HEAT THERAPY IN BRONCHOSCOPY

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THERMAL EFFECT ON BIOLOGICAL TISSUES

- 37 -40 c – normal
- >40 c – hyperthermia .
- >60 c- devitalization and coagulation
- >100 c – vaporization of tissue fluid and cutting due to mechanical tearing of the tissue
- > 150 c – carbonization.
- >300 c –vaporization of the entire tissue.

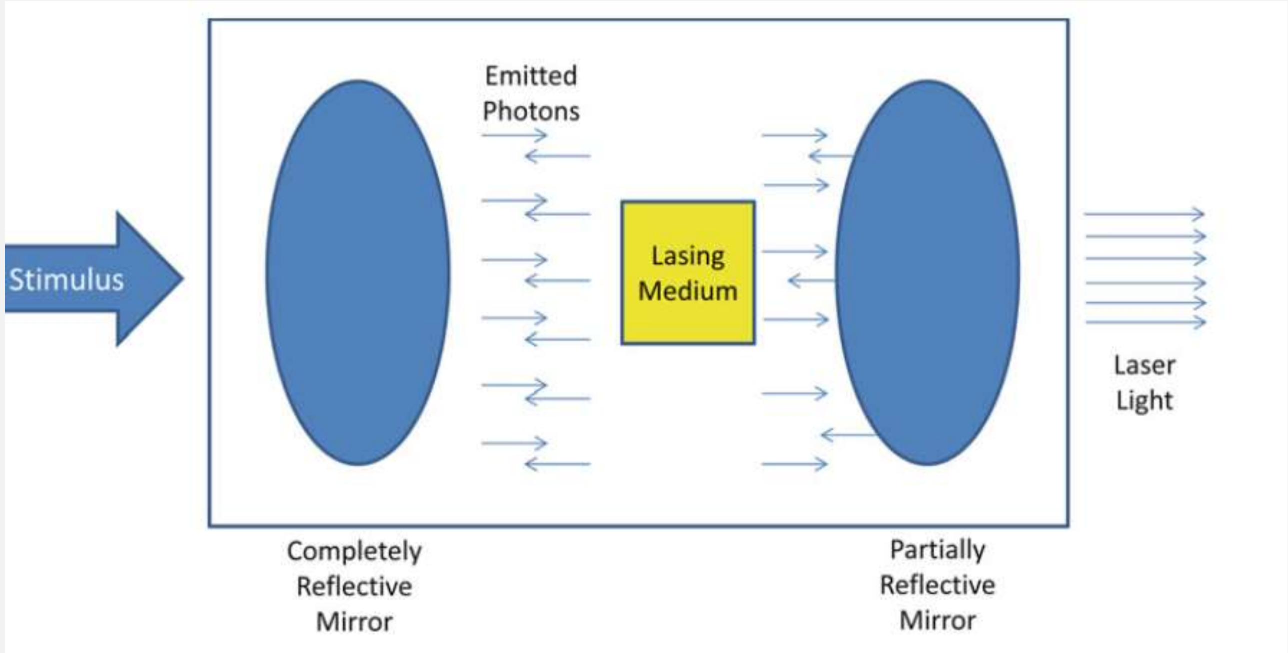
MODALITIES

- Endobronchial LASER
- Endobronchial electrocautery
- Argon Plasma Coagulation

ENDOBRONCHIAL LASER THERAPY – TECHNICAL ASPECTS

- LASER can be considered a form of light energy with 3 distinctive properties
  - Monochromacity –all the photons of laser light has a single wavelength.
  - Coherence –LASER light waves travel in parallel phase in relation to time and space.
  - Collimation – LASER light travel in a same direction with a very narrow beam of divergence.

PRODUCTION OF LASER



TYPES OF LASER

Table 1 Characteristics of medical lasers

Laser	Wavelength (nm)	Delivery device	Depth of penetration (mm)	Coagulation effect	Cutting effect
Argon	516	Quartz fiber	1.0–2.0	++	+
KTP	532	Quartz fiber	1.0	++	+
Diode	808	Quartz fiber	1.0	++	+++
Nd:YAG	1,060	Quartz fiber	0.5–1.5	+++	+
Nd:YAP	1,340	Quartz fiber	0.5–1.0	++++	+
Ho:YAG	2,100	Quartz fiber	0.5	+++	++
CO_2	10,600	Coupler and waveguide	0.23	+	+++

KTP, potassium titanyl phosphate; Nd:YAG, Neodymium-Yttrium, Aluminum, Garnet; Ho:YAG, Homium: Neodymium-Yttrium, Aluminum, Garnet.

MECHANISM OF LASER

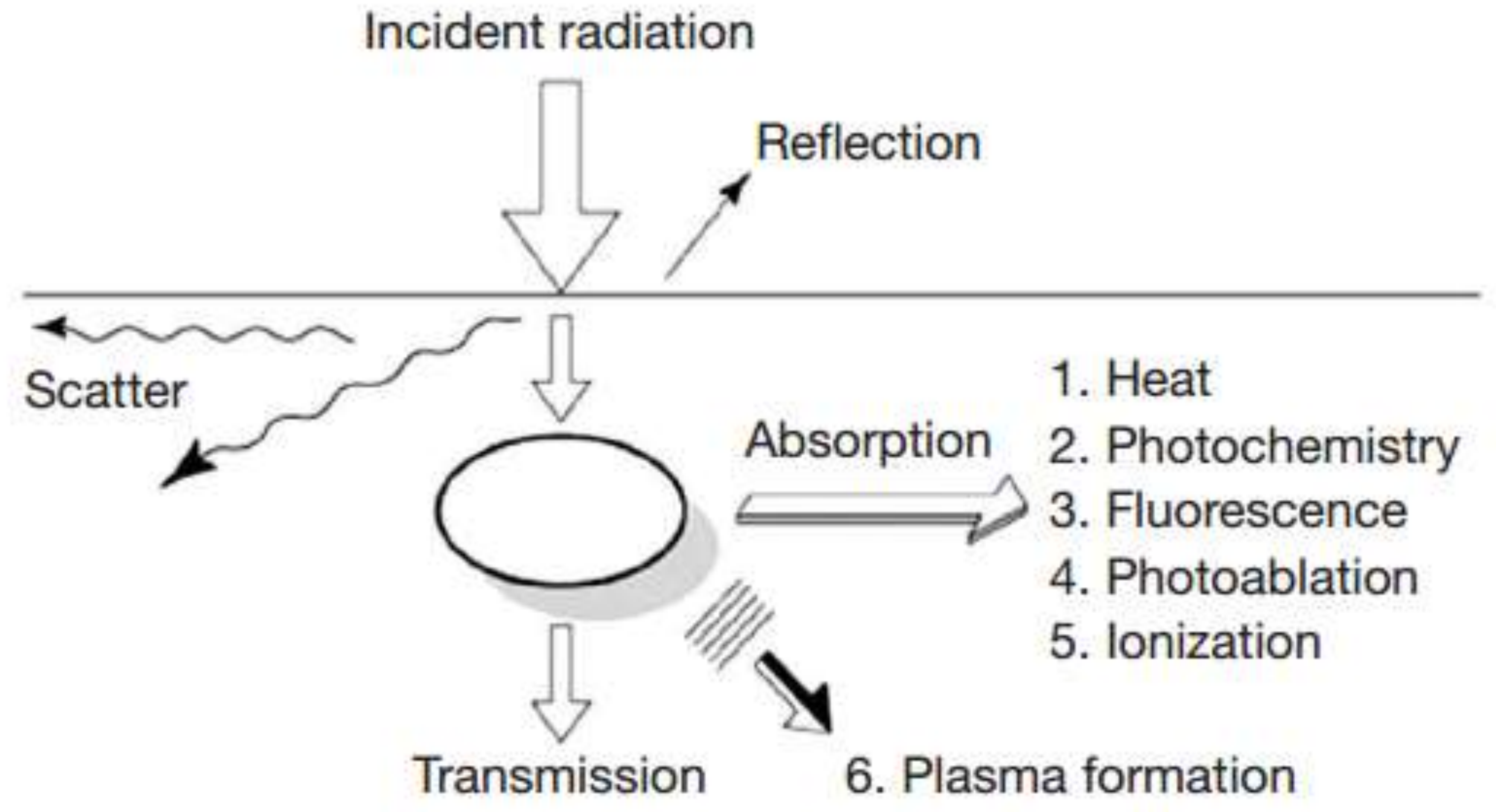


Figure 1 Laser tissue interaction (modified from: Google Images).

