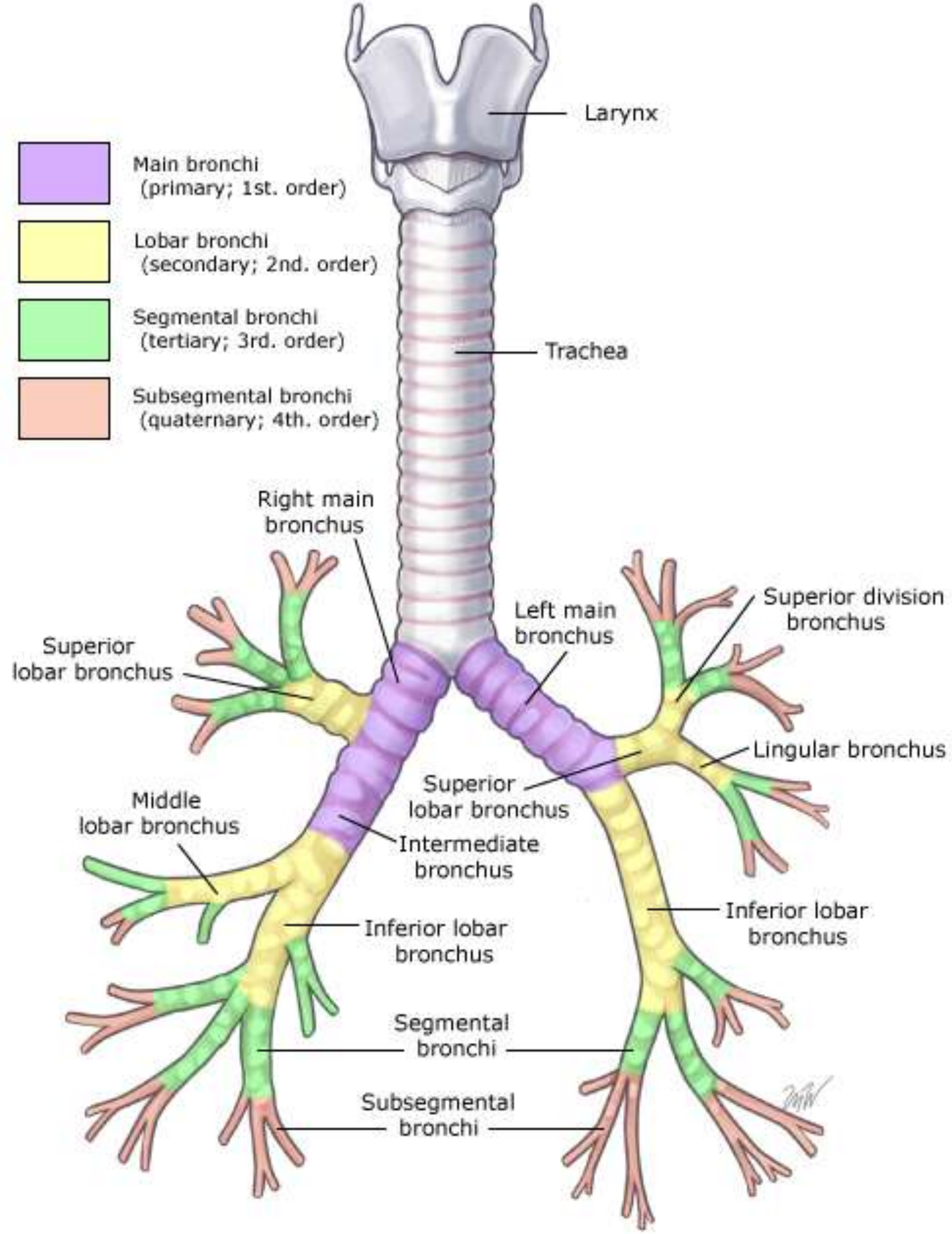
10-11-17

Central Airway Obstruction

Definition

- Central airway obstruction (CAO) refers to the obstruction of air flow in the trachea and main stem bronchi



CAO

- Syndrome of CAO: Occlusion of > 50 % lumen[1]
- Exact incidence and epidemiology is unknown
- 20-30% of lung cancer patients have complications due to airway obstruction[2]
- In USA, malignant neoplasms cause CAO in 80,000 cancer patients a year[3]

1-Murgu SD et al, Central Airway Obstruction, CHEST, Volume 150, Issue 2, 426 – 441
2-Ernst A et al, Am J Respir Crit Care Med. 2004;169(12):1278
3-Chen et al, J Emerg Med. 1998;16(1):83-92

CAO

- Dyspnea at rest
  - Tracheal lumen narrowed to 5 mm or 25 % of diameter

- Dyspnea on exertion
  - Tracheal lumen is narrowed to 8 mm or 50 % of diameter

Hollingsworth HM. Wheezing and stridor. Clin Chest Med. 1987;8:231–40

CAO - Classification

1. Malignant and non malignant
2. Intrinsic and Extrinsic
3. Dynamic and Fixed
4. Upper airway and lower airway

Malignant	Nonmalignant
Primary endolumenal carcinoma	Lymphadenopathy
Bronchogenic	Sarcoidosis
Adenoid cystic	Infectious (i.e., tuberculosis)
Mucoepidermoid	Vascular
Carcinoid	Sling
Metastatic carcinoma to the airway	Cartilage
Bronchogenic	Relapsing polychondritis
Renal cell	Granulation tissue from:
Breast	Endotracheal tubes
Thyroid	Tracheostomy tubes
Colon	Airway stents
Sarcoma	Foreign bodies
Melanoma	Surgical anastomosis
Laryngeal carcinoma	Wegener's granulomatosis
Esophageal carcinoma	Pseudotumor
Mediastinal tumors	Hamartomas
Thymus	Amyloid
Thyroid	Papillomatosis
Germ cell	Hyperdynamic
Lymphadenopathy	Tracheomalacia
Associated with any of the above malignancies	Bronchomalacia
Lymphoma	Webs
	Idiopathic
	Tuberculosis
	Sarcoidosis
	Other
	Goiter
	Mucus plug
	Vocal cord paralysis
	Epiglottitis
	Blood clot

Ernst A et al, Am J Respir Crit Care Med 2004; 169:1278

Pathogenesis Of CAO

- Intraluminal compromise due to *intrinsic or extrinsic compression* from benign or malignant tumours
- Endobronchial *granulation tissue* or calcium deposition from trauma or infection
- Airway wall *thinning or collapse from cartilage* disorders or tracheobronchomalacia
- Airway *wall edema* from inflammation, infection, and bleeding

Clinical Features

- Dyspnoea
- Cough
- Wheeze
- Haemoptysis

Misdiagnosed as
•Exacerbation of COPD/BA
•Bronchitis
•Pnuemonia

None being specific

CAO- Imaging

SUBACUTE

- CXR
- CT Chest
  - Dynamic CT
  - Virtual bronchoscopy
- MRI (vascular ring)
- PFT

ACUTE

- Secure airway
- FOB/ Rigid

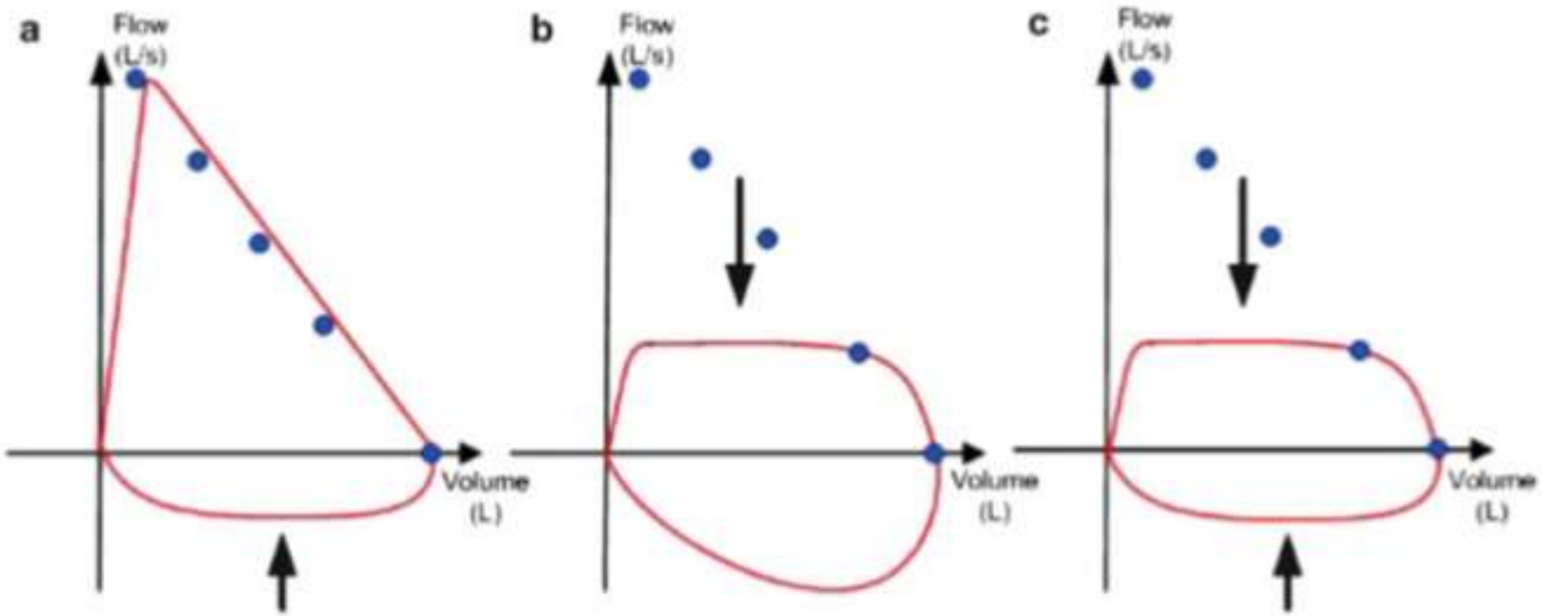
Diagnosis

- Visual inspection
- Tissue biopsy

Spirometry

- May be done in subacute presentation
- Flow volume loops will show characteristic signs of CAO before reduction in spirometry values

