



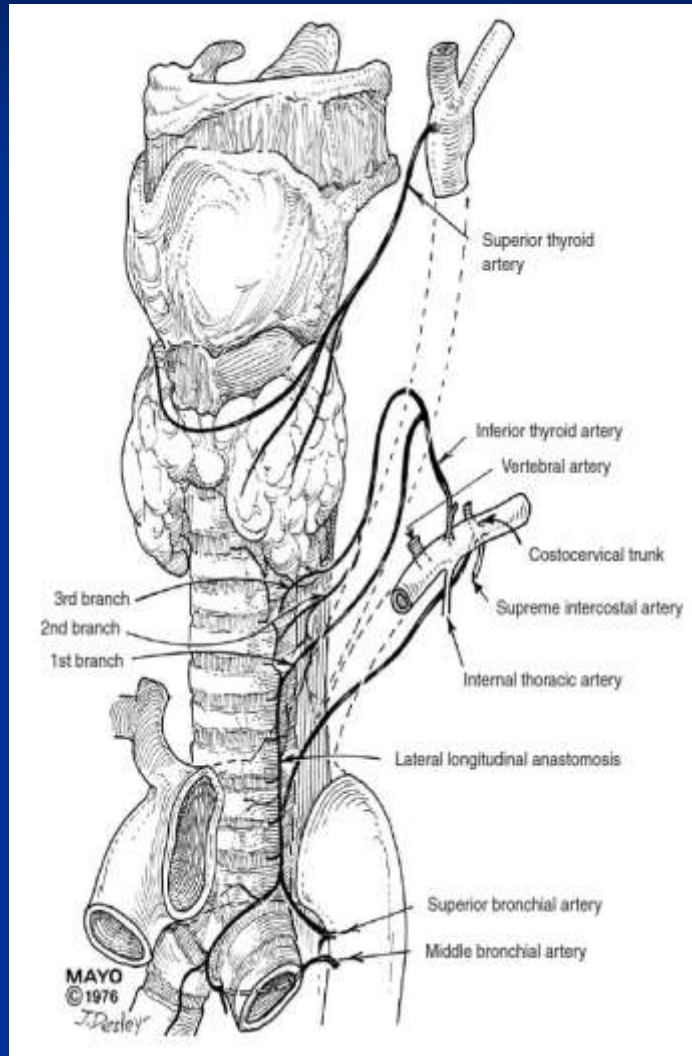
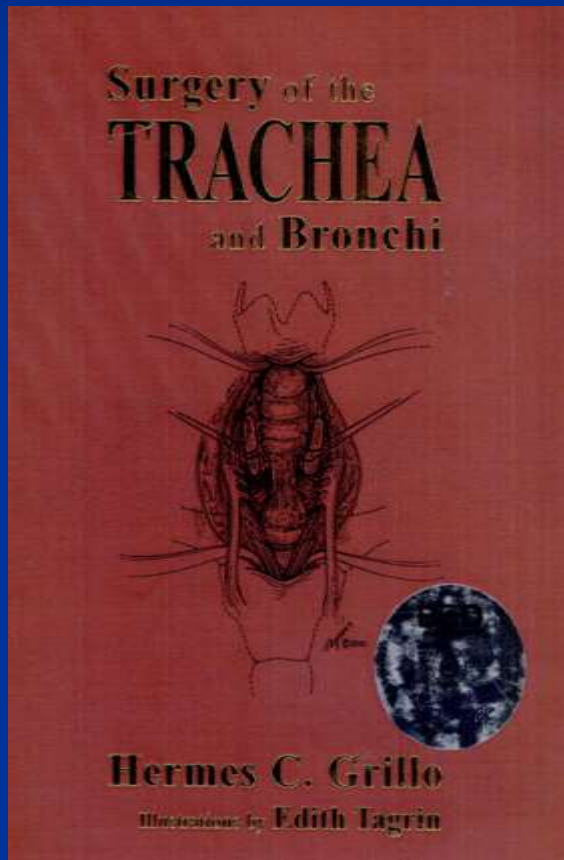
Anesthesia for tracheal and main bronchial resections with reconstruction

