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# Laser Surgery for ENT Procedures: our Experience

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**Abstract**
**Background and Aims:** *Smooth and safe general anaesthesia in compromised airway with abnormal anatomy, sharing of airway with surgeon, avoidance of potential laser hazards, prevention of awareness, wide awake patient after surgery with least postoperative complication are main challenges for anaesthesia for laryngeal laser surgery.*
**Methodology**: *The study was conducted on thirty patients of American Society of Anesthesiologists Grade I and II of age group 18–58 years, posted for elective laryngeal laser surgeries to study the outcome of our anaesthetic management. We also emphasized on currently available measures to prevent problems of laser surgery.*
**Results:** *None of the patents in our study shows complications except four patents represent difficulty in breathing postoperatively due laryngeal edema and managed accordingly.*
**Conclusion:** *With use of safety measures and special techniques for anaesthesia, the problems of laryngeal laser surgery are minimized.*
**Keywords:** *laser in ENT surgery, Safe anaesthesia techniques, operating room hazards.*

## Introduction

Laser microlarynygeal surgery poses critical challenges to the anesthesiologist which is compounded further by the ever-growing indications for laser surgery. Lasers are powerful tools in the surgical armamentarium and this power can be dangerous if they are used without checks and controls.[1] Problems include the conflicting needs of the surgeon and the anesthesiologist for access of the airway, fire hazards associated with the laser beams, the absolute necessity to ensure the adequacy of ventilation and the intense cardiovascular pressor response to sustained laryngoscopy. Operating room fires are rare but can be devastating. Every conceivable mode of airway management and ventilation has been used for laser surgery of the airway. All techniques have their advantages and drawbacks, which are dependent on the basic airway disease and the degree of airway compromise. The scope of laser surgery under local anesthesia and monitored anesthesia care is

expanding everyday as improvements in instrumentation using fibreoptic scopes are ongoing. Sedation in these patients is challenging in itself. On the other hand, robotics has taken complex airway surgery to another level with the requirement of airway management for long periods of time.[2,3] Many authors have preferred using total intravenous anesthesia (TIVA) to inhalational anesthetics. Laser surgery is fraught with dangers not only for the patient but for the operating room personnel as well. Because of which, the use of class 3 and 4 lasers (most surgical lasers) should be under supervision of a laser safety officer and performed in specified areas with all staff educated about the safety drills and protocols.[4]

With rapid advancement in ENT laser surgery there are new challenges to the surgeons and anaesthesiologist. It consists of package of some benefits and some problems. Anaesthesiologists and Surgeons are working in the same anatomic field and share the airway which is already compromised by the disease. Margin of safety is reduced. Close co-operation and communication between aneasthesiologist and surgeon is of paramount Importance. Airway fire is the major hazard.[5]

**Effects of laser**

Lasers are useful in surgery because they allow the application of a high amount of energy to a precise location. In addition, the laser light provides hemostasis because of its selective absorption by pigmented materials (blood). When a laser beam interacts with tissue, the tissue either reflects, adsorbs, transmits or scatters a portion of light. The surgical interaction of this radiant energy with tissue is caused only by that portion of light that is adsorbed (incident minus the reflected and transmitted portions). Lasers cause tissue effects by either causing thermal injury (burns secondary to energy adsorption), photochemical reactions secondary to interaction between specific molecules and radiant energy, and mechanical effects such as tissue disruption secondary to photo-acoustic shock waves.

**Types of lasers used in ENT surgery**

The CO2 laserhas been used in otolaryngology since the 1970s. The infrared radiation from CO2 lasers, with a wavelength of 10.6 mm, is readily absorbed by water, blood, and all biologic materials independent of pigmentation. The radiation from a CO2 laser is invisible to humans and acts via thermal injury, vapourising the cells. It has minimal penetration and causes minimal collateral damage. All medical lasers have been used for ENT surgery. The Nd:YAG laser has the highest tissue penetration of all currently available medical lasers.