DETERMINANT OF LASER EFFICACY

- Three main characteristics determine the suitability of a particular LASER for therapeutic bronchoscopy

1. **Power density rating**; Power density depends on laser technology and on factors such as target tissue and exposure time.
2. **Ratio of absorption and scattering coefficients in soft tissue** : By determining the volume of tissue that is heated, absorption and scattering make the difference between cutting and haemostasis. Lasers with high absorption as well as high scattering coefficients are good coagulators.
3. **The delivery system.**

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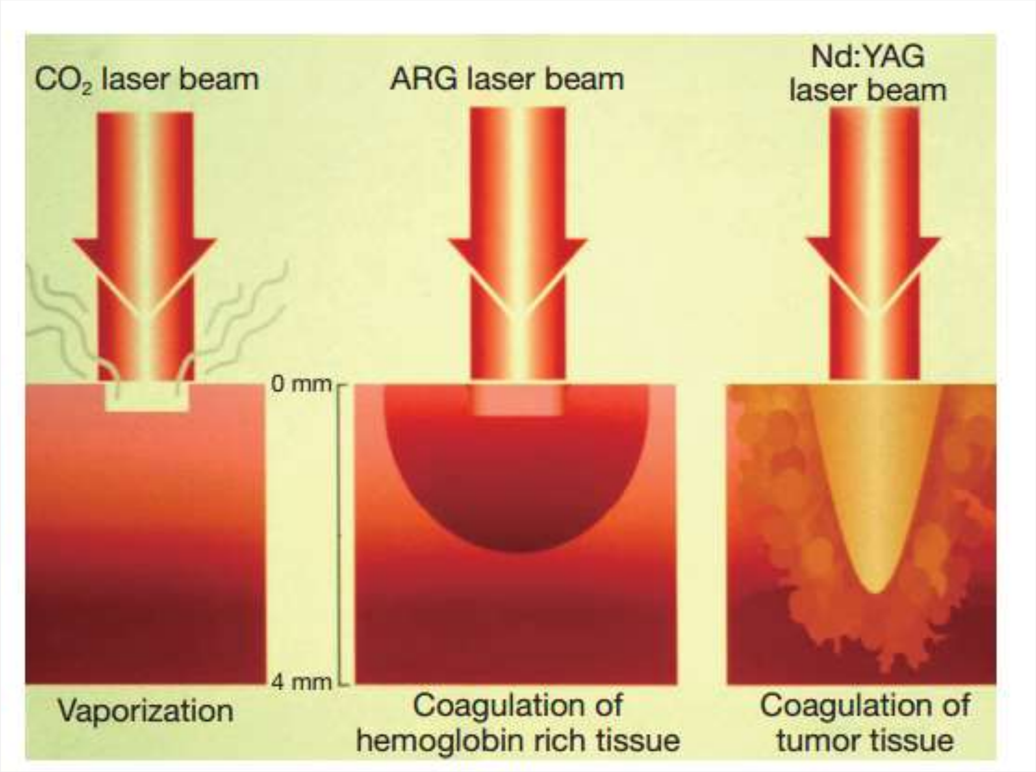
Bolliger etal Eur Respir J 2006; 27: 1258–1271



Relative depth of CO2, Argon and Nd:YAG lasers tissue penetration. Heavy absorption of the laser beam by either the water (CO2) or the hemoglobin content of the tissue (Argon) limits its penetration and thus variation in the effect.

PROCEDURE

- The neodymium:yttrium aluminium garnet (Nd-YAG) equipment is the most widely used type of laser for bronchoscopic interventions because it has sufficient power to vaporise tissues and produces an excellent coagulation effect.
- Its wavelength is1,064 nm, which is in the invisible range; a pilot light usually in the red colour range is required for the procedure.
- Both contact and noncontact probes are available.
- In the noncontact mode, the tip of the probe is held at about1 cm proximal to the target.

Bolliger etal Eur Respir J 2006; 27: 1258–1271

- An initial power setting of 20–40 Watts with a pulse duration of 0.5–1 s represents a safe initial setting to obtain devascularisation.
- To carbonise tissue, the tip of the probe is either moved closer to the target at about 3 mm or several pulses are applied at the same location.
- When treating obstructing lesions of the central airways, the aim is to devascularise the tumour and subsequently core out the bulk of the tumour with the tip of the rigid bronchoscope.
- When working with a flexible bronchoscope, the lesion is either devascularised or carbonised and the remaining tissue removed by forceps, or the whole lesion is vaporised.
- Protective eyewear is mandatory when the laser beam is activated

Bolliger etal Eur Respir J 2006; 27: 1258–1271

Table 2 Factors that influence outcome of Nd:YAG laser

Factors	Favorable	Unfavorable
Location	Tracheal, main bronchi	Lobar, segmental, upper lobe
Type of lesion	Endobronchial	Extrinsic
Appearance	Exophytic	Submucosal
Involvement	Localized	Extensive
Length of lesion	<4 cm	>4 cm
Distal lumen	Visible	Not visible
Duration of collapse	<4–6 weeks	>4–6 weeks
Clinical status hemodynamics	Stable	Unstable
Oxygen (FiO_2)	<40%	>40%
Coagulation profile	Normal	Abnormal
Pulmonary vascular supply	Intact	Compromised

Nd:YAG, Neodymium-Yttrium, Aluminum, Garnet; FiO_2, fraction of inspired oxygen.

Khemasuwan etal, *J Thorac Dis* 2015;7(S4):S380-S388

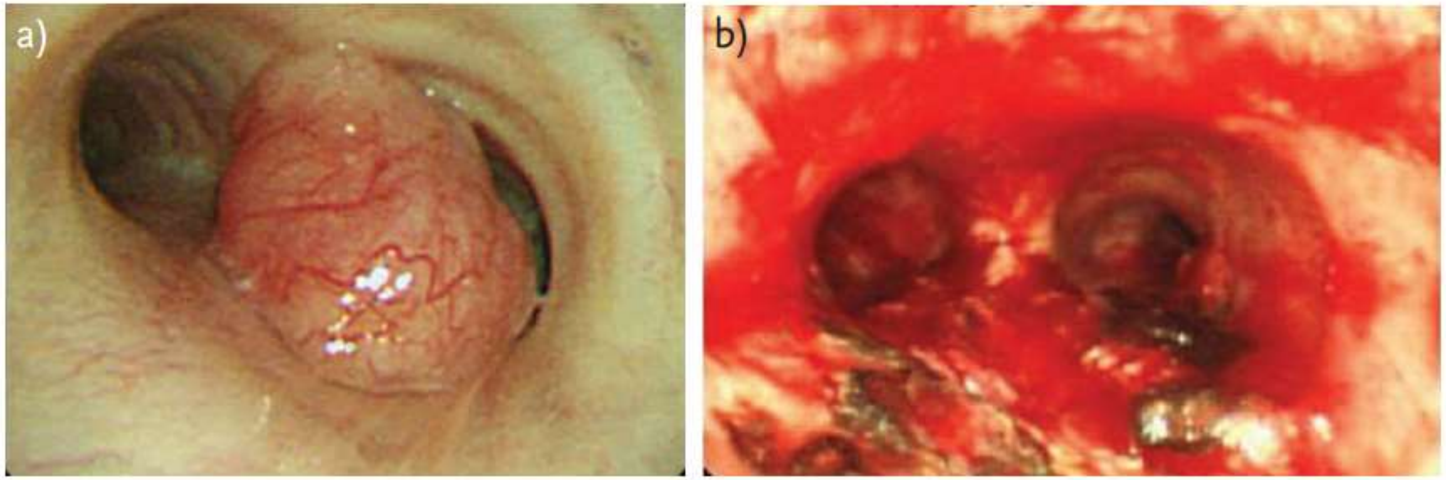
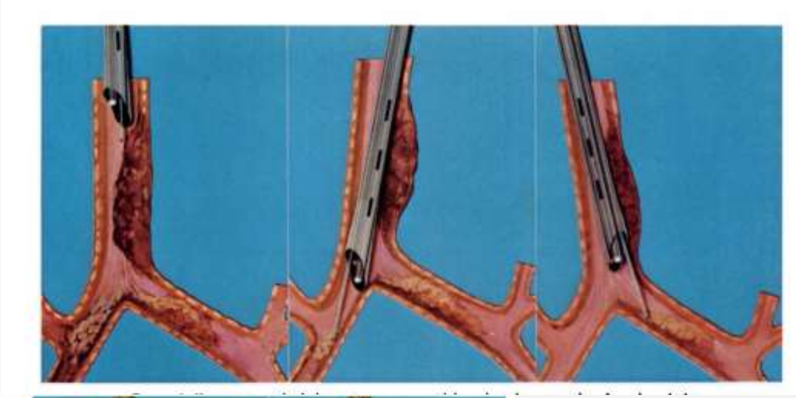


