Un-sedated Office-Based Application of Blue Laser in Vocal Fold Lesions

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Summary: Introduction. Office-based laser procedures in laryngology have gained a lot of popularity in the last decade with the use of the KTP, PDL and Thulium lasers. Preliminary investigations currently report on the use of the 445 nm wavelength Blue laser for the treatment of various laryngeal pathologies, given its dual photoangiolytic and cutting properties.

Objective. We aim to investigate the safety and efficacy of the Blue laser for the treatment of vocal fold lesions.

Methods. This is a retrospective chart review of eleven patients with a variety of vocal fold lesions (polyps, Reinke's edema, papilloma, and leukoplakia), that underwent un-sedated office-based treatment using the 445 nm blue laser. The primary outcome was to compare preoperative to postoperative Voice Handicap Index (VHI-10) score and self-reported voice improvement using a visual analog scale (VAS). We also compared fiberoptic laryngeal examination before and after treatment.

Results. Eleven un-sedated office-based procedures using the blue laser were performed. There was improvement in the mean VHI-10 score (n = 8) with a decrease from 15.13 ± 8.77 to 3.50 ± 3.46 (P= 0.015). Similarly, the mean VAS score (n = 7) decreased from 6.14 ± 1.21 to 1.71 ± 1.60 (P< 0.003). All patients had a complete or partial regression of the vocal fold lesions on fiberoptic laryngeal examination. None of the patients had complications after the procedure.

Conclusion. Blue laser therapy can be suggested as a safe and effective alternative treatment modality in office-based laryngology procedures for a variety of vocal fold lesions. A larger series is needed to better validate the efficacy of this laser as a new treatment modality.

Key Words: Blue laser−Laryngology−Office-based procedures−VHI-10.

INTRODUCTION

Office-based laser procedures in laryngology have gained a lot of popularity in the last few decades. This revolutionized practice is ascribed to the advent in technology and fiberglass delivery of the laser beam.[1,2] Patients with structural laryngeal disorders who were treated traditionally under direct laryngoscopy and general anesthesia are now offered un-sedated office-based laryngeal surgery, among which is laser therapy. Lasers used in laryngology are divided into two categories; namely the diode lasers and the photoangiolytic lasers. The carbon dioxide and Thulium lasers fall under the category of diode lasers and are considered cutting lasers with hemostatic properties.[3] Carbon dioxide lasers have a limited depth of penetration (0.05−0.6 mm) when compared to other diode lasers (0.5−5 mm) that are less frequently used in laryngology. Given their limited scattering and depth of penetration, the CO_2 lasers allow precise excision of mucosal and submucosal lesions of the vocal folds. However, their high cutting properties come with a cost, namely tissue necrosis and scar if used in an inappropriate setting[4]. Hence, extreme precaution should be taken in patient selection, mode of usage and energy delivery, particularly when operating on the vocal folds. Photoangiolytic lasers on the other hand, which include the Pulse dye laser (PDL) with a wavelength of 585 nm, and the potassium-titanyl-phosphate (KTP) with a wavelength of 532 nm, are selectively absorbed by oxyhemoglobin thus coagulating the superficial and subepithelial blood vessels while keeping the covering epithelium unharmed.[3,5] Given their mode of action, namely photoangiolysis, minimal scarring or web formation have been reported in the treatment of mucosal lesions of the vocal folds.

Recently, a novel blue light laser (TrueBlue; A.R.C. Laser Company) with a characteristic wavelength of 445 nm has been approved for the treatment of laryngeal and otologic disorders.[5] The distinguishing feature of this laser is the unique combination of both photoangiolytic and cutting properties, in addition to the device portability.[6] Preliminary investigations have been reported on the success of blue laser in the treatment of different vocal fold pathologies including recurrent respiratory papillomatosis and benign vocal fold lesions.[3,6] Similarly, animal-based studies comparing the blue laser with KTP laser have demonstrated reduced postoperative scarring and fibrosis with the use of the former.[5] To that end, the blue laser can be regarded as a novel and viable option with good efficacy and improved safety profile for the treatment of benign laryngeal pathologies.

Given the scarcity of reports on the use of blue laser in laryngology, the aim of this manuscript is to review the authors 'experience in the application of blue laser for the treatment of a variety of vocal fold lesions in an office setting.

