Guest Editorial

Lasers in Laryngology; Current Status

INTRODUCTION

The type of lasers used in laryngology includes carbon dioxide laser, Nd:YAG, diode and KTP laser. Carbon dioxide laser is rod delivery laser while the rest are fiber lasers.

Carbon dioxide laser is the best accepted for the work in the larynx. The laser scores over the cold instrumentation in precision, better healing, hemostasis and less scarring. The CO_2 laser induces very little collateral thermal tissue interaction when compared with other wavelengths used in the medical field, e.g. neodymium:yttrium-aluminum-garnet (Nd:YAG) laser, argon laser or potassium titanyl phosphate (KTP) laser. The CO_2 thermal penetration ranges in microns, whereas that of other wavelengths ranges in millimeters.[1] These features make CO_2 laser surgical workhorse when tissue incision or vaporization with minimum concomitant collateral damage is required.[1] The wavelength of CO_2 laser (10.6 μm) lies outside the visible spectrum and, therefore, an aiming beam of helium neon/diode is required. The latest generation CO_2 lasers are equipped with the robotic scanner and acublade. The acublade is a scanner software which allows the beam to travel across the target as a straight or curved line. Various lengths 0.5 to 3.5 mm and various depths 0.2 to 2 mm are programmable.

Before starting a laser program in laryngology with carbon dioxide laser, it is important that the surgeon checks the compatibility of the microscope, micromanipulator and the laser machine.

Laser Safety Protocol

Before any laser surgery, an exhaustive laser safety protocol needs to be followed and includes:

1. Wearing of protective eye wear for the surgeon, personnel around and the patient.
2. Avoidance of inflammable gases like nitrous oxide. Air oxygen mixture is preferred and FiO_2 needs to be less than 30.
3. Any combustible material, like charred tissue, gauze, etc. must be away from the beam.
4. It is preferable to use laser protective tubes.

Vocal Cord Cysts

CO_2 laser can be used very successfully for intracordal cysts using the mini-microflap technique. The vocal cord cysts are of two types: Mucus retention cyst and the epidermoid cyst. The vocal cord cysts lie very close to the vocal ligament, hence high degree of precision is required in dealing with them. The use should only be in expert hands and a beginner should use phonomicrosurgical techniques. An epithelial cordotomy 1 mm lateral to the cyst is done and the cyst is grasped with Bouchayer forcep and separated medially from the epithelium and laterally from the vocal ligament. In case the cyst ruptures care must be taken to remove the entire epithelium. The epithelium needs to be redraped. CO_2 laser gives the right amount of precision required in dealing with a lesion as delicate as a epidermoid cyst. The AcuBlade system has been shown to be a better alternative in this setting.[2]

Abductor Cord Paralysis

CO_2 laser is a very effective tool for the management of bilateral abductor cord paralysis. Posterior transverse laser cordotomy (PTLC) was first described by Dennis and Kashima[3] as a technique for providing an airway at the posterior glottis without pre-operative tracheotomy; they reported it as a successful method with satisfactory functional results. The other procedures include posterior cordectomy with or without partial arytenoidectomy, suture lateralization with longitudinal laser cordotomy.

Recurrent Respiratory Papillomatosis

Recurrent respiratory papillomatosis is another suitable condition for microsurgery using carbon dioxide laser. The laser may be used alone or along with a soft tissue shaver (microdebrider). The soft tissue shaver is used to debulk the papillomas, and carbon dioxide laser is used for fine work. The use of CO_2 laser is likely to produce very little damage to the vocal cords. This is an important aspect as these patients need to undergo repeat surgeries because of the biological behavior of the papillomas and once vocal cords are scarred cannot be corrected.

Early Laryngeal Cancer

Transoral laser surgery for early laryngeal cancer is an accepted modality today. The benefits are of short treatment duration, lower costs, oncological control similar to radiotherapy and possibility of successive treatments. The argument of better voice results with radiotherapy may not be entirely true today. Endoscopic laser surgery offers overall voice quality equivalent to that

of radiotherapy for patients with T1a midcord glottic carcinoma. In lesions beyond T1a the voice improves with speech therapy or primary or secondary vocal cord reconstruction can be done with autologous fat.