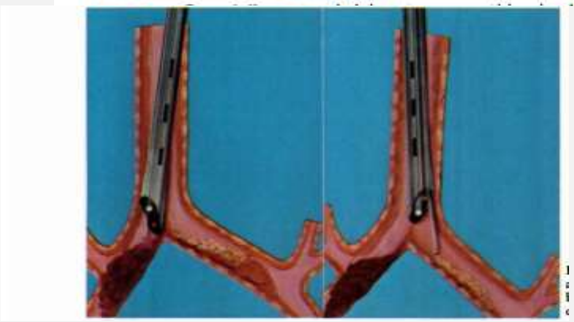
Figure 3 *a typical carcinoid situated in close proximity to the main carina a) before and b) after endoscopic laser resection.*

COMPLICATION OF ENDOBRONCHIAL LASER THERAPY -INTRAOPERATIVE

- Intraoperative : hypoxia and haemorrhage

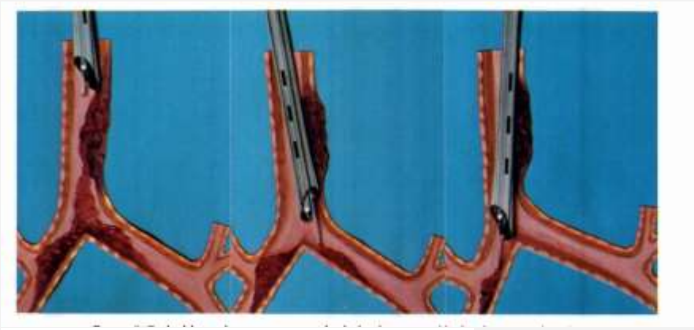


Hypoxia due to tracheal obstruction and operator's response –cross the obstruction



Hypoxemia due to unilateral obstruction and operator's response –ventilate the healthy lung

Dumon etal chest 1984, august 86.2



Tracheal haemorrhage –operator goes distal to the bleeding site, producing tamponade. Laser coagulation can be resumed when ventilation is satisfactory

Bronchial haemorrhage –operator cleans the area and continues to coagulate

Haemostasis technique –coagulate circumferentially and then to come at the point of bleeding

INTRA PROCEDURE COMPLICATIONS – CONTD,

- Tracheobronchial firing is one of the most dreaded complication of LASER use.
- Air embolism [occurs usually due to coolant system]

POST OPERATIVE COMPLICATIONS

- Cardiovascular complications and hypoxemia related to retained secretions or respiratory depression induced by excessive anesthesia;
- Secondary hemorrhage stemming from loosened eschar or coagulation irregularities and leading to hypoxemia;
- Perforation from delayed tissue necrosis with fatal sequelae such as mediastinitis or esophageal fistula; and,
- Infection and/or pneumonia after atelectasis or from retained secretions.

SAFETY OF LASER PROCEDURE

Meheta's rule of four

Table 2 "Rule of Four" for Successful Outcome for Endobronchial Laser Therapy

Duration of collapse	< 4 weeks
Length of lesion	< 4 cm
Distance	
Endotracheal tube to lesion	> 4 cm
Fiber tip to lesion (noncontact)	4 mm
Bronchoscope to fiber tip	4 mm
FiO_2	≤ 40%
Power (watts)	
Noncontact	40 W
Contact	4 W
Pulse duration	0.4 s
Number of pulses between cleaning	40
Operating room time	< 4 h
Laser team members	4

Dumon's ten commandments

- ❖ Know the anatomical danger zone
- ❖ Well trained laser team
- ❖ Proper patient selection
- ❖ Rigid bronchoscopy only
- ❖ Monitor the vitals
- ❖ Fire the LASER beam parallel to the wall
- ❖ Avoid LASER at >40 watts
- ❖ Donot neglect haemorrhage
- ❖ Before termination ensure thorough irradiation of resected areas
- ❖ Keep the patient under observation in a specially outfitted recovery

Folch et al, Semin Respir Crit Care Med 2008;29:441–452
Khemasuwan etal, *J Thorac Dis* 2015;7(S4):S380-S388

POPCORN EFFECT DURING LASER BRONCHOSCOPY

Before procedure

Tumor explosion during procedure

Post procedure

Petrella etal J Bronchol Intervent Pulmonol Volume 20, Number 2, April 2013

In a retrospective study from ITALY comprising over 12 years, 2610 LASER resection in 1838 patients, following complications were found with a mortality rate of around 0.4%.

	No.	Deaths
Hemorrhage	19	—
Pneumothorax	8	—
Respiratory failure	15	4
Heart failure	12	5
Myocardial infarction	5	2
Pulmonary embolism	1	1
Total	60	12

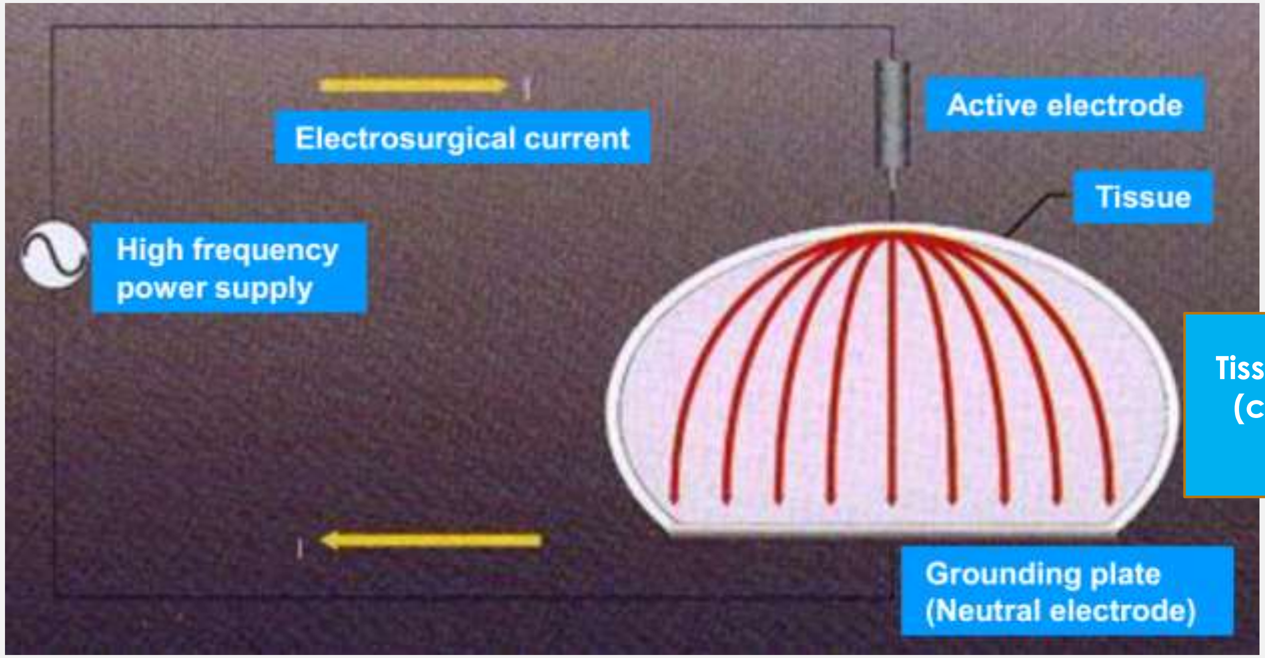
Cavaliere et al chest 1996: 110:1536-42

COMPLICATION IN LPR IN DIFFERENT PUBLISHED SERIES

Author (year)	No of pt (no of procedures)	Death	hemorrhage	Fire	Respiratory failure	others
Dumon 1982	111/205	None	None	None	none	none
Dumon 1984	839 (1503)	6 (.4%)	17 (1.06%)	None	19 (1.3%)	none
Personne 1986	1310(2284)	13(0.8%)	5 (0.3%)	None	24 pneumothorax	1 fistula
Cavaliere 1996	1838 (2610)	12 (0.4%)	19 (0.7%)	None	24 (1%)	Not significant
Moghissi etal (2006)	1559 (2235)	2 (.17%)	36 (3.1%)	2(.2%)	10 (3 pneumothorax)	N/S