**Laser hazards**

1) Airway fires: The high energy density of lasers poses a risk of combustion. Surgical lasers are cited to be the second most frequent ignition source in operating room fires (after electrosurgical units). Fires caused by surgical lasers are frequently serious and pose unique problems to the anesthesiologist when the surgical field is in, or close to, the airway.

2) Laser plume or Laser Generated Air Contaminants (LGAC): The interaction of laser with tissue produces a plume of smoke and fine particles (0.1e0.8 mm) which can deposit in the alveoli, capable of producing interstitial pnuemonitis, bronchiolitis, reduced mucociliary clearance, emphysema and have mutagenic potential.[6,7] The plume contains toxic gases, carcinogens and viable microorganisms. Contamination can be prevented by having smoke evacuators at the surgical site, or special efficiency masks (Protector II, Anago Tx).[8,9]

3) Tissue or vessel perforation.[10,11]

4) Eye injury

5) Embolism[12,13]

6) Ignition of surgical drapes[14,15]

7) Electrical tripping as the laser machines have high power

requirements
8) Chemical hazards due to variety of lasing mediums used such
as solvents, dyes or hazardous gases.
9) Noise: Lasers are frequently noisy with levels occasionally
going as high as 90 dB.

**Role of anaesthetist**

Maintain Oxygenation, Allow removal of $CO_2$, Keep patient anaesthetized. Reduce incidence of airway fire by special approaches. To deal with crisis.

**Anaesthesia Management**

**Anesthesia for laser surgery and ventilatory strategy**

An ideal anesthetic technique for laser surgery must provide the
following:
1) Depth of anesthesia sufficient to suppress hemodynamic
response.
2) A secure airway
3) Adequate ventilation
4) No movement of vocal cords
5) No risk of combustion
6) Scavenging of laser plume
7) Good post-operative care, as these patients are susceptible to laryngeal spasm and laryngeal edema in the post-operative period.

The technique of airway management and ventilation is essentially a modification of the technique for microlaryngoscopy. It will depend on the site of surgery, i.e. oral, hypopharyngeal, laryngeal or sub-glottic. It will also depend on the degree of airway obstruction and the age of the patient. The various techniques are broadly the following:

1) Conventional general anesthesia with endotracheal intubation
2) General anesthesia without intubation ("tubeless technique")
1. Intermittent apnea technique
2. Tubeless spontaneous breathing technique
3. Conventional jet ventilation
4. High-frequency jet ventilation/Superimposed High-
Frequency Jet Ventilation (SHFJV)
3) Topical/local anesthesia with sedation

***Pre-operative Consideration***

Reduce post operative complications.

**Material and Methods**

Prospective observational study was conducted at the SMHS Hospital, one of the associated hospital of Government Medical College Srinagar. A total of 30 patients of American Society of Anesthesiologists (ASA) physical status I and II of both genders, aged 18-58 years, weighing 45-80 kg, posted for elective laryngeal laser surgeries, were enrolled. All patients were admitted prior to the day of the surgery, and fasting of 6 hour was ensured. On arrival to the operation theatre, the baseline systemic blood pressure, heart rate, peripheral oxygen saturation (SpO2) and ECG were recorded. After establishing the intravenous line, lactate Ringer solution was started and they were pre-medicated with ondansetron (0.1-0.3mg/kg), glycopyrrolate (10 µg/kg), midazolam (0.07-0.15 mg/kg) and fentanyl (2 µg/kg), 15 min before induction of anesthesia. After pre-oxygenation for 3 min, anesthesia was induced with propofol (2 mg/kg) till loss of verbal command Intubation was done with special tube (Mallinckrodt tube) or ventilation with wrapped tracheostomy tube was done. Cuff was inflated with saline and methylene blue. Anesthesia was maintained with 60% nitrous oxide in oxygen and isoflurane dial concentration was titrated to achieve a systolic blood pressure 30% below the baseline values. Patients were mechanically ventilated to maintain the end tidal concentration (EtCO2) between 30 and 35 mm Hg. Intraoperatively, the heart rate, arterial blood pressure, ECG, EtCO2 and peripheral pulse oximetry (SpO2) were monitored and recorded at 5 min intervals till end of surgery.