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TABLE 1.
Demographics

N=11	Age	Gender	History of Smoking
1	66	M	Yes
2	50	M	Yes
3	65	F	Yes
4	61	M	Yes
5	54	M	Yes
6	30	F	Yes
7	42	M	No
8	71	M	Yes
9	47	F	Yes
10	82	M	Yes
11	39	M	Yes
Mean ± SD	55.18 ± 15.43		

MATERIALS AND METHODS

After obtaining the Institutional Review Board approval, a retrospective chart review of patients with different vocal fold lesions who were treated with blue laser therapy between July 2019 and January 2021 at the American University of Beirut Medical Center, was conducted. A total of 11 patients with a variety of vocal fold lesions were included in this study. These comprised polyps, papilloma, Reinke's edema, biofilm, leukoplakia, carcinoma in situ, and squamous cell carcinoma. Demographic data included age, gender, smoking status and type of lesion (Table 1). The procedures were performed on un-sedated patients using a fiberoptic nasolaryngoscope (Pentax Medical FNL-15RP3) with a working channel via the transnasal approach. An intramuscular injection of glycopyrrolate (200 μg/1 ml) was administered prior to the procedure in all patients in order to reduce pooling of secretions in the larynx. With the patient fully awake and in the upright sitting position, local nasal anesthesia, and decongestion were applied to both nasal cavities using sponges soaked with 1% lidocaine HCL with 1:100,000 Epinephrine and 0.1% Xylometazoline Hydrochloride. The oropharynx and hypopharynx were anesthetized using xylocaine spray (2%). Topical anesthesia to the larynx was achieved by dripping 2% lidocaine HCL via the working channel of the fiberoptic endoscope and while the patient was asked to sustain phonation. Following that, the blue laser (TrueBlue; A.R.C. Laser Company) fiber was advanced through the working channel of the fiberoptic laryngoscope to complete the procedure.

The laser was used in the noncontact mode for the majority of cases, however, the contact mode was additionally applied when treating vocal fold papilloma and leukoplakia. The settings used for the treatment of the different vocal fold pathologies were based on the default settings that are offered by the blue laser machine itself. The laser is set at 10 W with differences in pulse time and pauses for each lesion as outlined in Table 2.

TABLE 2.
Blue Laser Settings Including Pulse Time and Pause in Milliseconds for Different Vocal Fold Lesions

	Pulse time (ms)	Pause (ms)
Polyp	10	300
Papilloma	20	300
Leukoplakia/biofilm	30	300
Reinke's edema	40	300

The power was 10 Watts in all cases.

Objective voice outcome measures included the extent of resolution or regression of the lesion as seen on laryngeal endoscopy. In addition, subjective voice outcome measures included visual analog scale measurement of improvement in voice quality and Voice Handicap Index (VHI-10) as described by Rosen et al.[7]

STATISTICAL METHOD

Frequencies and means (±standard deviation) were used to describe categorical and continuous variables, respectively. Continuous variables were analyzed using paired t-test. All analyses were conducted using Statistical Package for the Social Sciences (SPSS) version 24 software package. A two-tailed P-value <0.05 was considered as statistically significant.