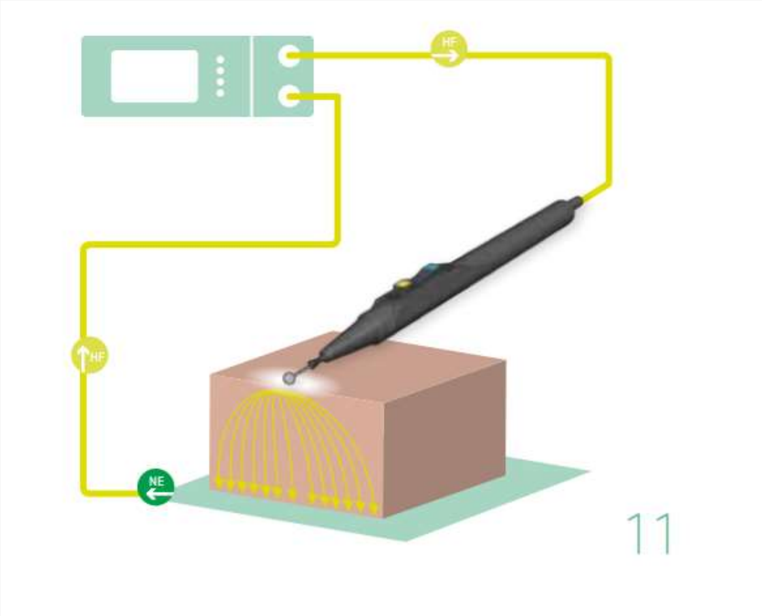
Moghissi etal,Lasers Med Sci (2006) 21: 186–191

MECHANISM OF ACTION FOR ELECTROSURGERY



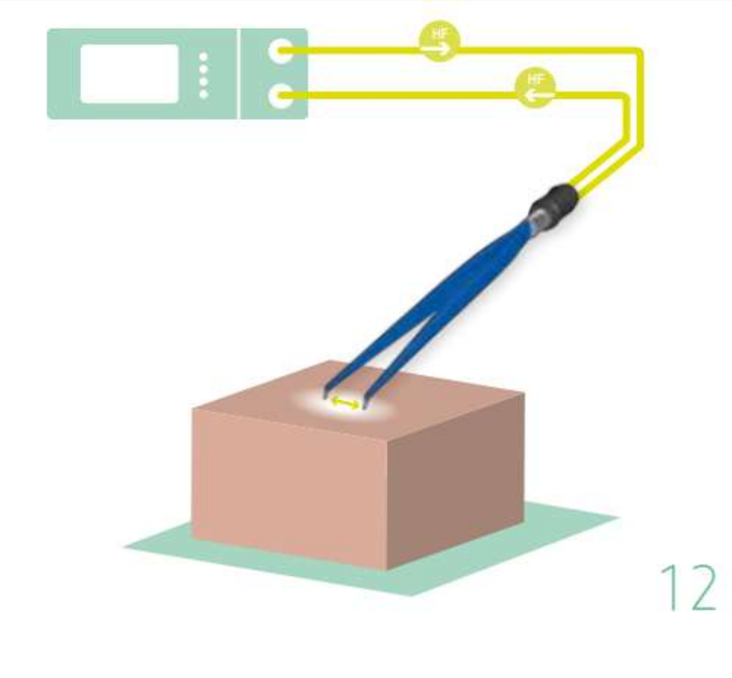
Tissue effects –coagulation at <100c (continuous mode) and cutting at >100c (intermittent mode)

TYPES OF DIATHERMY



Electrical circuit during monopolar surgery

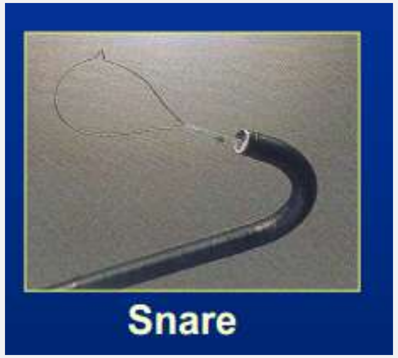
Monopolar –current flows through the patient



Bipolar –current doesnot flow through the patient –not required in EBES

ELECTROSURGICAL ACCESSORIES

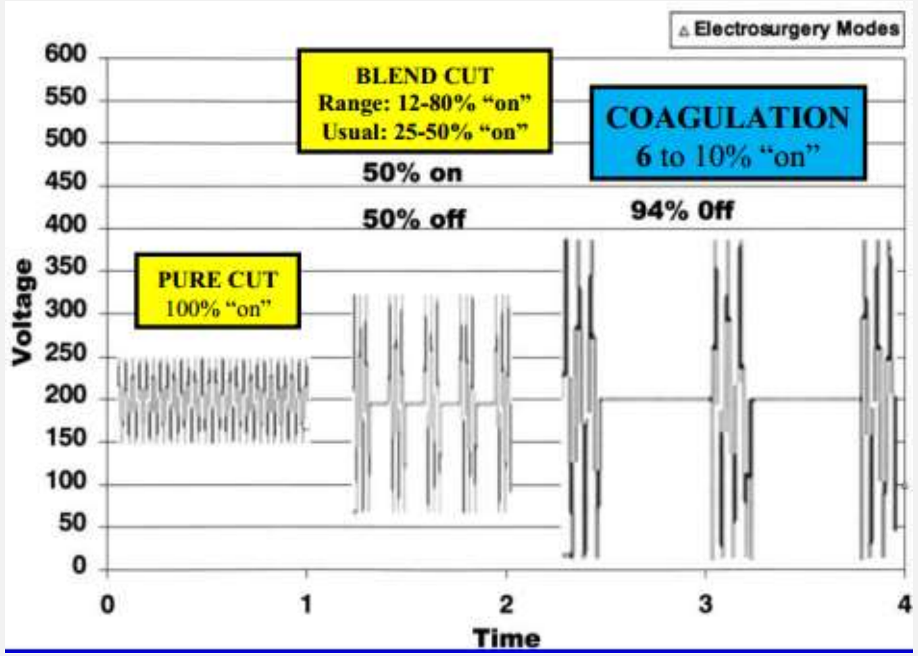
- Probe (Coagulation Electrode): Tumor coagulation and hemostasis (similar to direct contact laser)
- Electrosurgical Knife: Broad-based surface coagulation and tissue resection (eg, of webs, scars, and sessile and pedunculated lesions) in narrow airway lumens
- Electrosurgical Snare: "Lassoing" and removal of polypoid and pedunculated endobronchial lesions
- Hot Biopsy Forceps: Biopsies and cauterizes simultaneously for tissue collection and tumor debulking.