After surgery, the residual neuromuscular blockade was antagonized with neostigmine (0.05 mg/kg) and glycopyrrolate (0.008 mg/kg). Patients

were extubated after observing adequate motor recovery and spontaneous breathing efforts.

**Results**

Following laryngeal surgeries were included in our study

| Procedures | No. Of Patients |
|---|---|
| TOLE (Buccal mucosa fibroma ) | 07 |
| TOLE (CA Larynx) | 04 |
| CA Tongue (wide local excision of CA tongue with laser ) | 05 |
| TOLE (Supraglotic lesion) | 02 |
| TOLE (Vocal card growth) | 02 |
| R Laser stapdectomy | 02 |
| Laser coagulation of multiple nodules on posterior pharyngeal wall | 01 |
| Laser turbinoplasty | 03 |
| Laser assisted Uvulopalatoplasty (LAUP) | 02 |
| Multiwave locked system (MLS) | 02 |

None of the patents in our study shows complications except four patents represent difficulty in breathing postoperatively due laryngeal edema and managed accordingly.

**Discussion**

Airway surgery demands a high level of cooperation between surgical and anaesthetic teams. Evaluation of the location, size, extent, and mobility of any lesion is required. The effects on laryngeal function and airway patency must also be investigated. Previous anaesthetic and surgical findings are useful, though tumours may grow rapidly and radiotherapy can change tumour size, appearance, and mobility. Cross-sectional imaging helps to define upper and lower limits of lesions and nasendoscopy provides advance warning of their appearance. The population presenting for airway surgery mainly falls into two categories. The first group comprises elderly patients with coexisting respiratory and cardiovascular morbidity resulting from long-term smoking and high alcohol intake. These patients often have malignant lesions and may show side-effects of its treatment (e.g. radiotherapy). They often require invasive intraoperative monitoring and short-acting opioids such as remifentanil. The second group comprises young children or those with learning difficulties who inhale or ingest foreign objects. Psychosocial factors include fear of choking, death, and inability to communicate following tracheostomy. Many patients return for multiple procedures. Intraoperatively the anaesthetist must pay special attention to protecting eyes, neck, and teeth while optimizing surgical access in what may be a crowded area.[16, 19]

**Airway Fire and Explosion**

Airway fire and explosion is the major risk factor for laryngeal laser surgery.

Incidence - 0.5% to 1.5%. It is caused by Direct laser illumination, Reflected laser light.

Airway fire causes Thermal burns, Chemical response to burns. Approaches to reduce incidence of airway fire 1) Reducing flammability of ETT Special tubes those are laser resistant. Wrapping standard tubes. Cuff of ETT has to be inflated with saline+methylene blue 2) Using different modes of ventilation Intermittent Extubation Venturi JetVentilation,

Jet ventilation: (HFJV) there are different method of delivering HFJV, Trastracheal HFLV, Subglottic/ Traslaryngeal HFJV, Supraglottic superimposed HFJV Advantages: No obstacle to surgical field,Adequate ventilation Disadvantages: Surgical emphysema, barotrauma, pneumothorax, hypoxemia, hypercarbia, abdominal distension, compliant lung is required Contraindication: Patient requiring ETT <2.5mm 3) Fio <30%, AvoidN Oand volatile anaesthetics 4) Use of TIVA.[20-22]

**Oxygenation and Ventilation**

Several methods have been successfully used to provide oxygenation and ventilation during endoscopy. The best approach is to have several alternatives available at the time of induction of anaesthesia. For adult patients, wrapped tubes, metal tubes and jet ventilation should be on hand. Each method has its own sets of problems and benefits. Most commonly the patient is intubated

with small diameter endotracheal tube through which positive pressure is administered. Advantages of this is, smooth maintenance of airway throughout surgery. Disadvantage is small size which increase airway resistance and it obstructs surgical field.[23,24]

**Conclusion**

With use of safety measures and special techniques for anaesthesia, the problems of laryngeal laser surgery are minimized.