PFT



Stoller JK Cleve Clin J Med. 1992;59:75–8

Type	Cause	Flow characteristic
Variable intrathoracic	Tracheomalacia Malignant tumours	Obstruction during forced expiration
Variable extrathoracic	Tumours Vocal cord palsy Glottic strictures	Obstruction during inspiration
Fixed obstruction	Post intubation stricture Goitre	Fixed flow in inspiration and expiration

Management

- Life threatening obstruction
  - Patients be oxygenated and their airway secured for adequate ventilation
  - Upper airway obstruction: Tracheostomy/cricothyrotomy
  - Distal airway obstruction : ETT, rigid bronchoscopy

CAO – Endotracheal intubation

- Should be performed with anaesthesia of the mucous membranes in an ***awake or mildly sedated*** patient who is actively breathing

- Avoid paralytics

- Fibre optic assisted intubation with ETT placement under direct visualisation should be considered for proximal tracheal obstructions

- LMA is an alternative to ET intubation
- If any doubt regarding airway stability, rigid bronchoscopy is the procedure of choice
  - Provides secure airway
  - Enables oxygenation
  - Enables ventilation

Ernst A et al, Am J Respir Crit Care Med 2004; 169:1278

Heliox as an adjunct

- Has a lower reynolds number
- Reduces turbulence
- Provides laminar flow
- Decreases driving pressure to achieve given flow
- Reduces work of breathing

- Cannot deliver FiO_2 of >40%
- No randomized trials demonstrating improved outcomes

Role of bronchoscopy

- Once the airway is secured and adequate gas exchange is documented
- Immediately or in 12-24 hours
- Assessed visually, distal secretions are suctioned, and diagnostic tissue is obtained if feasible
- Plan further interventions

Non life threatening obstruction

- Imaging
- PFT
- Bronchoscopic evaluation

Bronchoscopy

- FOB with or without endobronchial ultrasound (EBUS)
  - Extent and nature of the obstruction (eg intrinsic versus extrinsic obstruction, involvement of the carina, oropharynx, or distal bronchi)
  - The identification of unexpected distal airway involvement
  - Tissue biopsy
  - Planning for additional interventions

EBUS

- Extremely sensitive for determining degree of tracheal invasion
- Aids in planning therapeutic interventions
- In a study by Herth and Colleagues, EBUS utilized *in 1174 of 2446 cases* over 3 yrs period. It was found ***to guide/change management in 43%*** and change included selecting proper stent size/guiding tumor debridement/selecting pts. for endoscopic therapy Vs surgery

Herath et al,Eur Respir J 2002; 20: 118–121

Choosing among the interventions

- Cause of the lesion
- Predicted response to therapy
- Operator experience
- Available expertise
- Patient prognosis
- Ability of the patient to tolerate a selected procedure

Availability of resources

- Rigid bronchoscopy is offered in only 4.4% of all pulmonary medicine programmes
- Whlie 31.3% of pulmonary programmes have interventional pulmonology service

Alraiyes AH, Machuzak MS. Rigid bronchoscopy. Semin Respir Crit Care Med. 2014;35:671-680

CAO – Malignancy

- Goal of Treatment
  - Airway patency
  - Symptom palliation

CAO - Malignancy

- Immediate therapeutic effect
  - Coring or mechanical debridement using a rigid bronchoscope
  - With or without dilation and stenting
  - APC, electrocautery and laser

  - Cryosurgery, PDT and EBBT should not be used as their *effects are delayed*

  - Multi modal treatment (laser therapy or electrosurgery with airway stenting) may be used

Bolliger CT, et al,Eur Respir J. 2002;19:356-373

Multi modality of treatment

Oviatt PL et al	Prospective study 37 patients	➢6 MWT – increased by 99.7m ➢FEV1 – increased by 448 ml ➢Dyspnoe scores improved in 90%
Amjadi K et al	Prospective study 24 patients	➢Improvement in airway diameter in all patients ➢80% patency in 80% patients ➢Dyspnoe scores improved in 85%

Oviatt PL et al, JThorac Oncol. 2011 Jan;6(1):38-42
Amjadi K et al,Respiration. 2008;76(4):421-8.

Complications

- Multinational retrospective study
  - 947 patients and 1115 procedures
  - overall complication rate was 3.9%

  - 767 were elective and 104 were emergency
  - More with urgent procedures (7.7% Vs 2.6)

  - 6 patients(0.5%) died due to procedural complication

Ost DE et al, Chest. 2015 Aug;148(2):450-71

PGI Data

- Retrospective study of 30 patients
- Only rigid bronchoscopy and debulking was effective in 83% patients

- Complications
  - 32.3%(10) patients
  - Significant bleeding in 8 patients which was easily controlled

Vishwanath G et al, J Bronchology Interv Pulmonol. 2013;20:127-133

Other Endoscopic Airway Interventions

THERMAL ABLATION

- LASER
- Electrocautery
- APC
- Cryotherapy

NON THERMAL INTERVENTION

- PDT
- Airway dilation
- Airway stent
- Microdebrider

LASER Therapy

- Can be used in emergent situations
- Used for rapid endobronchial debulking
- Laser resection has a complication rate of <3%
  - Bleeding and hypoxia[1]
- Only absolute contraindication is isolated extrabronchial disease

1-VenutaF et al, Ann Thorac Surg, 2002

LASER therapy

- Light Amplified by the stimulated Emission of Radiation [Laser]
- Properties :
  - Monochromatic: Narrow band of wavelength
  - Spatial Coherence: minimal divergence, maintains Intensity
  - Temporal Coherence: Energy packets travel in uniform time with equal alignment
- Amount of Energy delivered to a lesion depend on
  - Power setting of laser (watts)
  - Distance of laser tip to target
  - Duration of impact

LASER

- Mechanism of action
  - Laser absorbed by tissues
  - Water temperature in tissues raised to 100°C causes vaporization, cell shrinkage and death

  - Most commonly used are
  - CO_2 Laser
  - Neodynium: yttrium-Aluminum-garnet [Nd: YAG] Laser

Contraindications

- Coagulation disorder
- Total obstruction > 4- 6 weeks
- Extrinsic obstruction wihtout endobronchial lesion
- Lesion incursion into
  - major vessels
  - esophagus

LASER - Complications

- Hypoxia – due to compromised ventilation (haemorrhage/debris)
- Perforation of Underlying/Contiguous structure
  - Haemorrhage
  - Pneumothorax
  - Pneumomediastinum
- Complication rate <1%

Moghissi etal,Lasers Med Sci (2006) 21: 186–191
VenutaF ,Ann Thorac Surg, 2002

Mehta's 'Rule of Four' for laser photoresection

- Duration of collapse: <4 weeks
- Length of lesion: <4 cm
- Distance from ET tube to lesion: >4 cm
- Distance from fibre tip to lesion (non-contact): 4 mm
- Distance from bronchoscope to fibre tip: 4 mm
- FiO_2: <40%
- Power (watts) - non-contact: 40 W
- Power (watts) - contact: 4 W
- Pulse duration: 0.4 seconds
- Number of pulses between cleaning: 40
- Operating room time: <4 hours
- Laser team: 4

Cryotherapy

- Temperature required for tissue destruction is - 15 to -40 ºC
- Mechanism
  - Formation of extracellular ice crystals → cell shrinkage and membrane damage
  - Intracellular ice crystals damage organelles – Mitochondria, ER
  - Freezing → vasoconstricton, microthrombi formation

Cryotherapy

CRYOSENSITIVE

- Skin
- Mucous membrane
- Endothelium
- Granulation tissue
- Nerve

CRYORESISTANT

- Fat
- Cartilage
- Nerve sheath
- Connective tissue
- Fibrotic tissue

Cryotherapy - procedure

- Sedated → ETT intubation(provides airway control and removal of debris)
- Anaesthetize airways
- FOB→ Inspect airways & localize pathology
- Cryoprobe passed through working channel until tip protrudes from the scope by approx 2cm

Cryotherapy - procedure

- Under direct visualization tip applied to lesion perpendicularly/tangentially → Ice ball forms within 10-15 sec
- Freezing time of 30-60 sec.
- Multiple freeze – thaw cycles applied
- Forceps → Remove tissue debris

