	2
5	Glottis	NG	*Candida albicans*[c]	MSSA	AMX/CLV	No	12
6	Supraglottis	NG	NG	MRSA	TMP-SMX	Yes	6
7	L pyriform sinus	NG	NG	MSSA	TMP-SMX	No	3
8	glottis	Prevotella species	*C. albicans*	MOF, *Streptococcus dysgalactiae*	Fluconazole	Yes	<1
9	Posterior glottis	*Prevotella jejuni*	NG	MSSA, MOF	AMX/CLV	Yes	1

Abbreviations: AMX/CLV, amoxicillin/clavulanic acid; MOF, mixed oral flora; MSSA, methicillin-sensitive *Staphylococcus aureus*; NG, no growth; TMP-SMX, trimethoprim/sulfamethoxazole; TVF, true vocal folds.

[a]In-office laryngeal biopsy performed the following day, which grew *S. aureus*.

[b]Mucor and mycobacterium discussed with infectious disease, felt to represent environmental exposure and less likely to represent acute infection.

[c]Thought at the time to represent contaminant. In-office laryngeal biopsy performed 1 year later, which grew *C. albicans* and was treated successfully with nystatin.

all patients empirically treated for suspected chronic bacterial laryngitis may be unresponsive to treatment. Of those found to be unresponsive in their study, 70% had MRSA on culture. Among the MRSA cohort, 100% responded to redirected therapy with trimethoprim-sulfamethoxazole.[4] In-office culturing of the larynx with a flexible laryngoscope tip offers a noninvasive approach to identifying this antibiotic resistance.

To date, literature addressing the efficacy of in-office laryngeal swab culturing is limited.[2,5] In a retrospective review of 15 patients with dysphonia and chronic infectious laryngitis, Thomas et al. demonstrated in-office swabbing to be ineffective—yielding nondiagnostic cultures.[2] Subsequent laryngeal biopsies and cultures in this group of patients successfully cultured bacteria in 93% of the samples. In contrast, Hanshew et al. demonstrated no significant differences in the microorganisms grown from transoral swab specimens versus biopsy specimens of vocal folds in pigs, concluding that swabbing may be as efficacious as biopsy in identifying laryngeal pathogens.[5] Nasal contamination of the laryngoscope tip may be a limitation to this technique, just as oropharyngeal contamination may limit the reliability of transoral swabbing.

The Unified Airway Disease Hypothesis characterizes the upper respiratory tract as being linked to the lower respiratory tract and part of a coordinated inflammatory response to pathogens.[6] Based on this theory, one might expect similarity of the nasal and laryngeal flora. Additional investigation is needed to further characterize the relationship between nasal flora and laryngeal flora, and whether similar viral and bacterial pathogens colonize both sites. Insufficient evidence exists to support that nasal cavity cultures and laryngeal cultures are interchangeable—highlighting the potential importance of in-office laryngeal cultures. There is a possibility that laryngeal cultures could be contaminated by nasal flora in the process of obtaining a swab through the transnasal approach. For that reason, concurrent nasal culture at the time of transnasal laryngeal swabbing may be warranted.

Concurrent nasal culture was performed in two patients in this series to assess for possible nasal contamination of transnasal laryngeal culture specimens. In the case of the two patients who underwent concurrent contralateral nasal culture, it appears that there was overlap in aerobic pathogens identified in the nasal cavity and larynx. However, contralateral nasal cavity culture did not identify anaerobic pathogens cultured from the larynx such as *Prevotella* species nor did it identify *C. albicans* on fungal cultures. These results suggest that laryngeal culture may be useful particularly in identifying anaerobic and fungal pathogens, and that nasal cavity cultures may not reliably be used as a proxy for laryngeal culture. There did not appear to be nasal cavity contamination where anaerobic pathogens and fungal cultures were concerned. Further investigation may identify the degree to which aerobic pathogens in the nasal cavity and larynx are related and further elucidate the risk of nasal contamination of laryngeal cultures obtained through the transnasal approach. Comparison of the transnasal laryngeal biopsy technique to conventional culture of operative specimens would also offer important insight to the feasibility of this technique.

5 | CONCLUSION

Standard in-office otolaryngology equipment, such as transnasal flexible laryngoscopes permit swabbing and culturing of the larynx. We describe a novel approach of laryngeal swabbing with a laryngoscope tip that in our practice has been successful in identifying bacterial and fungal pathogens guiding antimicrobial therapy.

ACKNOWLEDGMENT

The authors thank Linda Boyken for her assistance in performing the post-defogging laryngoscope cultures.

CONFLICT OF INTERESTS

Henry T. Hoffman: IotaMotion (research consultant), UpToDate (author), Cook Medical (former research consultant). Daniel J. Diekema: ioMerieux, Inc. (research funding) and JMI Laboratories (consultant).

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REFERENCES

1. Klein AM, Tiu C, Lafreniere D. Malignant mimickers: chronic bacterial and fungal infections of the larynx. *J Voice*. 2005;19(1):151-157.
2. Thomas CM, Jette ME, Clary MS. Factors associated with infectious laryngitis: a retrospective review of 15 cases. *Ann Otol Rhinol Laryngol*. 2017;126(5):388-395.
3. Shah MD, Klein AM. Methicillin-resistant and methicillin-sensitive *Staphylococcus aureus* laryngitis. *Laryngoscope*. 2012;122(11):2497-2502.
4. Carpenter PS, Kendall KA. MRSA chronic bacterial laryngitis: a growing problem. *Laryngoscope*. 2018;128(4):921-925.
5. Hanshew AS, Jetté ME, Tadayon S, Thibeault SL. A comparison of sampling methods for examining the laryngeal microbiome. *PLoS One*. 2017;12(3):e0174765.
6. Turley R, Cohen SM, Becker A, Ebert CS Jr. Role of rhinitis in laryngitis: another dimension of the unified airway. *Ann Otol Rhinol Laryngol*. 2011;120(8):505-510.

How to cite this article: Michael A, Vesole AS, Diekema DJ, Stegall H, Hoffman HT. Use of a transnasal flexible laryngoscope tip for laryngeal culturing: A novel in-office technique. *Laryngoscope Investigative Otolaryngology*. 2022; 7(1):197-201. doi:10.1002/lio2.712