**Bibliography**


1. P. Dhar, A. Malik / Anesthesia for laser surgery in ENT and the various ventilatory techniques Trends in Anaesthesia and Critical Care 1 (2011) 60e66 .
2. Tomit Y, Mihashi S, Nagata Kea. Mutagenicity of smoke condensates induced by CO2 laser and electrocauterisation. Mutat Res 1981;89:145.
3. Kokosa J, Eugene J. Chemical composition of laseretissue interaction smoke plume. J LaserAppl 1989;2:59e63.
4. Smith J, Moss C, Byrant CJ, Fleeger AK. Evaluation of a smoke evacuator used for laser surgery. Lasers Surg Med 1989;9:276.
5. Meyers A. Complications of CO2 laser surgery of the larynx. Ann Otol, 1981; 90: 132-4.
6. Tomit Y, Mihashi S, Nagata Kea. Mutagenicity of smoke condensates induced by CO2 laser and electrocauterisation. Mutat Res 1981;89:145.
7. Kokosa J, Eugene J. Chemical composition of laseretissue interaction smoke plume. J LaserAppl 1989;2:59e63.
8. Smith J, Moss C, Byrant CJ, Fleeger AK. Evaluation of a smoke evacuator used for laser surgery. Lasers Surg Med 1989;9:276.
9. Smith J, Topmiller J, Shulman S. Factors affecting emission collection by surgical smoke evacuators. Lasers Surg Med 1990;10:224.
10. Faintuch J. Endoscopic laser therapy in colorectal carcinoma. Hematol Oncol Clin North Am 1989;3:155.
11. Dittrich K, Armbruster C, Hoffer F. Nd:YAG laser treatment of colorectal malignancies: an experience of 4 1/2 years. Lasers Surg Med 1992;12:199.
12. Peache T, Eason J, Moxham J. Systemic air embolism during laser bronchoscopy. Anesthesia 1988;43:872.
13. Ross DJ, Mohsenifar Z, Potkin RT, Roston WL, Shapiro SM, Alexander JM. Pathogenesis of cerebral air embolism during Nd-YAG laser photoresection. Chest 1988;94:660.
14. Bauman. Laser drapes fire. How much of a risk? Lasers Med Surg 1989;7:2. 11.
15. American National Standard for safe use of lasers; 1996. p. Z136.1.
16. Baer G, Paloheimo M, Rahnasto J, et al. End-tidal oxygen concentration and pulse oximetry for monitoring oxygenation during intratracheal ventilation. J Clin Monit 1995; 11: 37
17. Cowl CT, Prakash UB, Kruger BR. The role of anticholinergics in bronchoscopy: a randomised, clinical trial. Chest 2000; 118: 188
18. McRae K. Anesthesia for airway surgery. Anesthesiol Clin North America 2001; 19: 497–541,
19. Kain ZN, O'Connor EZ, Berde CB. Management of tracheobronchoscopy and esophagoscopy for foreign bodies in children: A survey study. J Clin Anesth1994; 6: 28.
20. Rampil IJ. Anesthesia for laser surgery. In: Miller RD, ed. Miller's anesthesia, 6th ed. Philadelphia: Churchill Livingstone, 2005:2573-2588.

21. McRaeK. Anesthesia for airway surgery. Anesthesiol Clin North America 2001;19(3):497-541.
22. Werkhaven JA. Microlaryngoscopy-airway management with anaesthetic techniques for CO2 laser. Pediatr Anesth 2004;14:90- 94.
23. Jaquet Y, Monnier P, Van Melle G, et al. Complications of different venti lation strategies in endoscopic laryngeal surgery. A 10 year review.Anesthesiology 2006;104:52-59.
24. Borland LM. Airway management for CO2 laser surgery on the larynx: venturi jet ventilation and alternatives. Int Anesthesiol Clin 1997;35:99-106.