Cryotherapy - complications

- Bleeding

- Pneumothorax
- Bronchospasm
- Fever
- Bradycardia

Cryotherapy - complications

Study	Year	No	Major complications	Bleeding (APC ± Electrocautery)
Hetzel et al	2004	60	Nil	10%
Schumann et al	2010	225	Nil	12%
Inaty et al	2016	88	Nil	4%

DiBardino DM et al, Ann Am Thorac Soc. 2016 Aug;13(8):1405-15

Electrocautery

- Alternating current at a high frequency [10^5-10^7Hz] is used to generate heat which coagulates, vaporizes or cuts tissue

- Tissue resistance to current generates heat
  - Evaporation of Cell water →Tissue destruction
  - Chemical breakdown of cell/tissue constituent

- A t 70ºC tissue coagulates, >200ºC tissue carbonizes

- Electrocautery devices are monopolar

APC

- Mode of non contact electrocoagulation
- Tungsten electode creates 5000-6000 V spark at tip of probe → ionized argon released →argon plasma(conductive argon gas) → coagulative necrosis
- The argon plasma is applied to the surface in 1 to 3 sec bursts

APC - Precautions

- Proper grounding must be ensured
- $FiO_2 < 40\%$
- In pts wt pacemaker → may cause malfunction

APC - Complications

- < 1 %
- No deaths have been reported

- Airway fire

- Burned bronchoscope

- Airway perforation

Balloon Bronchoplasty

- Rigid or flexible bronchoscopy
- Use increasingly larger diameter balloons filled with saline and maintain in position for 15-60 (30)seconds to gently dilate the airway
- Less mucosal trauma and subsequent granulation tissue formation than does rigid dilation

Balloon Bronchoplasty

- Immediate improvement in 79% patients
- But effects are not long lasting
- Has to be followed by other therapies such as laser resection, radiotherapy, or stenting
- Complications - stenosis recurrence, pain, mediastinitis, bleeding, pneumothorax or pneumomediastinum

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

Modality	Mechanism	Advantage	Disadvantage	Restoration of airway lumen	Relief of symptoms
Nd:YAG laser	Thermal energy produced by laser light	Excellent debulking	Expensive; cumbersome setup	83–93%	63–94%
Electrocautery	Thermal energy produced by an electrical current	Excellent safety profile; inexpensive	Contact mode requiring frequent cleaning of probe	88–89%	70–97%
APC	Thermal energy produced by the interaction between argon gas and an electrical current	No undesired deep tissue effect	Ineffective for indepth tissue coagulation or debulking	91%	100%

Wahidi et al, Chest. 2007 Jan;131(1):261-74

Modality	Mechanism	Advantage	Disadvantage	airway lumen	symptoms
PDT	Injection of photosensitizer followed by destruction of presensitized tumor cells by illumination with nonthermal laser	Relatively long-lasting effect	Expensive; need for multiple bronchoscopies; skin photosensitivity lasting up to 6 wk	46–67%	100%
Brachytherapy	Direct delivery of radiation therapy into the airway	Long-lasting effect; synergistic with external beam radiation	Higher incidence of complication, particularly hemorrhage	78–85%	69–90%
Cryotherapy	Destruction of tissue by alternating cycles of freezing to extreme cold temperatures and thawing	Good tool for retrieval of foreign objects and removal of large mucus plugs or clots	Not suitable for debulking in acute airway obstruction; need for multiple bronchoscopies	77–79%	70–93%

Wahidi et al, Chest. 2007 Jan;131(1):261-74

CAO – Subacute presentation

- Supplemental oxygenation
- Bronchodilators
- CPAP
- Diagnostic FOB
- Endoscopic intervention
- Surgery

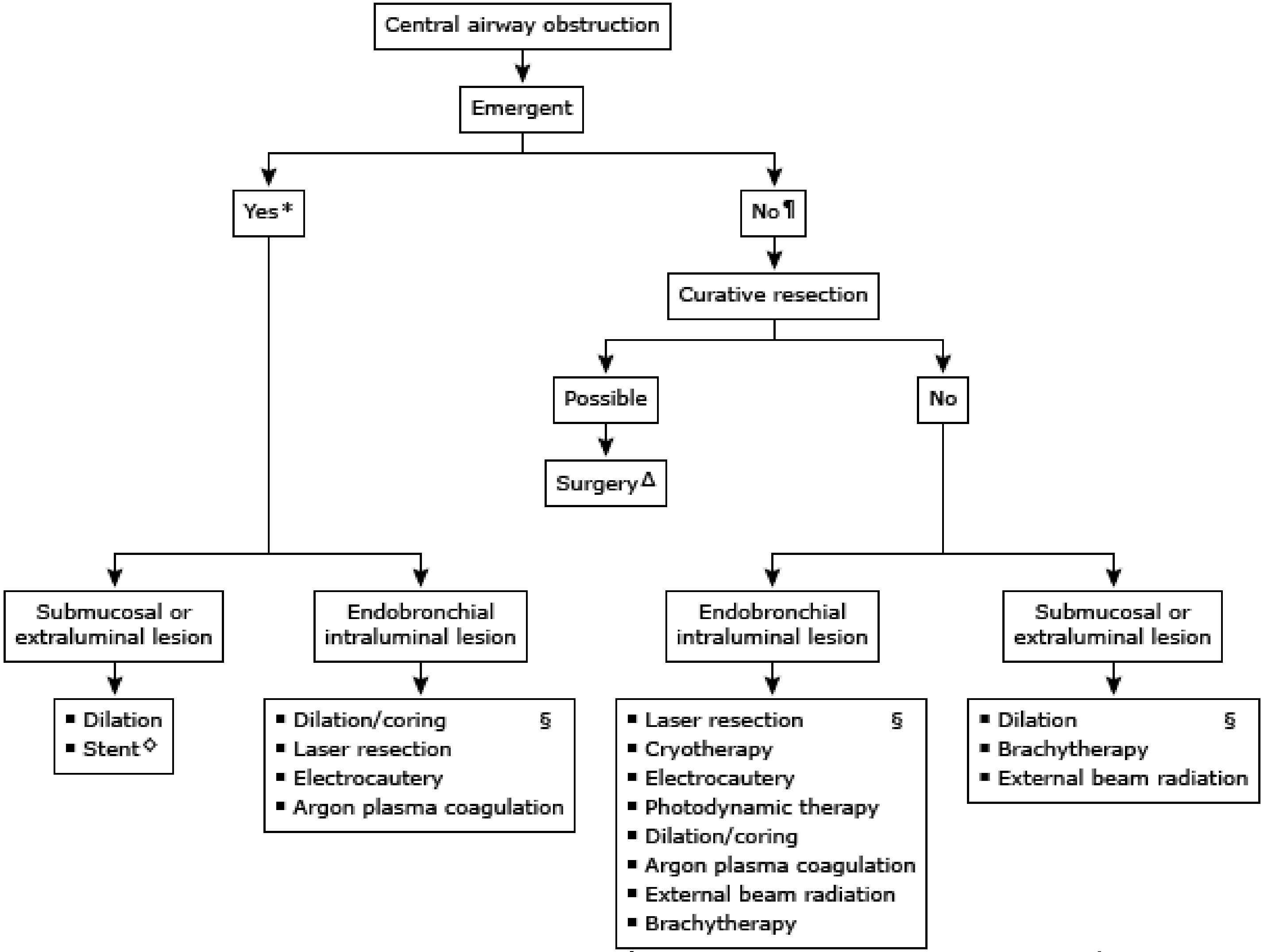
Tracheobronchomalacia[1]

Murugu SD et al, Ann Thorac Surg. 2007 Dec;84(6):1870-7

CAO - Malignancy

- Non life threatening obstruction
  - All bronchoscopic ablative techniques can be used
  - Effects of radiation therapies tend to last longer than locally ablative therapies such that both techniques can be used
    - success rates for haemoptysis, airway obstruction, and atelectasis of 84%, 21%, and 23% respectively