A retrospective cohort study[4] was conducted of all individuals who received either RT or TLM for the treatment of Tis or T1a glottic SCC between 2004 and 2009 at the London Regional Cancer Program.[5] The primary outcome measure was voice-related quality of life, as assessed by the Voice-Related Quality of Life questionnaire (V-RQOL). Secondary outcomes included local control, overall survival and laryngectomy-free survival. Fifty-seven patients were eligible for this study; 34 received RT and 23 received TLM. Forty (70.2%) out of the 57 patients completed the V-RQOL. No statistically significant difference in total V-RQOL score was observed between the RT and TLM cohorts ($p = 0.228$). There was, however, a trend toward higher scores (i.e. less voice disability) in the physical function domain of the V-RQOL for the RT group (90.0%) compared to the TLM group (80.2%) ($p = 0.05$). No significant differences were observed in recurrence or overall survival between the two groups. The study concluded that both oncologic outcomes and self-rated voice-related quality of life are similar in patients treated with RT and TLM for early glottic carcinoma.

Another study by Peretti et al[6] who did a cost analysis, comparison of voice results and the curative results between external beam radiation and laser surgery for early cancer larynx. The study concluded that cure rates are equal, voice results are comparable and the total cost of external radiotherapy significantly higher as compared to the laser surgery for early cancer larynx and the author recommended laser surgery over external beam radiotherapy. Perreti[7] et al also confirmed good surgical outcomes for T1, Tis and selected T2 and T3 glottic tumors with laser. They also achieved high rates (65%) of rescue endoscopic retreatment in case of early detected local failure, achieving an ultimate local control with laser alone of 93.4%, 95%, 85.6%, and 71.6% for Tis T1, T2, and T3 respectively. Another study[8] from the same center concluded that selected recurrences after primary RT for T1 and T2 glottic carcinoma are eligible for endoscopic salvage surgery with oncologic results comparable to those with open neck procedures but with a lower complication rate and a favorable functional outcome.

Vocal Cord Polyps

CO_2 laser has been advocated for the treatment of benign vocal fold lesions since Benninger's 2000 randomized trial[8] that demonstrated the absence of difference in outcomes on blinded comparisons of stroboscopy, voice quality or recovery between cold instruments and laser in the treatment of benign superficial vocal fold lesions. With improvement of introduction of the acublade system, the results are getting better.

Laser is of benefit in vascular polyps where it scores over conventional instruments in terms of hemostasis and precision.

Vascular Lesions

Vascular lesions, like hemangiomas of larynx, subglottic hemangioma in children are very suitably dealt with the carbon dioxide laser.

Laryngotracheal Stenosis

Most commonly used in the airway for laryngotracheal stenosis are CO_2, Nd:YAG and the potassium-titanyl-phosphate (KTP) laser. The CO_2 laser has been the mainstay in the management of most airway lesions because of surgeon familiarity and its precise cutting properties. Its main drawback is difficulty with delivery of the beam through the subglottiscope or bronchoscope. The development of microsubglottoscopy with specially designed scopes and more sophisticated micromanipulators has overcome this problem to a large degree. The Nd:YAG laser has the advantage of transmission through flexible fibers and delivery by either contact or noncontact mode. This greatly facilitates its use via the bronchoscope when addressing tracheal stenosis. Nd:YAG laser also offers good hemostatic properties, but its heat diffusion characteristics may cause surrounding thermal damage. KTP is a better hemostat because of its preferential absorption by hemoglobin.[9]

Laser is useful for limited stenosis of larynx and trachea. Stenosis of the supraglottic and glottic larynx may be approached with standard suspension microlaryngoscopy while exposing stenoses of the subglottis or upper trachea may require the rigid bronchoscope or specially designed subglottiscopes. As described by Ossoff et al,[10,11] the subglottiscope modification of the Dedo laryngoscope provides access to the subglottis with a port for jet ventilation, while still allowing the use of the microscope and the CO_2 laser aiming system. Laser is also useful for managing postoperative granulations and webs in the glottis.

Laryngomalacia

It is normally a self limiting condition in children and here CO_2 laser can be very effectively used, if the condition does not improve.

Office-based Laser Surgery

Kaufmann et al[12] have described good results with unsedated office-based laser surgery (UOLS) of the larynx and trachea for laryngotracheal pathology, including recurrent respiratory papillomas, granulomas, leukoplakia and polypoid degeneration. UOLS delivered by flexible endoscopes has dramatically impacted office-based surgery by reducing the time, costs and morbidity of

surgery. Out of the 443 cases, 406 were performed with the pulsed-dye laser, 10 with the carbon-dioxide laser and 27 with the thulium:yttrium-aluminum-garnet laser. There was no significant complication in this series.

CONCLUSION

Laser is a useful tool which scores over conventional instrumentation in terms of better precision, better hemostasis and less surrounding tissue damage resulting in less postoperative scarring. However, a proper case selection, proper laser safety precautions and surgeons and properly trained personnel are a prelude to running a proper laser program.

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