Conf. Dr. Radu Stoica

Anesthesia and ICU

**Institute of Pulmonology „Marius Nasta”
București**

„The father of modern-day tracheal surgery“



Prevention and management of complications following tracheal resections—lessons learned at the Massachusetts General Hospital

Luis F. Tapias^{1,2}, Douglas J. Mathisen^{1,2}

¹Division of Thoracic Surgery, Massachusetts General Hospital, Boston, MA, USA; ²Harvard Medical School, Boston, MA, USA

Correspondence to: Douglas J. Mathisen, MD, Division of Thoracic Surgery, Massachusetts General Hospital, 55 Fruit Street, Founders 7, Boston, MA 02114, USA. Email: dmathisen@mg.harvard.edu.

Tracheal surgery has developed and evolved over the last 50 years, becoming an integral part of the clinical practice of modern thoracic surgeons. Today, surgeons can safely and effectively operate on most patients suffering from post-intubation tracheal stenosis, tracheal tumors and other pathologies that result in an abnormal shape and function of the central airways. The Massachusetts General Hospital (MGH) in Boston witnessed first-hand the birth and growth of tracheal surgery under Dr. Hermes Grillo, becoming a reference center and accumulating one of the largest institutional experiences in the world. This vast

Cite this article as: Tapias LF, Mathisen DJ. Prevention and management of complications following tracheal resections—lessons learned at the Massachusetts General Hospital. *Ann Cardiothorac Surg* 2018. doi: 10.21037/acs.2018.01.20

17. Cordos I, Bolca C, Paleru C, et al. Sixty tracheal resections--single center experience. *Interact Cardiovasc Thorac Surg* 2009;8:62-5; discussion 65.

908 patients in 28 years

Postoperative mortality 1,2%

Overall complications 18%

Anastomotic complications 8%

A retrospective review of 60 tracheal stenoses of various etiologies (2001- 2008)

Table 2
Lesion locations

Location	Lesion	No.
Upper third 53 cases	Postintubation stenosis	46
	Typical carcinoid tumor	2
	Thyroid carcinoma	2
	Squamous cell carcinoma	1
	Thyroid adenoma	1
	Adenoid cystic carcinoma	1
Middle third 3 cases	Squamous cell carcinoma	2
	Hemangioma	1
Lower third 4 cases	Squamous cell carcinoma	2
	Fibroma	1
	Atypical carcinoid tumor	1
Total		60

Interactive CardioVascular and Thoracic Surgery 8 (2009) 62-66

www.icvts.com

Institutional report - Thoracic general Sixty tracheal resections – single center experience[☆]

Ioan Cordos, Ciprian Bolca*, Cristian Paleru, Radu Posea, Radu Stoica

1st Clinical Department of Thoracic Surgery, National Institute of Pneumology Marius Nasta, 90, Viilor Street, Sector 5, Bucharest, Romania

Masachussets Gen Hospital
1975-2003 901 patients

Postintubation tracheal stenosis
(PITS) 589 patients

Tumor 208 patients

Idiopathic laryngotracheal
stenosis (ILTS) 83 patients

TEF in 21 patients

Auchincloss Hg, Wright DW, Complications after
tracheal resection and reconstruction: prevention and
treatment J Thorac Dis 2016;8(0):S160-S167

Institute of Pulmonology
2001-2018 281 patients

PITS subglotic (crico- or thyro-
tracheal anastomosis) 67

Tracheal (tracheo-tracheal) 115

Primitive neoplasia – 31

Thyrod invasion – 21

Metastatic – 3

Post-traumatic 2

Post-tuberculosis 2

Benign tumors or ILTS 7

TEF 14 Other 19

Malignant airway disorders

- Primitive neoplasia – **31** patients (6 carinal resection and reconstruction)
- Secondary malignant tumors
 - Thyroid invasion – **21** (thyroidectomy and tracheal resection)
 - Metastatic – 3
- **Lung cancer – 25** (pneumonectomy or superior lobectomy with carinal resection and reconstruction)
- **Reintervention 1**
- **Deaths 4 (1,4%)**