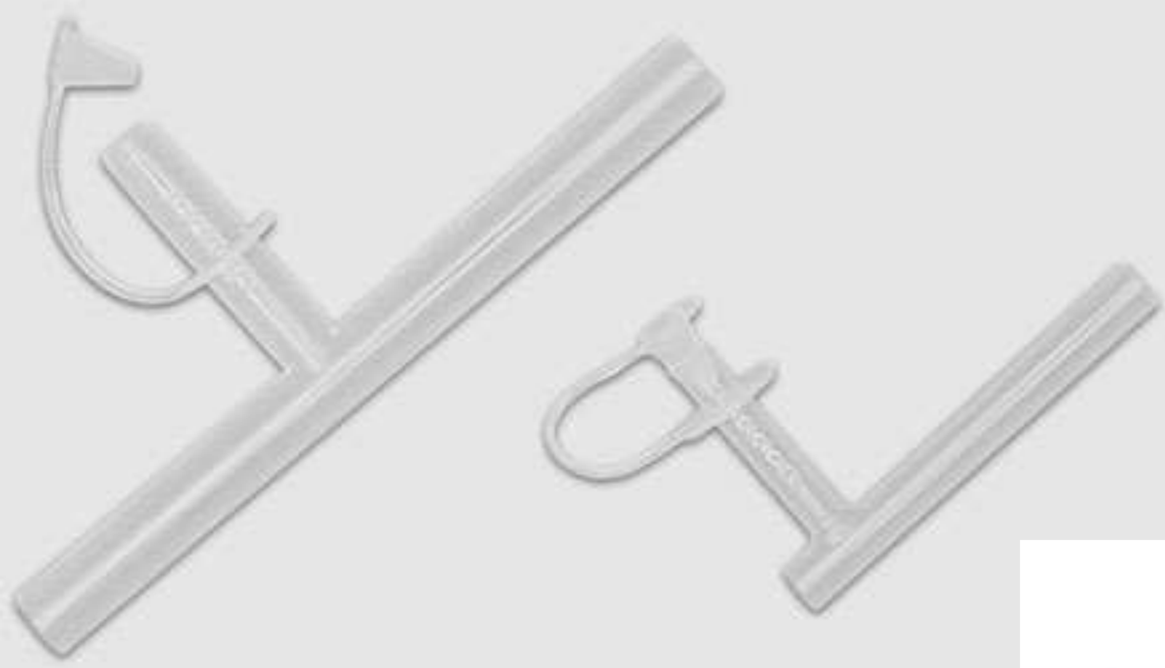
Management



Ernst A et al, Am J Respir Crit Care Med 2004; 169:1278

Stent- History

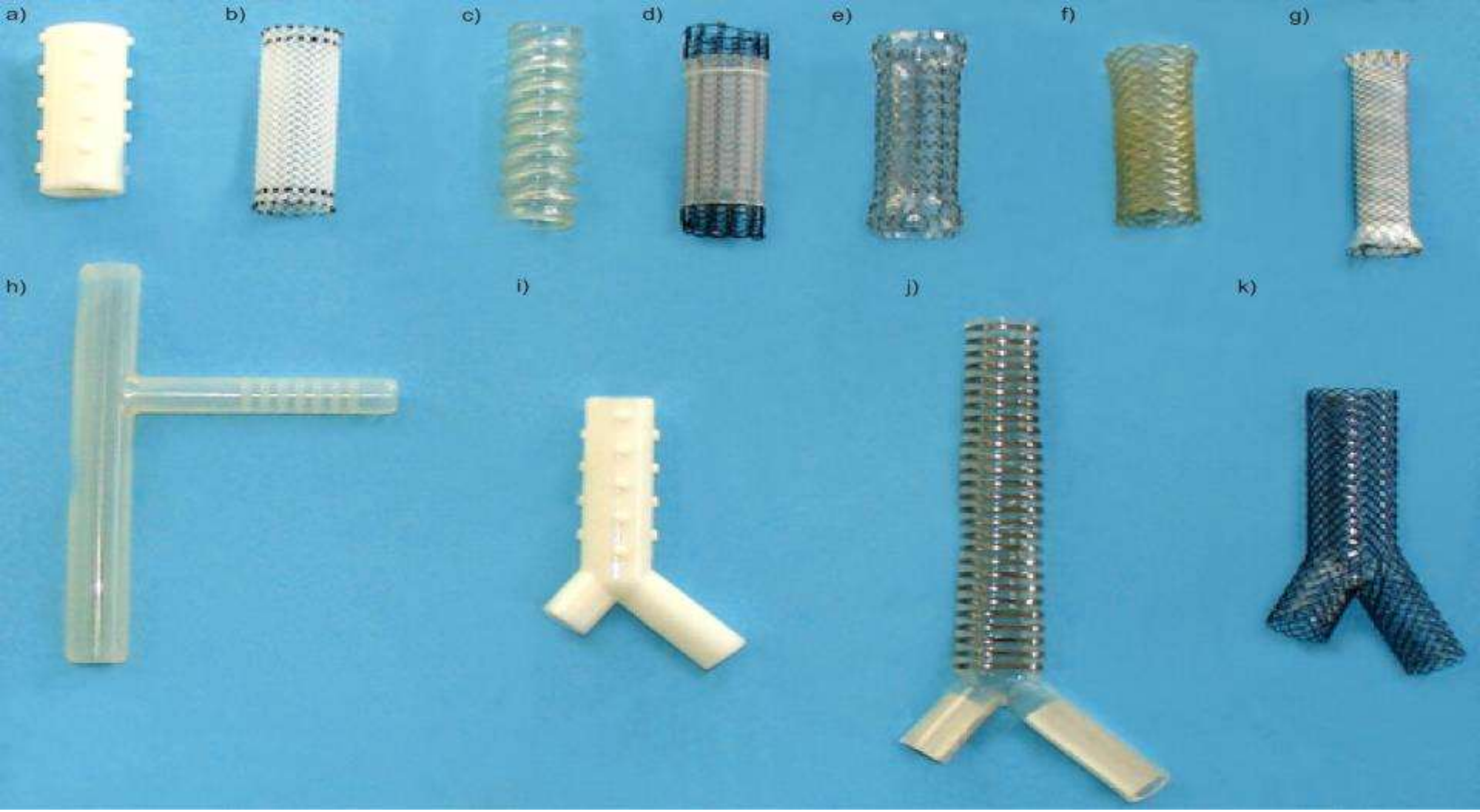
- Began when Montgomery introduced a silicone T-tube in 1965, for use in patients with tracheal stenosis
- In 1982, Westaby and coworkers modified the Montgomery T-tube and designed the T-Y tube which enabled splinting of the carinal region



Airway stents

- In 1990, first dedicated, completely endoluminal airway stent was introduced by Jean Francois Dumon in 1990
- His team placed 118 studded silicone prostheses in 66 patients with airway obstruction due to both benign and malignant disease
- Immediate relief of respiratory symptoms and significant quality survival were achieved in all but two patients, and none of the patients who died did so from airway obstruction

Dumon JF. A dedicated tracheobronchial stent. Chest 1990;97:328–332



a) Dumon stent
b) Polyflex stent
c) Noppen stent
d) covered Ultraflex stent
e) Alveolus Areo stent
f) Wall stent
g) Mandel and Rupp bronchial stent
h) Montgomery t-stent
i) bifurcated Dumon stent
j) Dynamic stent
k) Micro-tech bifurcation stent

Airway stents

- Ideal stent:
  - Easy to insert and remove, yet not migrate
  - Sufficient strength to support the airway, yet flexible enough to mimic normal airway physiology and promote secretion clearance
  - Biologically inert to minimize the formation of granulation tissue
  - Available in a variety of sizes

Indications

- Malignant tracheobronchial obstruction
- PITS that fails endobronchial resection and dilation
- Benign tracheal or bronchial stenosis
  - not a surgical candidate
  - awaiting a response to systemic therapy
  - surgical resection is pending

Indications

- Localized severe expiratory central airway collapse, such as tracheobronchomalacia
- Anastomotic stricture or dehiscence following lung or heart-lung transplantation
- Tracheal or bronchial esophageal fistula

Contraindications

- Prior to laser therapy, endobronchial electrocautery or argon plasma coagulation
- Contraindications due to general anesthesia and/or procedural sedation
- EBRT and brachytherapy are not contraindications to airway stenting

Types of stents

- Silicone
- Metal
- Hybrid

Silicone stents

- Firm, stable in high temperatures, and able to repel water
- Do not break down, and resist extrinsic compression from tumour, enlarged lymph nodes, and circumferential fibrotic scars
- But generally require GA and rigid bronchoscopy

Chest. 1999 Feb;115(2):582-3.

Dumon stent placement via endotracheal tube.

Nomori H[1], Horio H, Suemasu K.

⊕ Author information

Abstract

BACKGROUND: Dumon stent placement requires use of a technically difficult rigid bronchoscope. A recently developed technique for placing a Dumon stent introduced via a conventional endotracheal tube is detailed herein.

METHODS: The conventional endotracheal tube is inserted beyond the stenosis site; this procedure is observed with the use of a flexible bronchoscope with the patient undergoing general anesthesia. The Dumon stent is folded and inserted into the endotracheal tube and is introduced into the stenosis site with the use of a cylindrical-tipped stainless steel wire as a pusher. The endotracheal tube is withdrawn while the pusher is positioned to expand the stent at the stenosis site. Dumon stents of 12 to 16 mm in diameter were put in place using the present method in 5 cases of tracheobronchial stenosis.

RESULTS: The mean time from endotracheal tube insertion to stent placement was 181 s. The present method positioned the Dumon stent more easily and safely than the original rigid bronchoscope because the endotracheal tube used was flexible. One patient, however, required a tracheostomy and surgical forceps to remove the stent 3 months after placement.

CONCLUSION: While Dumon stent removal may require a rigid bronchoscope or tracheostomy, stents can be introduced without difficulty via a conventional endotracheal tube.

Nihon Kokyuki Gakkai Zasshi. 2001 Mar;39(3):178-81.

[Dumon stent placement via endotracheal tube].

[Article in Japanese]

Nomori H[1], Horio H.