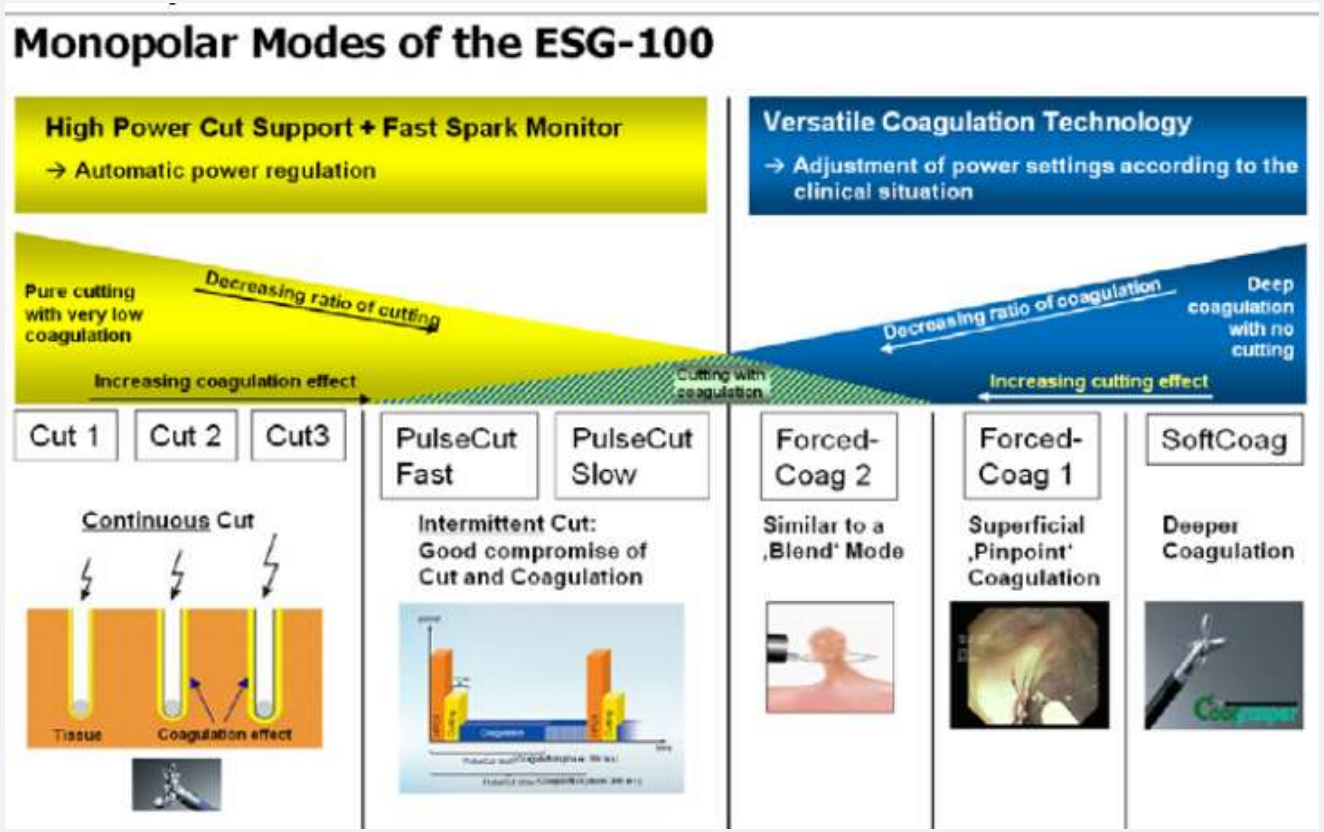
MODES

- Cutting mode
- Coagulation mode
    - Soft -Voltage is kept <200 V and no electrical arc is produced between tissue and the probe. Deeper coagulation.
    - Hard –voltage is kept at least 500 V and an electrical arc is produced between tissue and probe, allowing deeper tissue penetration.
    - Spray- it is a type of non contact coagulation where current spark or jumps from probe to tissue, can cause wider coagulation, good for tumor surface or hidden bleeder.
- Blending
- Carbonization mode (usually not recommended)

COMPARISON OF DIFFERENT MODES



AVAILABLE MODES



CHOICE OF MODES

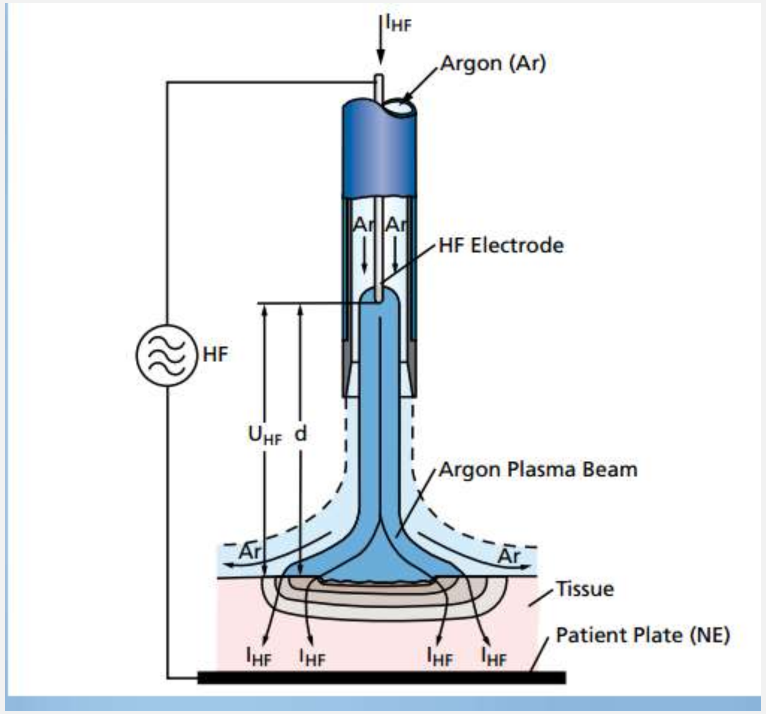
HF Instrument				
Lesion Type	Less extended lesion, bleeding	Polypoid lesion (intraluminal mass)	Web-like stenosis	Biopsy
Favourite Mode	**SoftCoag** 20-30W ↑ by effect	**Forced-Coag 2** 30-40W ↑ by effect	**Forced-Coag 1** 20-30W ↑ by effect	**Cut 2** automatic regulation
Alternative	**Forced-Coag 1** 20-30W ↑ by effect (pinpoint)	**Cut 2, PulseCut** automatic regulation (lesser coag)	**Cut 2** automatic regulation (less coag)	**Forced-Coag 1** 20-30W ↑ by effect (as coagulation instrument)

TISSUE EFFECT OF BRONCHOSCOPIC ELECTROCAUTERY

Study	Prospective (Amsterdam 1999)
Population	In 6 patients with NSCLC BE procedure was done immediately before surgery
Method	BE was graduated from 1-5 seconds; Bronchoscopic appearance was documented photographically and compared with histological appearance.
Outcome	Superficial damage was obtained by short duration of BE (< 2 s), and longer duration of coagulation (3 s or 5 s) caused damage to the underlying cartilage. Bronchoscopic appearance after endobronchial electrocautery corresponded with the histologic changes