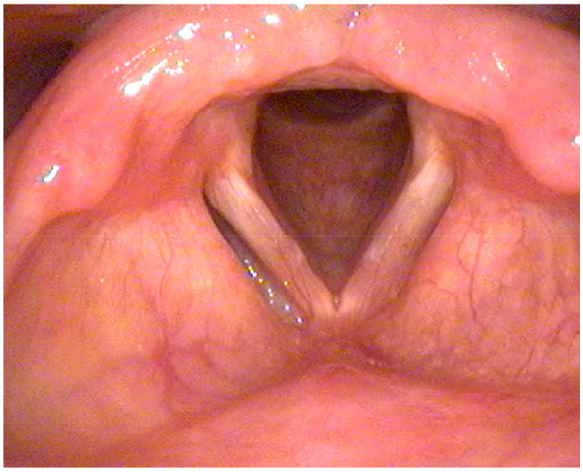
RESULTS

A total of 11 patients were enrolled in this study with 8 males and 3 females. The mean age was 55.18 ± 15.43 years with a range between 30 and 82 years. Ten patients had a history of smoking. Patient demographics are summarized in Table 1. Vocal fold lesions included polyps (n = 4), Reinke's edema (n = 2), leukoplakia (n = 1), carcinoma in situ (n = 1), squamous cell carcinoma (n = 1), papilloma (n = 1), and biofilm (n = 1). The mean duration for follow-up was 53.13 ± 41.10 days. Four of the 11 patients had incomplete data on follow-up. Fifty percent (4 out of 8 patients) had complete regression of the vocal fold lesion on endoscopic laryngeal examination while the remaining 50% had partial regression (See Figures 1−3). There was also restoration of mucosal waves in the patients with papilloma and leukoplakia on stroboscopic examination with almost normal vocal fold pliability. Seven patients had improvement in the VHI-10 score after the procedure with decrease in mean VHI-10 score of the total group from 15.13 ± 8.77 to 3.50 ± 3.46 (P= 0.015; Table 3). Similarly, there was statistically significant improvement in voice quality as determined by a decrease in the mean visual analog scale score from 6.14 ± 1.21 to 1.71 ± 1.60 (P< 0.003) (Table 4).

DISCUSSION

Office-based laryngeal laser therapy has transformed the clinical practice in laryngology. It has spared patients the

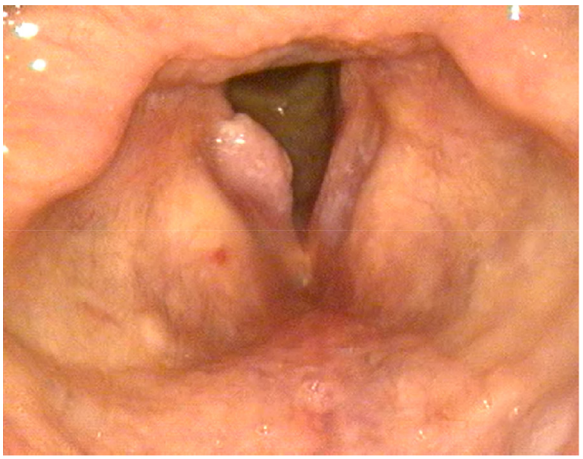
A.



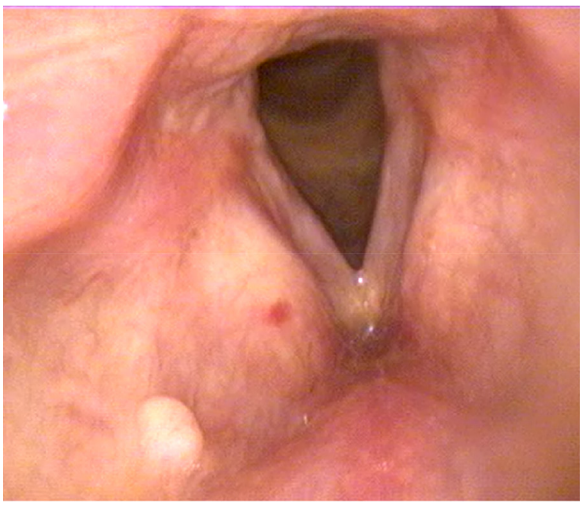
B.

FIGURE 1. **A.** 46-year-old woman with a left vocal fold polyp and a reactive lesion on the right. **B.** Follow-up laryngoscopic examination 4 weeks after blue laser therapy.

risk of general anesthesia and the morbidity associated with direct laryngoscopy. In addition to hastening the rate of recovery, un-sedated office-based laser therapy has reduced the cost of surgery with marked impact on healthcare spending.[8,9] Up until recently, the choice of lasers for the treatment of vocal fold lesions was limited between cutting lasers (mainly the CO_2 laser or thulium laser) and photoangiolytic lasers (PDL and KTP).[10] Recent studies in the literature have reported the safety and efficacy of the novel blue light laser given its dual characteristics, which combine both photoangiolytic and cutting properties.[3,5] This laser has a characteristic wavelength of 445 nm, with unique properties which include a high level of absorption in hemoglobin, collagen, and melanin, but lower absorption in water compared to other diode lasers. In addition, the blue laser has excellent coagulation abilities with limited depth of penetration during incisions.[11,12] Hess et al were the first to report on the use of blue laser in laryngeal pathologies, with successful treatment of ectatic vessels, recurrent respiratory papillomatosis, poylps, Reinke's edema, and granuloma with no reported adverse reactions or complications.[3] Similarly, Miller et al in 2020 reviewed their series on 29 patients



A.



B.