⊕ Author information

Abstract

We conducted a Dumon stent placement via endotracheal tube for 10 patients with airway stenosis. The conventional endotracheal tube is inserted beyond the stenosis site; this procedure is conducted with the use of a flexible bronchoscope under general anesthesia. The Dumon stent is folded and inserted into the endotracheal tube and is then introduced into the stenosis site with the use of a cylindrical-tipped stainless steel wire as a pusher. Although the Dumon stents were placed using a rigid bronchoscope for the first 7 patients, the present procedure was used for the latest 10 patients. Compared with the rigid bronchoscope technique, this procedure is suitable for the placement of a larger stent for a shorter time. It has the following advantages over the rigid bronchoscope technique: (1) the use of an endotracheal tube and flexible bronchoscope makes the stent placement easier for the practitioner and less stressful for the patient; (2) because of the flexibility of the endotracheal tube, a Dumon stent can be placed easily, even in the left main bronchus or in a markedly shifted trachea or bronchus, and also in a patient who has difficulty in expanding the neck; (3) a stent can be placed safely in a patient with severe tracheal stenosis and orthopnea. The present procedure does, however, have the disadvantage that it is difficult to control the direction of the tip of the endotracheal tube. We concluded that the present procedure could be a useful method for Dumon stent placement.

Silicone stent by FOB

- Use of an ET tube and flexible bronchoscope makes the stent placement easier for the practitioner and less stressful for the patient

- Due to the flexibility of the ET tube, a Dumon stent can be placed easily
  - even in LMB
  - markedly shifted trachea or bronchus
  - patient who has difficulty in expanding the neck

Nihon Kokyuki Gakkai Zasshi. 2001 Mar;39(3):178-81

Silicone stent by FOB

- Mean time from endotracheal tube insertion to stent placement was 181 sec
- Dumon stents of 12 to 16 mm in diameter were put in place

Nomori H1, Horio H, Suemasu K, Chest. 1999 Feb;115(2):582-3

Types of silicone stents

- Smooth walled Hood stent
- Studded Dumon stent
- Studded Hood stent
- Reynders Noppen tygon stent

Smooth walled Hood stent

One of the first silicone airway stents

Straight or Y shaped

Newer versions of the smooth walled Hood stent have a small flange on its proximal and distal aspects to prevent the stent from being easily displaced

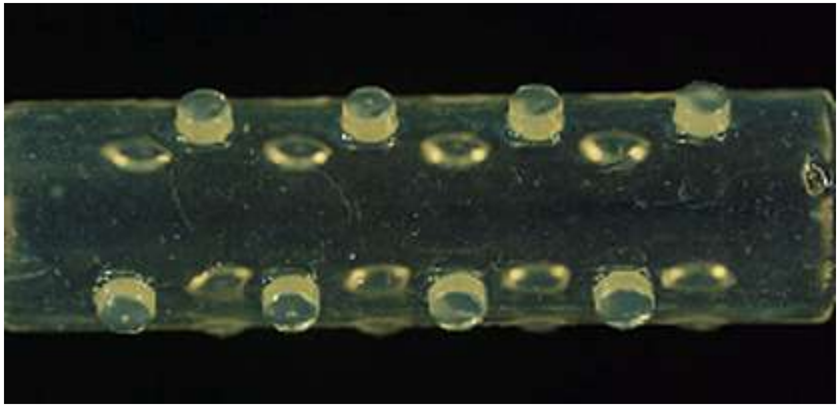
Studded Dumon stent

Outside surface bears regularly placed studs to prevent displacement

In study by Dumon group 118 prostheses have been placed in 66 patients

Migration occurred 12 times

Several shapes : straight/L /Y shaped

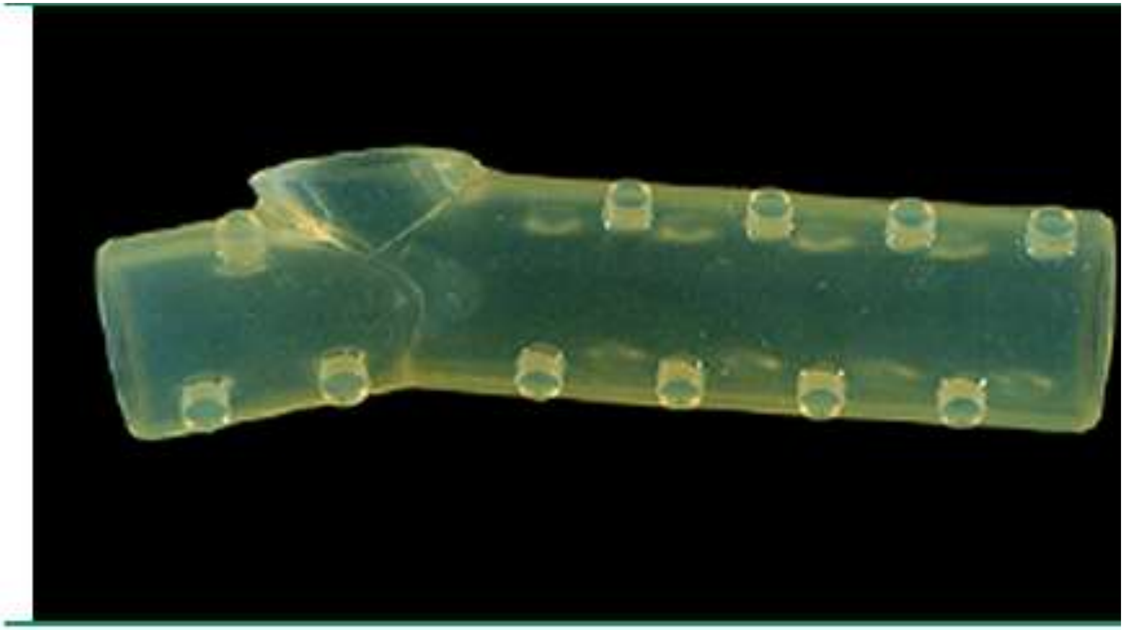


Dumon JF Chest. 1990;97(2):328

Studded Hood stent

Similar configuration as the studded Dumon stent

Equivalent to those of the studded Dumon stent



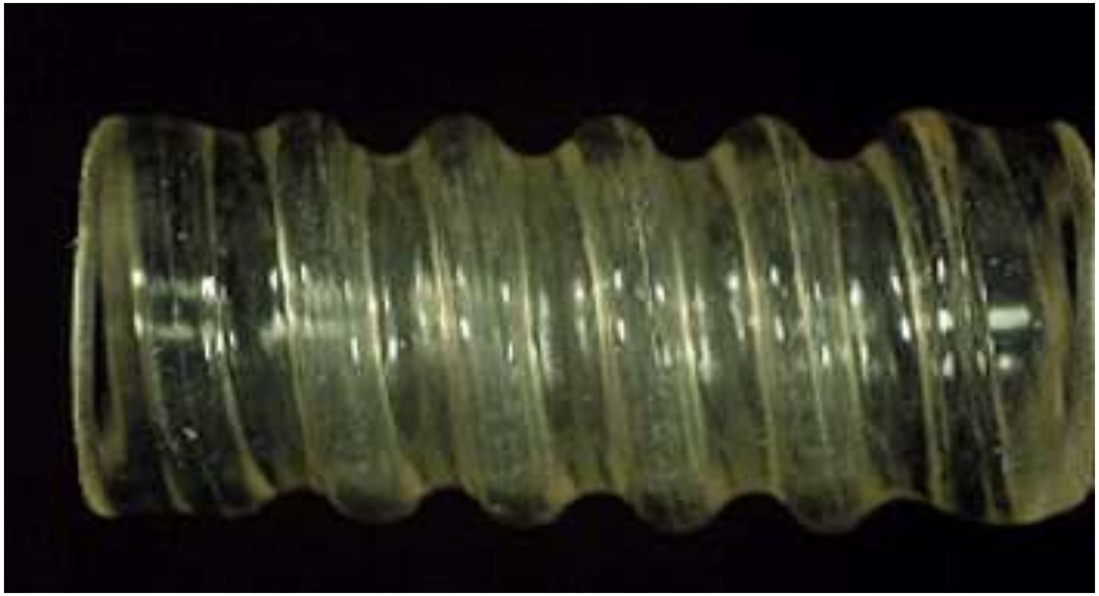
Studded silicone Hood tracheobronchial stent with cut-off for right main bronchus.