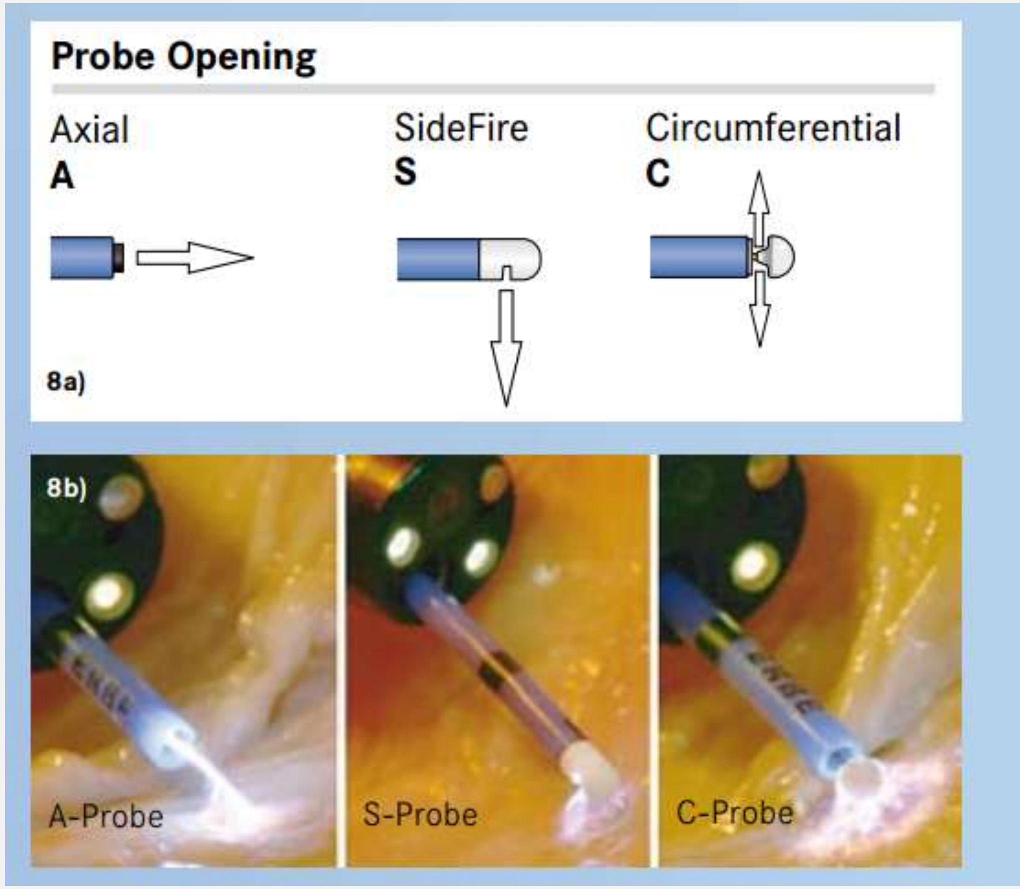
Van Boxem et al, chest 2000; 117:887– 891

ARGON PLASMA COAGULATION MECHANISM



APC is a monopolar electrosurgical procedure in which electrical energy is transferred to the target tissue using ionized and, thus, conductive argon gas (argon plasma), without the electrode coming into direct contact with the tissue

APC ACCESSORIES



APC MODES

- FORCED APC -continuous mode with current flow varying with output setting and distance. .
- PULSED APC Effect 1 & 2 – pulsed but constant energy output.
- PRECISE APC – output is automatically controlled with effect size, does not need the mandatory distance of 5 mm from the target.

CHARACTERISTIC OF DIFFERENT MODES

Table 1 Suggested Guidelines for the Flexible Bronchoscope and Accessories Using Argon Plasma Coagulation[a]

Indication	APC Pulsed Effect 1[b] (monopolar noncontact)	APC Pulsed Effect 2[b] (monopolar noncontact)	APC Forced[b] (monopolar noncontact)
Obstruction			
Argon plasma coagulation	• 15 watts • Gas 0.3–0.8 L/m • Slow pulses • Deeper coagulation • Active regulation (i.e., elastic plasma)	• 15 watts • Gas 0.3–0.8 L/m • Fast pulses • Superficial coagulation • Active regulation (i.e., elastic plasma)	• 15 watts • Gas 0.3–0.8 L/m • Continuous output • Superficial to deep thermal insult depending on: (a) time/length of activation and (b) power setting
Hemostasis			
Argon plasma coagulation	• 15 watts (above) • Gas 0.3–0.8 L/m	• 15 watts (above) • Gas 0.3–0.8 L/m	• 15 watts (above) • Gas 0.3–0.8 L/m

[a]This is a synthesis of literature and manufacturer information.
[b]Wattage and gas flow are recommended as a starting point. Physicians may adjust parameters based upon tissue effect objectives intraoperatively and anatomic presentation pre- and intraoperatively.

Seski etal Seminars in Respiratory and Critical Care Medicine, volume 25, number 4, 2004

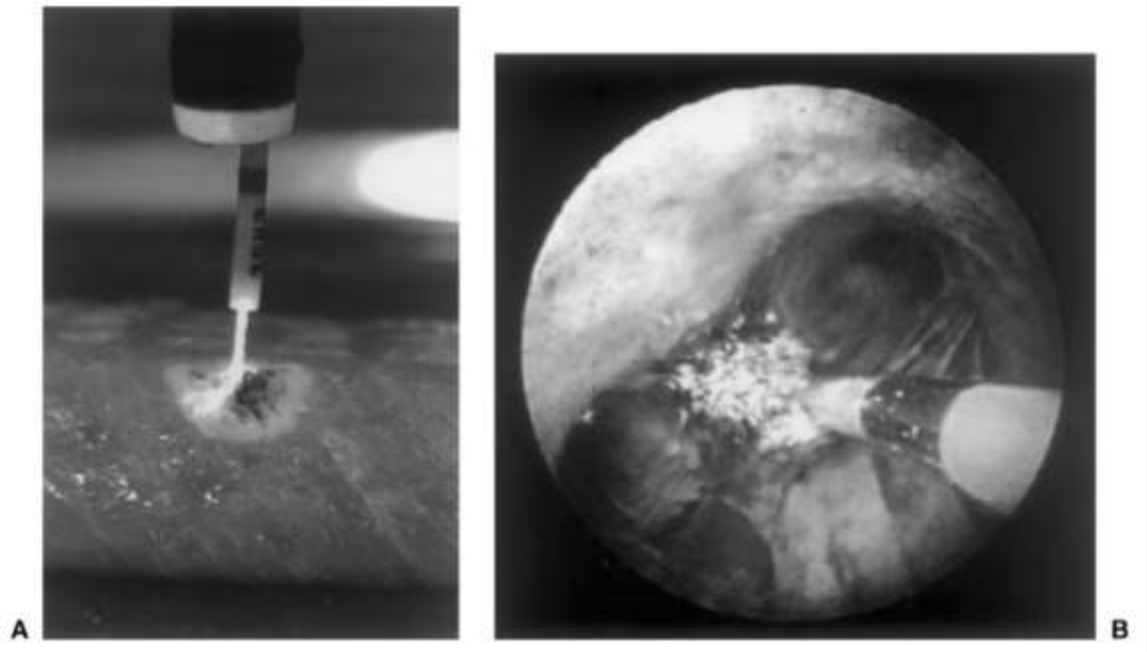
PROCEDURE

- A grounding pad is placed on the patient's lower back or flank, utilizing highly vascularized anatomy that is optimally close to the operative site.
- Power settings from 30 to 80 W and application times of < 2 to 3 seconds have been utilized.
- The argon flow rate is kept between 0.3 and 2 L/min.
- The flexible probes are 1.5 or 2.3 mm in diameter and 220 cm in length and pass through the instrument channel.

Seksi etal Seminars in Respiratory and Critical Care Medicine, volume 25, number 4, 2004

- With the probe extended beyond the bronchoscope by several centimeters to prevent burning the bronchoscope, the probe tip is placed within 1 cm of the target. but not in contact with it.
- The argon plasma is applied to the surface in 1- to 3-second bursts
- When debulking tissue, the eschar is removed and the APC is applied to fresh tissue. This process is repeated until the tumor is debulked sufficiently.

- Increasing the power and the application time allows deeper current penetration and tissue damage.
- With brisk bleeding, increasing the argon flow rate may allow better visualization of the source and the chance to control it, by blowing the blood off the lesion.



The APC probe and white coagulam are shown

COMPLICATIONS OF APC

- Airway perforation leading to pneumomediastinum, subcutaneous emphysema, and pneumothorax; airway fire; and ‘‘burned’’ bronchoscope are reported complications of APC but <1%.
- Ignition of nonmetallic stent material, electric shock, and gas embolism are theoretical complications,
- Massive bleeding may occur as in other modalities due to excessive removal of the tissue.