FIGURE 2. **A.** 60-year-old man with a right vocal fold papilloma confirmed by biopsy. **B.** Follow-up laryngoscopic examination 3 months after blue laser therapy.

who underwent office blue laser transnasal flexible laser surgery, and showed a statistically significant decrease in the mean VHI-10 score postoperatively in patients with RRP

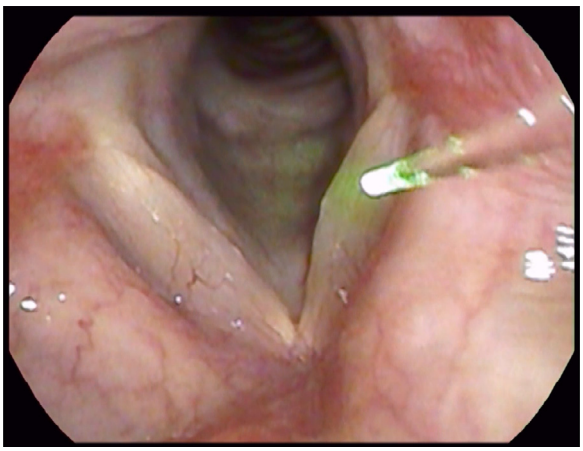


FIGURE 3. Application of blue laser therapy for bilateral grade 1 Reinke's edema.

TABLE 3.
VHI-10 Score Pre and Post Laser Therapy

N = 11	VHI-10 Pre	VHI-10 Post
1	8	
2	8	2
3	14	2
4	6	
5	8	1
6	32	1
7	18	
8	6	6
9	20	0
10	12	10
11	21	6
Mean ± SD	15.13 ± 8.77	3.50 ± 3.46
p-value	0.015	

TABLE 4.
Visual Analog Scale for Voice Quality Pre and Post Laser Therapy

N = 11	VAS Pre	VAS Post
1		
2		
3	7	1
4		
5	6	1
6	8	0
7		
8	5	4
9	5	0
10	5	3
11	7	3
Mean ± SD	6.14 ± 1.21	1.71 ± 1.60
p-value	0.0026	

($P< 0.01$) and benign lesions of the vocal folds ($P= 0.045$).[6] Interestingly, Lin et al also reported their results on animal studies comparing the degree of vocal fold scarring after blue and KTP laser therapy based on histologic changes in rats. The results showed that the degree of scarring was significantly less after blue laser treatment, with a significantly higher degree of protein deposition/fibrosis in the KTP group.[5] This 445 nm laser has also shown higher level of cutting effectiveness when used in contact mode and at a high power setting (10 W), leaving a very thin coagulation margin in proximity to the dissected tissues, leading to shorter operation times.[3,12]

The results of our study show similar outcomes to what has been published thus far in the literature. The application of blue laser in patients with different vocal fold pathologies has been shown to significantly impact patient-reported voice outcome through improvement in VHI-10 scores and visual analog scale scores on voice quality. In addition, blue laser therapy was found to result in complete or partial resolution of all vocal fold lesions as documented by follow-up laryngeal endoscopy. Our study is only the second systematic report on the use of the blue laser in un-sedated office-based laryngeal laser surgery, concurring with the results of previous reports that assert the safety and efficacy of un-sedated office-based blue laser therapy of different laryngeal pathologies.[6] Notably, this review also indicates that blue laser can be used successfully in the treatment of carcinoma in situ (with complete resolution) and squamous cell carcinoma with promising results on short-term follow up. Given the limited number of patients with squamous cell carcinoma enrolled in this study (n = 1), the authors do not advocate office-based blue laser therapy in laryngeal cancer until a large prospective study is conducted. Blue laser in an office setting can be used to treat patients at a high risk for general anesthesia, noting that it does not preclude other treatment modalities such as radiation therapy.

Introducing a valuable combination of photoangiolytic and cutting properties in one wavelength at 445 nm, along with the ability of being transmitted through small glass fibers and the portability of the laser,[3] the blue laser appears to be a promising alternative in office-based laryngeal laser surgeries for the treatment of a multitude of vocal fold pathologies.

The main limitation of our study is the small sample size and its retrospective nature. Future studies should be based on larger prospective series comparing the blue laser to the different lasers that are currently used in the treatment of the different benign and malignant laryngeal pathologies.

CONCLUSION

The results of this study suggest that blue laser therapy can be used as a safe and effective alternative treatment modality in office-based laryngology procedures for a variety of vocal fold lesions. Further research is needed with a larger number of patients and long-term follow-up in order to better assess the efficacy of this treatment modality.

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