Reynders Noppen tygon stent

Cylindrical tygon plastic tube that has been molded into a screw-thread shape

More rigid than the other silicone stents

Placement requires a specific introducer



Noppen M et al, Chest. 1999;115(2):532

- 50 patients with tracheal stenosis who were treated with either the studded Dumon stent or the Reynders Noppen Tygon stent
- Stent migration occurred more often in more patients who received studded Dumon stents than in patients who received Reynders-Noppen stents (24 Vs 5 %)
- Not significant statistically

Noppen M, Meysman M, Claes I, D'Haese J, Vincken W Chest. 1999;115(2):532

Metal stents

- Metal stents rarely migrate within the tracheobronchial tree
- SEMS may generate sufficient force to distend strictures, which is helpful if the airway cannot be dilated before stent insertion

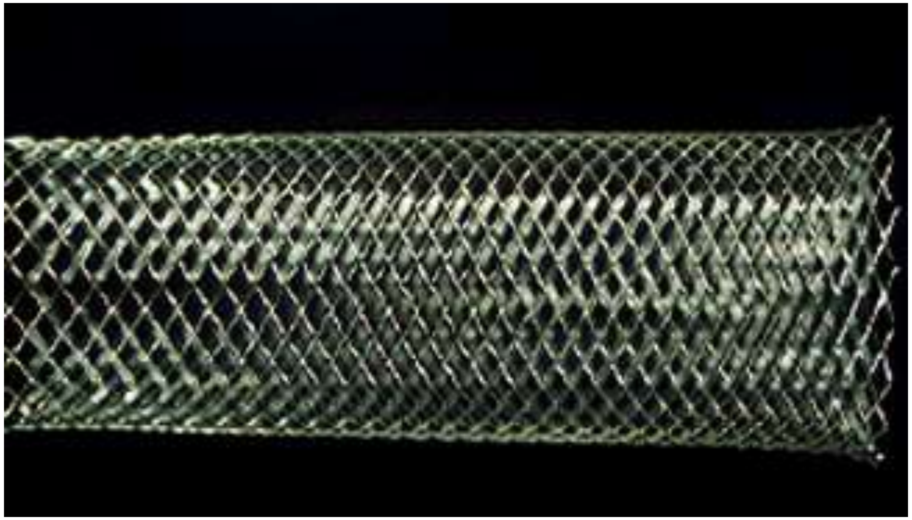
Wallstent /Schneider stent

Self expanding airway tubular mesh of cobalt alloy braided filaments

Variety of lengths and diameters are available

Doesnt require rigid bronchoscopy

Loaded into a delivery catheter and then expands and shortens upon deployment



Rousseau H et al, Radiology. 1993;188(1):199

Ultraflex stent

Single layer of braided, knitted flexible **nitinol** (nickel-titanium alloy) wire

Deployed by gradually removing a suture that holds the stent in a compressed state

Ultraflex stents are available with or without an outer silicone covering

Cook-Gianturco stent

Continuous loop of stainless steel wire

Compressed into a narrow cylinder, which expands immediately following bronchoscopic deployment

Maintains an expansive force once deployed and small hooks embed in the airway mucosa to retard migration

Hybrid stents

- Incorporate two or more different materials
- More expensive than airway stents that are made exclusively of one material
- Types
  - Covered wall stent
  - Dynamic Y stent
  - Polyflex stent

- Aero stent
- Hanarostent
- Leufen stent

Covered Wallstent

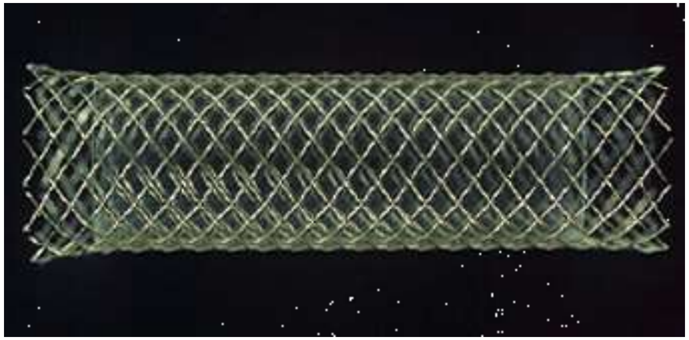
Similar to the schneider stent

Partially covered by a thin silicone membrane

Prevent the extension of tumor or granulation tissue between the thin wire struts

Fits into a catheter for bronchoscopic insertion, is self expanding following deployment, and maintains its expansile force

However, it is difficult to reposition or remove

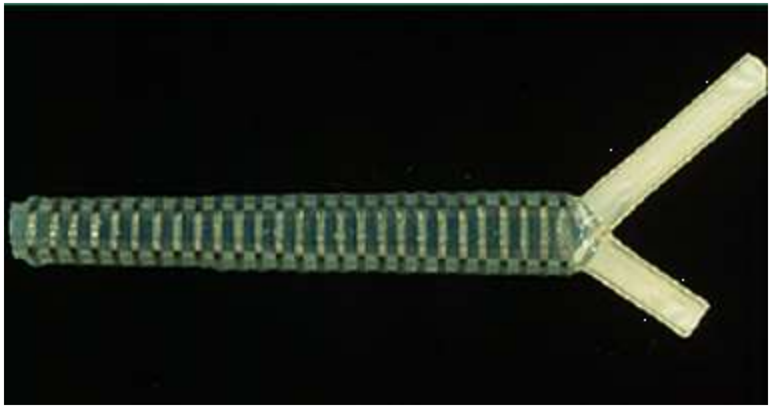


Dynamic Y stent

Silicone y-shaped airway stent that has a **firm anterior wall** made of horseshoe-shaped metal struts and **a posterior wall made of soft silicone**

Appropriate choice for patients with significant tracheobronchomalacia or long strictures involving the trachea and/or mainstem bronchi

Difficult for patients to effectively clear airway secretions and obstruction can occur

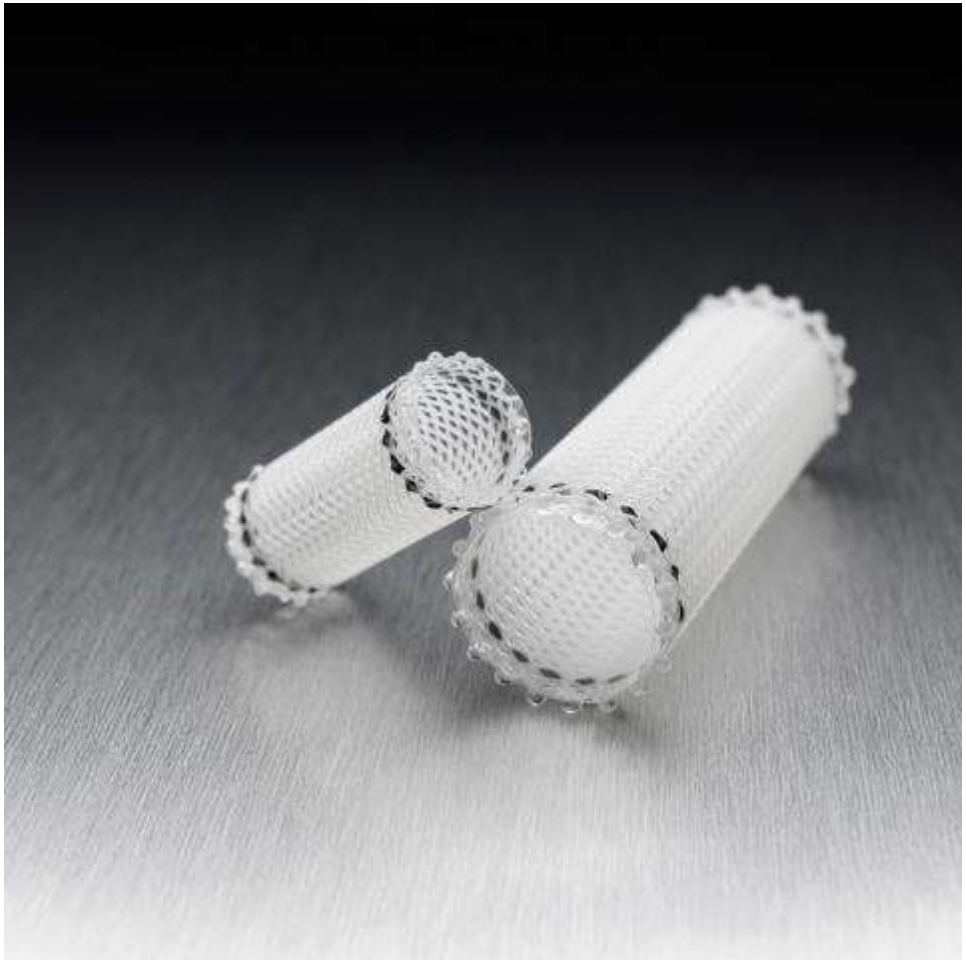


Polyflex airway stent

Self-expanding plastic airway stent that consists of polyester mesh covered with silicone

Removable and causes less trauma to surrounding tissues than metal stents

Migration of the stent is common



Airway Stents

- Aero stent
  - Consists of a covered piece of nitinol
  - Comply with irregular airway anatomy better than other stents
- Hanarostent
  - Made of nitinol and silicone
  - Has a silk thread attached to the proximal edge of the stent to assist with deployment and retrieval

Stent insertion

- Initial FOB
- The distance from the vocal cords to the lesion
- Length of the lesion
- Diameter of the lesion should be measured

- Choose optimal airway stent

Choice of stent

- Operator preference
- Cost
- Availability
- Experience

Timing of stenting

- Part of a bronchoscopic intervention
- May be done days or weeks later as a palliative measure if the lesion recurs
- Depend upon the clinical circumstances and the patient's preferences