- Limiting the inspired oxygen concentration, the power setting (< 80 W), and the application time (<5 sec) should minimize the risk of airway perforation or fire.
- Keeping the probe tip several cm from the bronchoscope or any combustible material should limit damaging equipment or airway fire.
- Grounding the patient and keeping the probe tip away from the bronchoscope tip should minimize the chance of electric shock.
- Lastly, keeping the argon flow rate (<2 Lpm) should lessen the chance of gas embolism.
- No deaths directly related to APC have been reported so far

USER'S GUIDE FOR APC

- To prevent any damage to the instrument channel and/or the tip of the endoscope, the APC probe must extend at least 10 mm beyond the end of the scope.
- Activate only when tissue being treated is within field of vision.
- Use of lowest possible setting to achieve the desired thermal effect.
- A distance of 1-5 mm to be maintained with targeted tissue when being fired en face.
- Avoid APC activation in close proximity to any metal object unless manipulation of such a device is intended.
- APC should work in an environment with <40% oxygen

INDICATIONS FOR LASER/ELECTROSURGERY

- Malignant disorders
  1. Primary lung cancer
  2. Endobronchial metastasis (from breast, colon, kidney, thyroid gland, oesophagus)
  3. In situ carcinoma
  4. Typical carcinoid
- Benign tumours: Papilloma, fibroma, lipoma, hamartochondroma, leiomyoma etc.

Bolliger etal Eur Respir J 2006; 27: 1258–1271

INDICATION -CONTD

- Stenosis Due to the following:
  1) Anastomosis (lung transplantation, surgical resection)
  2) Intubation, Tracheotomy, tracheostomy
  3) Tuberculosis
  4) Sarcoidosis
  5) Wegener’s granulomatosis
  6) Trauma
  7) Inhalation injury
  8) Radiation therapy
  9) Granulation tissue

Bolliger etal Eur Respir J 2006; 27: 1258–1271

INDICATION -CONTD

- Miscellaneous
  1) Reduction of bleeding
  2) Amyloidosis
  3) Endometriosis
  4) Closure of oesophago-bronchial fistulas
  5) Foreign body removal (lithotripsy)

Bolliger etal Eur Respir J 2006; 27: 1258–1271

CONTRAINDICATIONS FOR LASER/ELECTRO SURGERY

- Anatomical contraindications
  I. Extrinsic obstruction without endobronchial lesion.
  II. Lesions incursion into bordering major vascular structure.
  III. Lesion incursion into bordering oesophagus with potential for fistula formation
  IV. Lesion incursion into bordering mediastinal structure with potential for fistula formation.

***Mathur etal Flexible Bronchoscopy*, Third Edition.**

CONTRAINDICATION -CONTD

- Clinical contraindications
  I. Candidate for surgical resection.
  II. Unfavourable short time prognosis.
  III. Coagulation disorder.
  IV. Total obstruction for more than 4/6 weeks

COMPARISON BETWEEN ELECTRO SURGERY AND LPR

Electrosurgery	LASER photo resection
During Electrosurgey electrons collide with the tissue to generate heat for desired effect, hence it follow the rules of electromagnetism	It causes tissue destruction by LASER, a form of light energy, hence follow the rules of OPTICS.
EC /APC can burn/destroy the tissue but usually donot vaporizes, hence mechanical debulking is required	With sufficient energy LASER can vaporizes tissue
Wet surfaces eg blood with higher electrical conductance can significantly attenuate effectivity, of electrosurgery.	LASER has no such problem.
Its effect is much superficial than LASER (2-3mm for APC)	Too deep necrosis (upto 10mm) with LASER may endanger great vessels
Probes delivering electrical current/ or ionized Argon gas can be steered to different corners of tracheobronchial tree.	LASER beams cannot be directed to such angles
Cost of electrosurgical equipments are cheaper, hence also known as poor man's LASER	LASER is a costly affair.

IMPACT OF ENDOBRONCHIAL ELECTRO SURGERY ON THE NEED FOR LPR

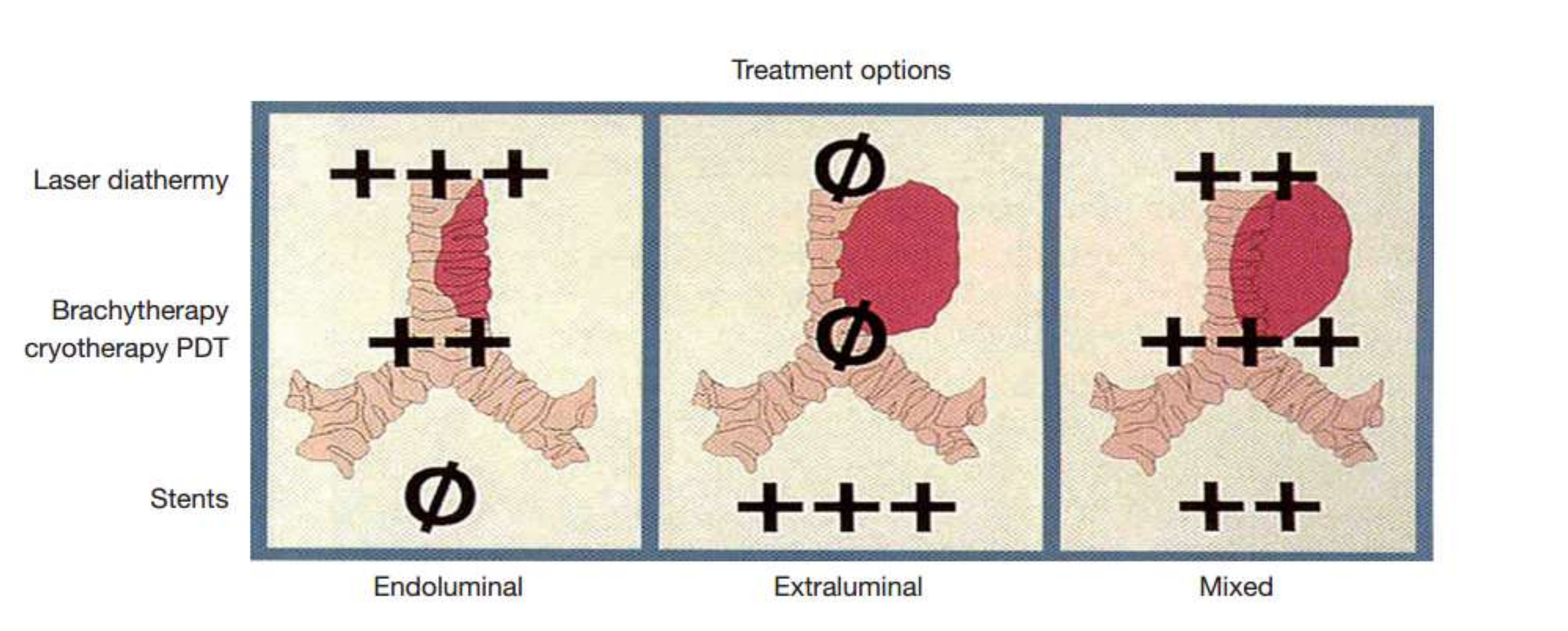
Study	Prospective observational study (Cleveland ,2000)
Population	118 patients who were evaluated for LPR at bronchoscopy unit.
Method	Patients who were having <50% luminal obstruction and <2cm growth were considered for EBES instead of LPR
Outcome	Of the 47 procedures, 42 (89%) were successful in alleviating the obstruction, thus eliminating the need for LPR. No major complications were encountered

Coulter etal chest 2000; 118:516–521

THERAPEUTIC BRONCHOSCOPY INDICATIONS –MALIGNANT AIRWAY OBSTRUCTION

- More than 20% to 30% of patients with lung cancer will experience central airway obstruction
- Symptoms related to the endobronchial progression of lung cancer
  are often associated with a major reduction in quality of life and a short-term prognosis (1 to 2 months median survival)
- Surgery is often contraindicated in very proximal lesions, and chemotherapy has uncertain and delayed benefits, whereas radiation therapy solves atelectasis in 54.2% of cases, but the result is also delayed (median, 24 days)

Guibert etal, Ann Thorac Surg 2014;97:253–9


Treatment options
Laser diathermy
Brachytherapy
cryotherapy PDT
Stents
+++
++
Ø
Ø
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+++
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+++
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Endoluminal
Extraluminal
Mixed

