

Laser Surgery of the Laryngotracheal Stenosis

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I. Anesthesiological aspects

A. Choice of anesthetic methods

1. depends on - personal preferences and experiences
- the pharmacological properties of the particular substance
2. propofol+ alfentanil or remifentanil+ prophylactic anticholinergic glycopyrrolate : particularly good experiences

B. Monitoring

1. controlling the inspiratory oxygen concentration
- disconnection, stenosis, fall of O₂ concentration, and a nitrous oxide gate
2. pulse oxymetry - special value during the use of an argon laser
3. capnometry

C. Endotracheal tubes

1. Red rubber tube wrapped with metal tape
2. Laser shield II(Xomed Treace) :
- double coating of a silicone tube with aluminum and Teflon without the use of an adhesive
- methylene blue crystals within the cuff -> facilitate the detection of an intraoperative cuff leak
3. Laser-Trach by Sheridan
- fabric covered, embossed copper foil-wrapped red rubber
- resistant to carbon dioxide, but not to Nd-YAG laser radiation
4. Laser flex (metal tube by Mallinckrodt) : the

safest E-tube

- resist the direct irradiance with high power for longer than any other tube
- two cuffs, the proximal of which protects the distal against the laser beam
- great scattering effect and reflective properties
-> lead to tissue damage

D. Jet ventilation

1. FiO₂ < 0.4
2. monitor the arterial partial pressure of CO₂ : ABGA
3. clinical indication
- microsurgical laser procedures in the larynx and operation in the trachea
- used for laryngoscopes and bronchoscopes
4. especially suited to shorter procedures
- since regurgitation and aspiration cannot be excluded
5. contraindications
- markedly decreased compliance of lungs and thorax
- severe bronchopulmonary and cardiovascular disease
- gross obesity and very old age

II. Laser Safety

A. General guidelines for patients safety

1. eye protection by special eye shields or covered

with metal tapes

2. skin protection with wet towels : CO₂ laser radiation is absorbed by water

B. Effect of the inspired anesthetic gasses on combustion

1. during laser surgery only use 30% oxygen concentration

2. no nitrous oxide during laser operation

C. Fire hazards

1. prerequisites-ignition or necessary temperatures

- 60 C : thermal denaturation of tumor tissue

- 80-100 C : coagulation of blood vessel

- 100-250 C : vaporization of tissue

- flammable materials

: dry swabs

: endotracheal tube materials : PVC, red rubber, silicone

: adequate amount of carbonized tissue

- atmosphere that can sustain a fire

D. Sequence of measures in case of the fire or explosion (in order)

1. discontinuation of ventilation

2. removal of all instrumentation and swabs

3. extubation and fire extinction with saline

4. ventilation via mask

5. reintubation

6. consolidation phase

7. bronchoscopy

E. checklist of safety measure for laser in the operating room

1. appoint a laser safety officer

2. provide laser safety training to health care personnel

3. set up and follow standard operating procedure

4. label entrances to laser treatment rooms

5. install warning lights at the entrances to laser treatment rooms

6. make laser protective eye wear available

7. apply prophylactic measures against fire

8. provide laser, safety eye wear

9. train the staff annually

10. prevent fire

11. remove hazardous laser plume

III. Instruments and Operation Room Safety

A. Laryngo-Pharyngoscopes

1. The closed laryngoscopes with narrow lumen and extra length

children or when the medium-sized laryngoscope is inappropriate

2. The medium-sized, closed adult laryngoscope when the bivalved laryngoscope does not provide sufficient exposure

3. The distending laryngo-pharyngoscope work on supraglottis and hypopharynx

4. The distending operating oropharyngoscope procedures at tongue base, vallecula and lingual epiglottis

5. Ventilating bronchoscope attached with CO₂ laser

7. Flexible fiberscope with optical fiber

B. Special Microinstruments

: enabling the surgeon to operate effectively with a minimum number of instruments

1. Grasping forceps

different designs of varying size with serrated or toothed jaws

2. Suction tubes

a. two well insulated suction tubes of different diameter are useful

b. for suction purposes and monopolar electrocautery

3. Coagulation forceps

a. microlaryngeal forceps with curved, serrated jaws

b. clip forceps, jaws curved left/right

4. Protection shields

C. Introducing the Laryngoscope

1. tooth guard insertion

2. right-handed surgeon introduce the laryngoscope from the right, with the endotracheal tube placed on

the left

D. Cutting Technique

1. when cutting through soft tissue, it is advantageous to follow a fine zigzag line with the toggle stick

2. During laser dissection, it is recommended to repeatedly remove any char forming on the cut surface, by wiping it with a moist swab.

E. Counseling for Laser Operations

1. Laser-specific risks

- saline to inflate the cuff
- shielding of the tube
- operating in the apneic phase in certain situations

2. Complications

- possibility of persisting granulation tissue that requires repeated ablation for months after the surgery
 - development fo webs and stenoses after extensive resections
- symptomatic mucosal edema : may require postoperative administration of corticosteroids or rarely a laser excision of the edematous mucosa

IV. Laser application on laryngotracheal lesion

A. Indication

1. Supraglottic stenosis

2. Glottic stenosis

- cause: glottic web, fibrotic bands between vocal process(post-intubation) previous operation
- maybe, requiring open surgery, maintaining tracheostomy

3. Subglottic stenosis

- cause: congenital, endotracheal intubation, blunt trauma, high tracheostomy
- mostly, using soft silastic stent
- small age group

4. Tracheal stenosis

- unable at circumferential scarring wider 1cm, loss of tracheal cartilage tracheomalacia, bacterial tracheal infection

- alternatively, tracheal resection and end-to-end anastomosis

B. Controversy

1. sometimes, needs repeated operation

- at all laryngeal stenosis, 77.6% managed successfully, 71.4% required multiple procedure
- 2. dilatation
 - used prior to lasering
 - to provide temporary working place, important adjunct in managing coexistent glottic web
- 3. systemic antibiotics therapy
 - important role in preventing restenosis in tracheostomy, subglottic stenosis
- 4. intralesional corticosteroids
 - injection prior to laser vaporization
 - to inhibit collagen production, reduce inflammation, enhance collagen tissue breakdown
- 5. tracheostomy
 - should be avoided because it may lead to post-operative infection, because post-laser airway may be adequate without it

C. Failure causes

1. reformation of scar tissue

2. excissive application of laser energy

- unnecessary necrosis in nearby tissue with resultant undesired scar-tissue formation
- 3. bacterial infection associated with tracheostomy
- 4. circumferential cicatrical scar
- 5. scar tissue wider 1cm in vertical dimension
- 6. fibrotic scarring of post laryngeal inlet with arytenoid fixation

D. Laser technique

1. mucosa, granulation, scar all vaporized easily

2. circumferential removal be avoided

- possible cicatrix formation

- may be breaking mucocilliary cleansing system

3. avoid exposure of perichondrium, cartilage

- perichondritis, chondritis responsible for stenosis

4. immature stenosis be treated frequently

- as often as weekly, until epithelialization