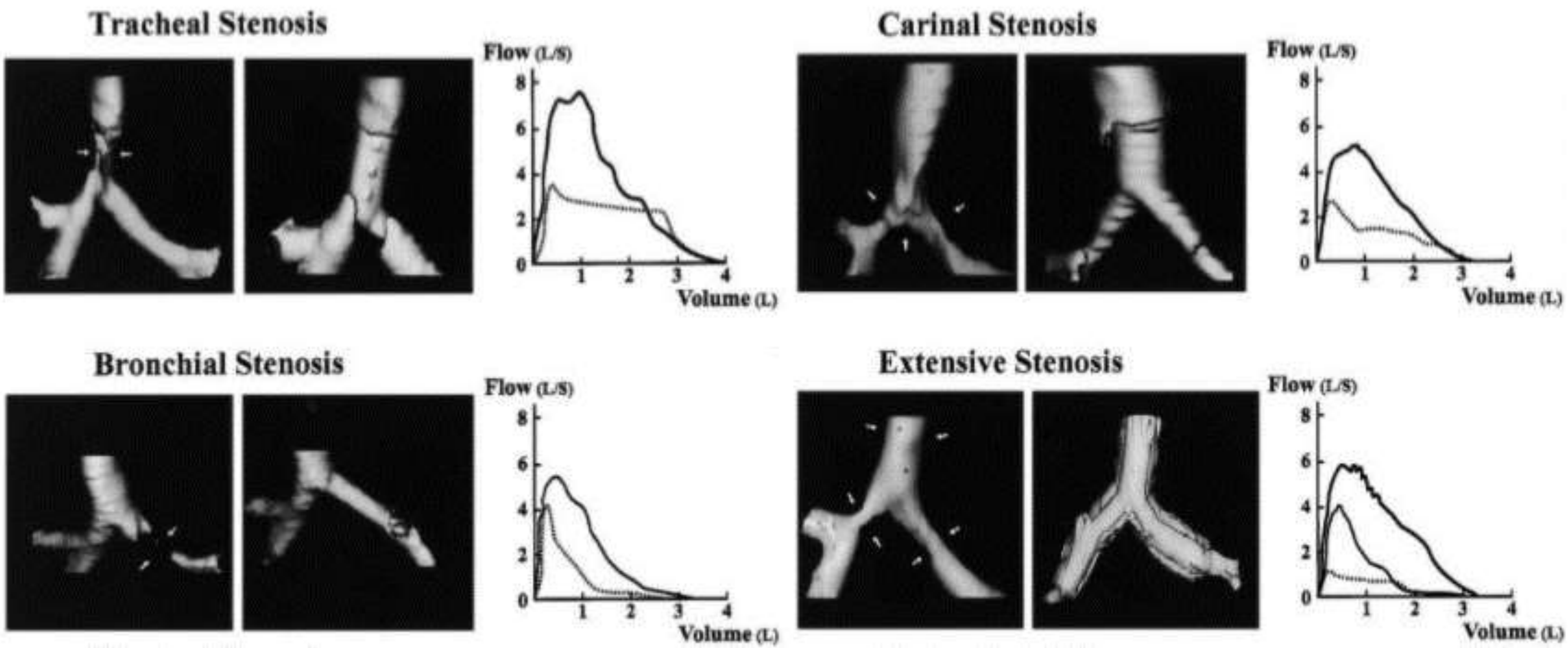
Airway stenting

- If a stenotic lesion cannot be resected, dilation should be performed prior to stenting
- This allows the stent of greatest diameter to be inserted
- If the rigidity of a lesion makes dilation unsafe or impractical, sequential stents of increasing size can be inserted
- As an alternative SEMS be used to may restore airway patency

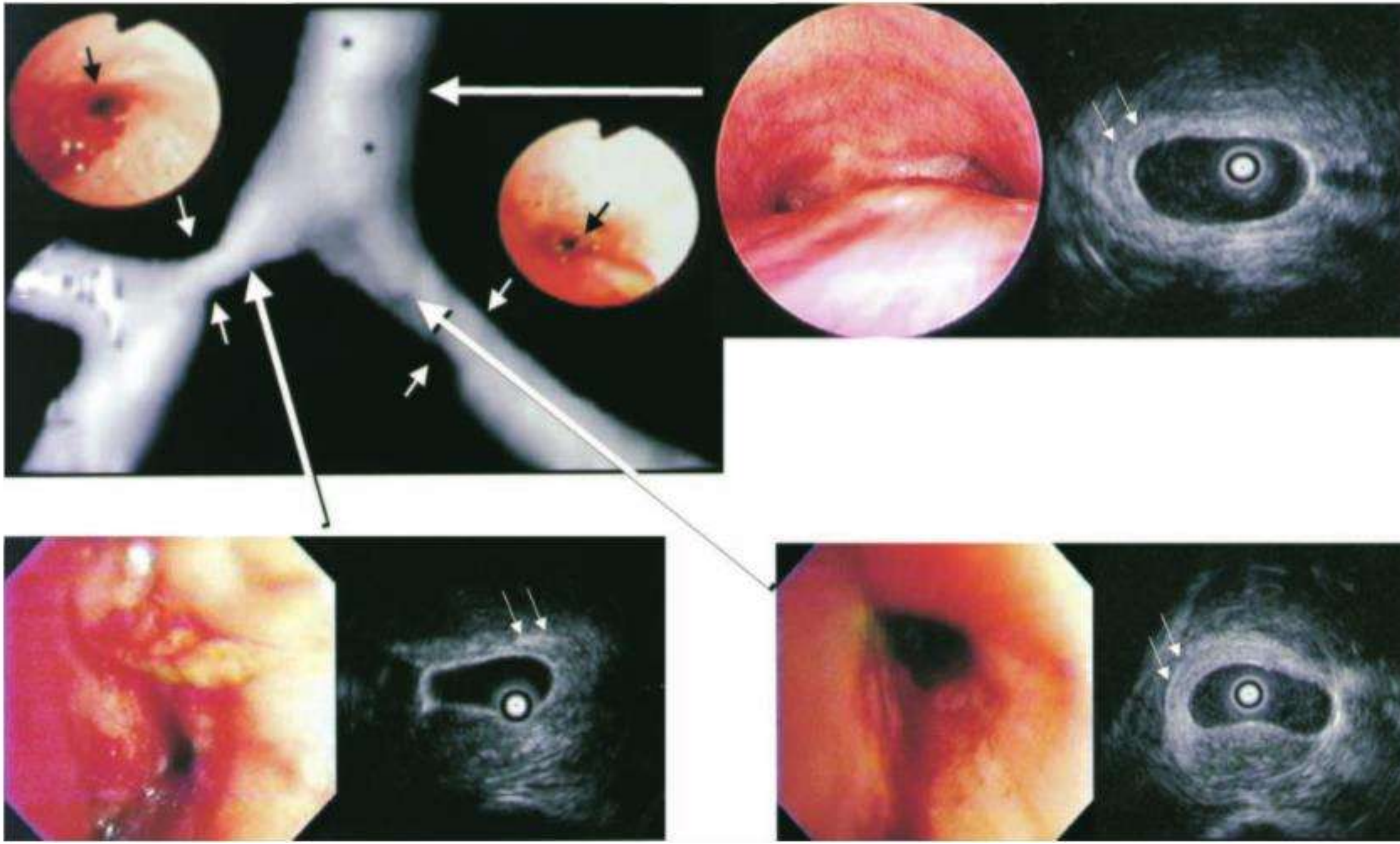
Identification of choke point

- Identifying critically narrowed airway segment (ie, the "choke point") may be difficult during bronchoscopy
- Sequential multimodality assessment with spirometry, ultrathin bronchoscopy, and endobronchial ultrasound were used to guide placement of stent
- The choke point may migrate following stent placement, requiring revision or placement of a second stent

Miyazawa T et al,Am J Respir Crit Care Med. 2004 May 15;169(10):1096-102



Miyazawa T et al,Am J Respir Crit Care Med. 2004 May 15;169(10):1096-102



Miyazawa T et al,Am J Respir Crit Care Med. 2004 May 15;169(10):1096-102

Airway stents

- In a retrospective study of carinal and pericarinal stent insertion
  - Of 23 patients
  - Technical success was achieved in 96.9%
  - Symptomatic improvement was observed in 90.6%
  - Stent-related complications were observed after 10 procedures (31.3%)
  - Stent obstruction occurred in 7 patients (21.9%), most commonly because of tumour progression

Kim J et al, Am J Roentgenol. 2014 Apr;202(4):880-5

Outcomes following stenting

- Symptoms and signs of CAO decrease immediately (88-96 %)
- Similarly lung function, exercise capacity and quality of life improve

1-Wood DE et al, Ann Thorac Surg. 2003;76(1):167
2-Profili S et al, Cardiovasc Intervent Radiol. 2007;30(1):74

Airway stent - Complications

- Displacement
- Mucus impaction
- Granuloma formation at stent ends
- Obstruction from tumor or granuloma (uncovered stents)
- Halitosis and chronic infection
- Perforation of airway wall
- Hemoptysis
- Pain
- Cough
- Airway fire during laser resection

Bolliger, CT, Mathur, PN, Beamis, JF, et al. Eur Respir J 2002; 19:365

Airway stent - Complications

- Stents causing significant complications may have to be removed
- In retrospective analysis of 10 years who underwent SEMS removal
  - 58 % of procedures to remove a metal stent had a complication
    - Reobstruction (46%)
    - Post procedure respiratory failure(33%)
    - Mucosal tear (16%)
    - Tension pnuemothorax (2%)