CHOICE OF PROCEDURE

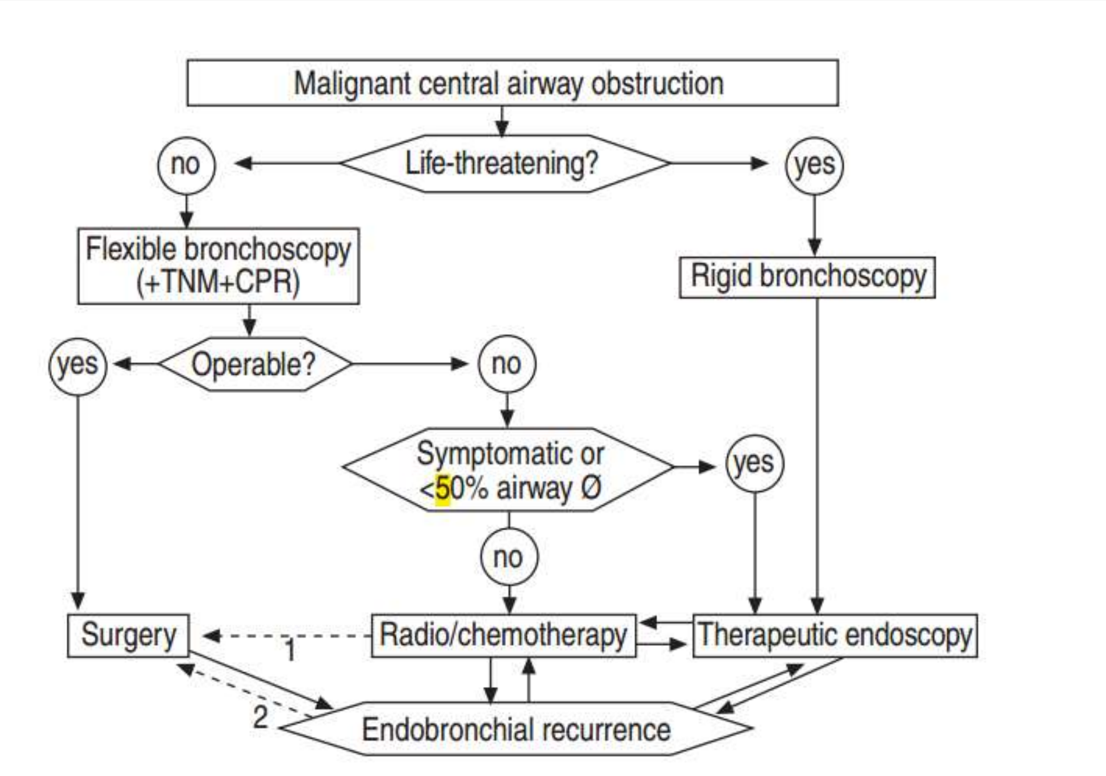
Table 3. – Indication for endoscopic therapeutic modalities in the treatment for the three basic types of endobronchial stenosis

Procedure	Endobronchial lesion	Extrinsic lesion	Mixed lesion
Laser	+	-	+
Electrocautery	+	-	+
Cryotherapy	+#	-	+#
Brachytherapy	+#	-	+#
APC	+	-	+
PDT	+#	-	+#
Stents	-	+	+¶

APC: argon plasma coagulator; PDT: photodynamic therapy. #: contraindicated in impending respiratory failure; ¶: indicated if postinterventional airway lumen is <50% of normal.

Bollinger etal Eur Respir J 2002; 19: 356–373

ALGORITHM FOR MALIGNANT OBSTRUCTION OF CENTRAL AIRWAY



Bollinger etal, Eur Respir J 2002; 19: 356–373

COMPARISON OF ENDOBRONCHIAL LASER THERAPY AND EXTERNAL BEAM RADIATION FOR CAO

Study	**Retrospectively matched case control study (Germany 1994)**
Population	75 patients who underwent endobronchial LASER therapy for malignant airway obstruction along with external radiation.
Method	Comparison with a matched historic cohort in respect to age, sex, TNM staging, external radiation dose etc
Outcome	LASER resection did not influence overall survival, But in patients who had a complete reopening of the airway time from treatment to death increased by 4 months.

Macha et al Chest 1994: 105:1668-72

THERAPEUTIC BRONCHOSCOPY FOR MALIGNANT AIRWAY OBSTRUCTION – AQUIRE REGISTRY

Study	Prospective multicentre registry 2014
Population	947 patients who underwent 1115 procedures for malignant airway obstruction
Method	Technical success (primary outcome), relief of symptoms as well as complications and prognostic factors were noted
Outcome	Therapeutic bronchoscopy was successful (defined as restoring >50% lumen) in 93% cases. Endobronchial obstruction and stent placement were significantly associated with success whereas higher ASA score, primary lung cancer, renal failure, lt main lesion and TEF were associated with failure

OST etal CHEST 2015; 147(5):1282-1298

ROLE OF ENDOBRONCHIAL ELECTROCAUTERY IN CAO

Study (place, year)	**Retrospective review (2014, Durham)**
Population	94 patients who underwent endobronchial electrocautery in between 2004 -2009.
Method	Data on efficacy and safety were collected
Outcome	Among 117 electrocautery procedures on 92 malignant and 25 non-malignant lesions. Endoscopic improvement was seen in 94% of cases, 71% of patients reported symptomatic improvement. Radiographic studies demonstrated luminal improvement in 78% of patients on chest CT, improved aeration on chest CT and chest x-ray in 63% and 43% of patients, respectively. The rate of major complications was 0.8%, whereas minor complications occurred in 6.8% of cases. There was no perioperative mortality.

Wahidi etal, *J Thorac Oncol.* 2011;6: 1516–1520

USEFULNESS OF APC

Study	Retrospective (Texas 2001)
Population	A total of 60 patients with bronchogenic carcinoma, metastatic tumors affecting the bronchi or benign bronchial disease. Indications for intervention were hemoptysis (n = 31), symptomatic airway obstruction (n =14), and both (n =25)
Method	APC, a noncontact form of electrocoagulation, was performed via flexible bronchoscopy. 60 patient received total 70 sessions
Outcome	Hemoptysis was controlled immediately and did not recur during a follow up of >90 days/ there was also significant improvement in airway lumen

Morice etal *CHEST 2001; 119:781–787*

ENDOBRONCHIAL LASER FOR BENIGN TUMORS

Study	Retrospective (France 1993)
Population	185 patients with benign tracheobronchial tumors who underwent total 317 LASER procedures
Method	Charts, video recording of endobronchial procedure and histology were reviewed
Outcome	The LASER resection were very good (i.e. only single procedure was required) in 115 i.e. 62% cases whereas good (multiple procedures required without complication) in 70 1.e. 38%. Complications were low.

Shah etal *chest 1995; 107:1744-51*

ELECTROCAUTERY FOR BENIGN AIRWAY STENOSIS

Study (place,year)	Retrospective analysis(Boston ,2015)
Population	36 patients who underwent endobronchial electro cautery for benign airway stenosis (total no of procedure 57)
Method	Data were collected for etiology of airway stenosis, stenosis type, presenting symptoms, endoscopic tracheal diameter, spirometry, symptom improvement, time to re intervention and complications.
Outcome	In 91% procedures patients noted symptomatic improvement, mean airway diameter and FEV1 was also significantly improved. Complication rate was 8.8% with no mortality.

Barry etal, Am J Respir Crit Care Med 191;2015:A3724

INTERVENTIONAL BRONCHOSCOPY FOR POST INTABATION /POST TRACEOSTOMY STENOSIS

	PT group (n = 20)	Number of procedures	PI group (n = 11)	Number of procedures
RB and FB (mean and range)	20	41 (2.1, 1–5)	11	36 (3.2, 1–17)
Surgery	0	0	1	1
Nd:YAG Laser	8	9	6	14
Electrocautery	5	7	0	0
APC	1	1	2	2
Balloon dilatation	6	8	3	3
Cryotherapy	1	1	1	1
Stent	11	15	6	11
Montgomery tube	2	2	0	0
Mechanical debulking/dilation	5	5	6	7

APC: Argon Plasma Coagulation, Nd:YAG: Neodymium-Doped Yttrium Aluminium Garnet, PI: Post Intubation, PT: Post Tracheostomy. RB: Rigid bronchoscopy, FB: Flexible bronchoscopy.

Zias etal BMC Pulmonary Medicine **2008, 8:18**

TAKE HOME MESSAGE

- Endobronchial electrosurgey can be a optimal replacement for LASER therapy for central airway obstruction.