ABSTRACT

Introduction

Microvascular ablation is a valuable method of treating many vocal fold lesions. There are several 532-nm potassium titanyl phosphate (KTP) lasers available but settings are not always transferrable. Previous studies have established settings for the Aura XP KTP laser. Our investigation seeks to establish settings for the Lumenis Novus Spectra KTP laser that result in selective vessel ablation.

Materials and Methods

Using the avian chorioallantoic membrane model, a pulse width of 50-300 msec, pulse energy of 1000-2000 mW, and working distance of 1-3 mm were tested. Vessels 0.01-0.14 mm in diameter were utilized.

RESULTS

Pulse widths of 200 m/sec, lower energies (1000-1500 mW) and longer working distances (3 mm) are most effective at producing vessel coagulation.

Conclusions

The Lumenis Novus Spectra KTP laser is less powerful compared to other KTP lasers but still effective at producing selective vessel ablation without rupture. This study provides a guideline for settings for potential use of the laser on laryngeal mucosa.

INTRODUCTION

Microvascular ablation and photothermolysis with pulsed dye lasers (PDL) has arisen as a valuable method of treating many vocal fold lesions. Initially, a significant proportion of vessels treated ruptured with extravasation of blood into the superficial lamina propria (SLP) of the vocal fold.1,2 Subsequently, a pulsed KTP laser was developed which enabled the user to adjust the pulse width and deliver more effective intravascular coagulation which resulted in less vessel rupture.

Broadhurst et al. were the first to actually test the KTP laser in an effort to determine the effective laser settings that would lead to selective vessel ablation. They tested the Aura XP with starpulse KTP laser on the chick chorioallantoic membrane (CAM) model.3 The CAM provides a model of the vascular network within the superficial lamina propria of the avian vocal cord mucosa and has been substantiated by Broadhurst et al. as a model for the human true vocal folds.

Unfortunately, the settings from that laser are not transferrable to other KTP lasers. Therefore, we performed this study in an effort to define the optimal settings for the Lumenis Novus Spectra Verapulse KTP laser. This laser is compact, suitable for both the operating room and clinic setting, and used in other fields such as ophthalmology and dermatology. We used a method similar to the Broadhurst et al. group and varied the energy setting, pulse width, and working distance using the CAM model to establish optimal laser settings for this KTP laser.

METHODS AND MATERIALS

Research grade-leghorn chicken eggs were obtained at post-fertilization day #1 and maintained on an egg rocker and incubated at 100°F. On days 14-16 post-fertilization, the eggs were removed from the incubator. Third order vessels (0.01 to 0.14 mm) most closely approximate the caliber of vessels in the human vocal mucosa fold, and such vessels were measured and identified for use in this study with a micrometer.

A 532-nm pulsed KTP laser (Lumenis Novus Spectra Verapulse) was fitted with the Lumenis EndoOto™ Probe and tested at the following settings: pulse width of 50, 100, 200, and 300 m/sec, pulse energy of 1000, 1500, and 2000 mW, and working distance of 1 and 3 mm. In all cases, a pulse rate of two pulses per second was used.

CONCLUSIONS

The Lumenis KTP photoangiolytic laser possesses a broad range of possible settings that effectively ablated vessels similar to those of the human vocal folds using the CAM model. Longer pulse widths allow for more effective coagulation however there may be a limit and further work needs to be done to define this. In addition longer working distances (3 mm) and lower energies (1000-1500 mW) provided more reliable vessel ablation. The Lumenis Novus Spectra KTP laser is less powerful compared to other KTP lasers but still effective at producing selective vessel ablation without rupture. This study provides a guideline for settings for further studies on the use of the laser on laryngeal mucosa.

DISCUSSION

The Lumenis laser is a less powerful laser compared to the Aura XP laser and thus the aim of this study was to determine if the laser would have enough energy to produce vessel ablation in this setting. And if so, we aimed at determining optimal settings that would result in safe and reliable vessel ablation.

Increasing the pulse width initially led to a decreased rupture rate with 0% at 200 mS. However at a pulse width of 300 mS the rupture rate increased to 20%. This may indicate that there is an upper limit for the pulse width. We postulate that with longer pulse widths the energy is delivered over too long a period of time and effective intravascular coagulation cannot be achieved before rupture of the vessel occurs.

Similarly to Broadhurst et al., lower energies (1000 and 1500 mW) and longer working distances (3 mm) were more likely to result to effective intravascular coagulation. Interestingly, even at a higher energy of 2000 mW a longer working distance (3 mm) resulted in safe and reliable vessel ablation.

In this study as well as the Broadhurst et al. study, vessels were treated until they ruptured or were ablated and depending upon the settings this can take one pulse or sometimes greater than ten. This has implications especially in the office setting where awake patients may not tolerate extended treatment times secondary to the increase in number of pulses delivered.

REFERENCES