Alazemi S et al, Chest. 2010;138(2):350

Follow up

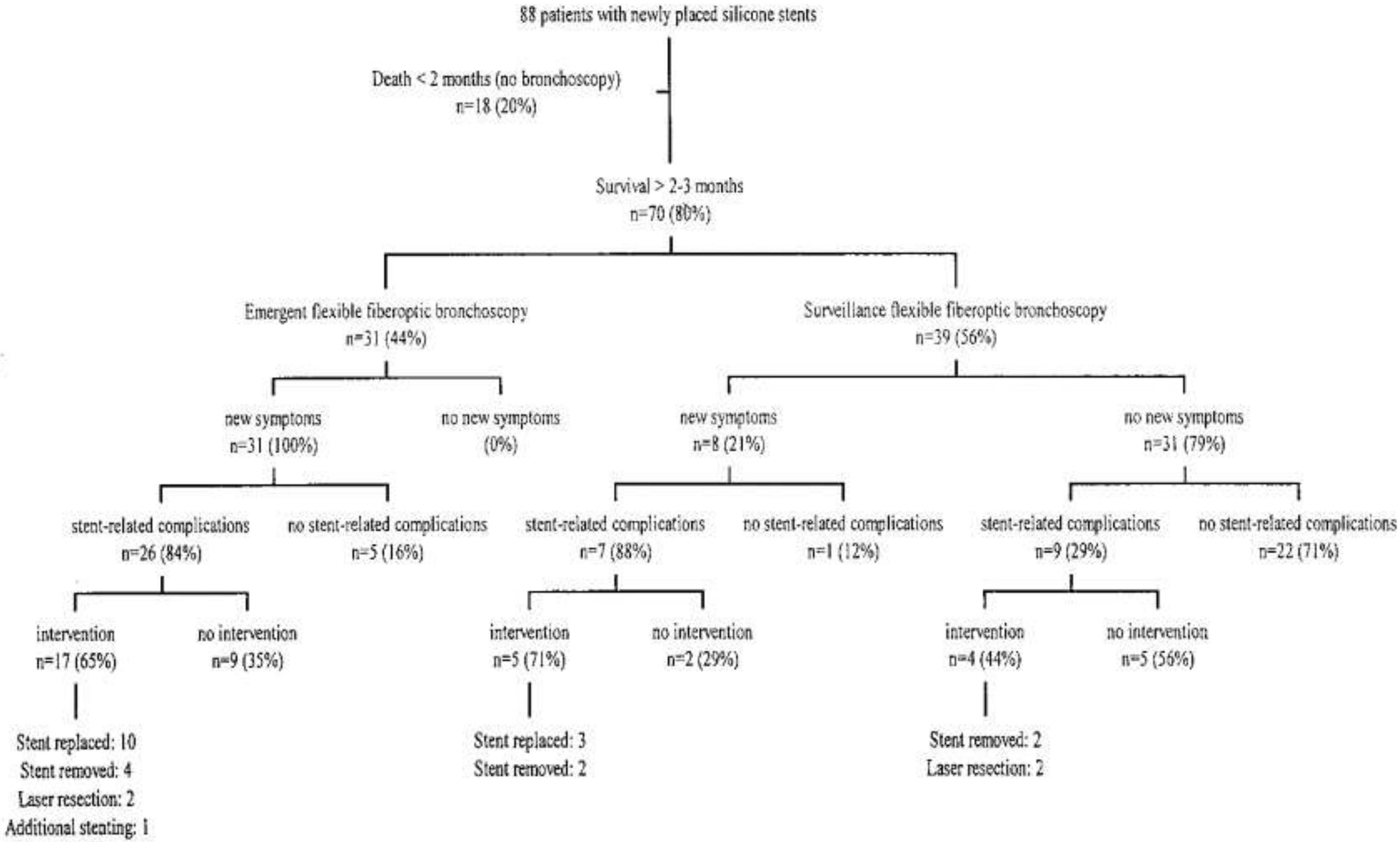
- Any patient with an airway stent developing new onset respiratory symptoms should undergo bronchoscopy

Role of surveillance bronchoscopy

- 101 silicone stents in 88 patients
- Stent related complications were detected in 9 of 31 asymptomatic patients (29%) undergoing SFFB

- Stent related complications were detected in 9 asymptomatic patients (10% of total)
- Of these 4 required intervention

Matsuo T et al, Chest. 2000 Nov;118(5):1455-9



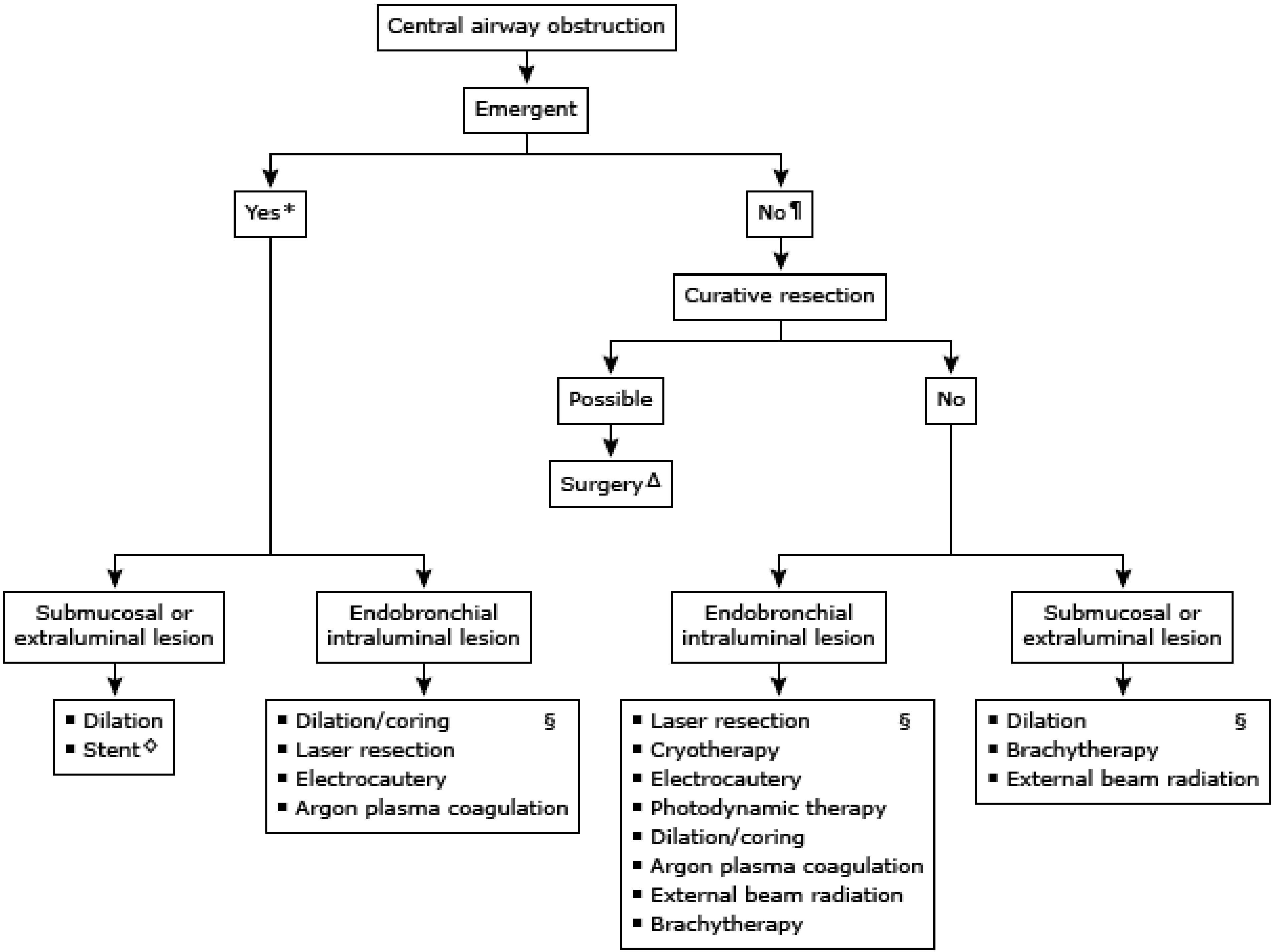
Matsuo T et al, Chest. 2000 Nov;118(5):1455-9

Stent alert card

- 2005, the FDA issued a warning that the use of metallic stents should be avoided in benign diseases

- Stent alert card :
  - Type of stent
  - Location
  - Appropriate size of ET tube to be used in emergency situation

	Advantages	Disadvantages
Silicone	•Easily inserted •Repositioning and removal are easy	•Rigid bronchoscopy and GA required •Stent migration is common •Granulation tissue may obstruct proximal or distal ends of stent
Metal	•May be introduced with fiberoptic scope without GA •Self expanding; and resist extrinsic compression •Minimal migration after placement	•Cannot be easily removed or repositioned •Granulation tissue or tumor easily grows through spaces between metal struts •Expansile force may rupture airways and vascular structures •Expensive
Hybrid	•Resist extrinsic compression •Silicone membrane resists ingrowth of tumor or granulation tissue	•Cannot be easily removed or repositioned •Most expensive


Central airway obstruction
Emergent
Yes *
No ¶
Curative resection
Possible
No
Surgery Δ
Submucosal or extraluminal lesion
Endobronchial intraluminal lesion
Endobronchial intraluminal lesion
Submucosal or extraluminal lesion
Dilation
Stent ◊
Dilation/coring
Laser resection
Electrocautery
Argon plasma coagulation
§
Laser resection
Cryotherapy
Electrocautery
Photodynamic therapy
Dilation/coring
Argon plasma coagulation
External beam radiation
Brachytherapy
§
Dilation
Brachytherapy
External beam radiation
§