Site of lesions

- **Tracheal**

- Proximal (subglottic)
- Medial
- Distal

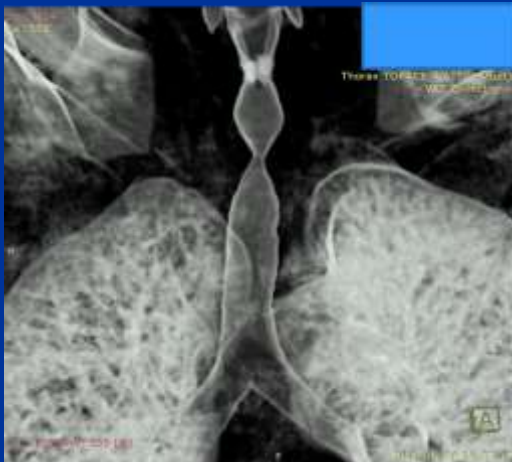
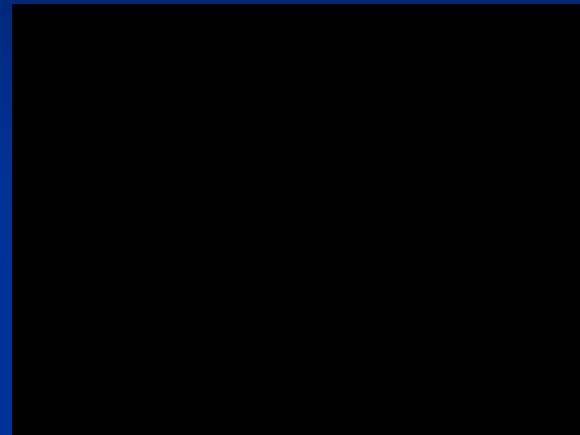
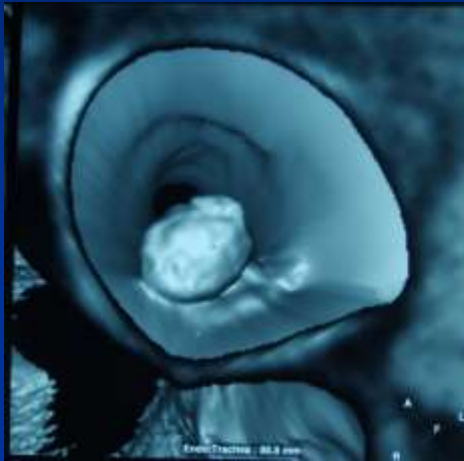
- **Carinal**

- **Carinal + sleeve resections (lobectomy or pneumonectomy)**

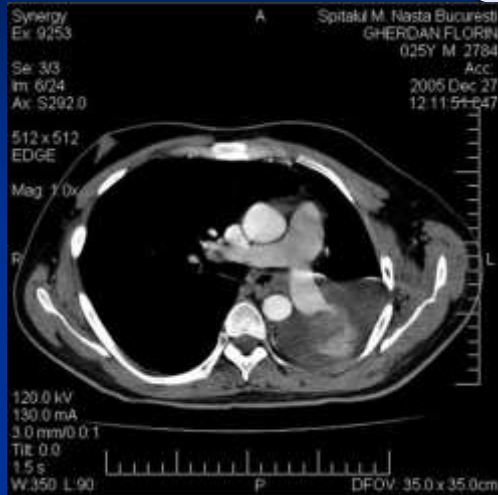
Proximal and medial benign



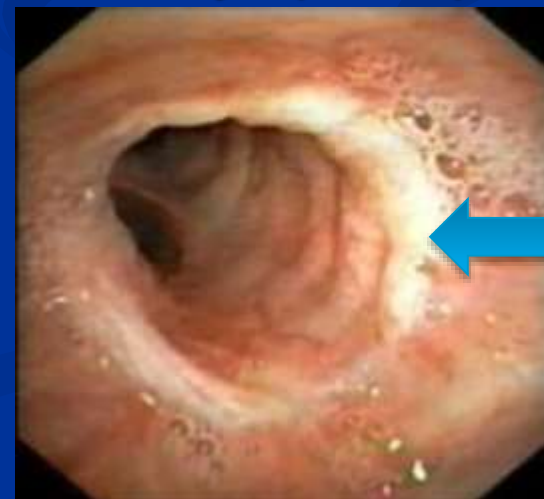
Other benign. Median and distal



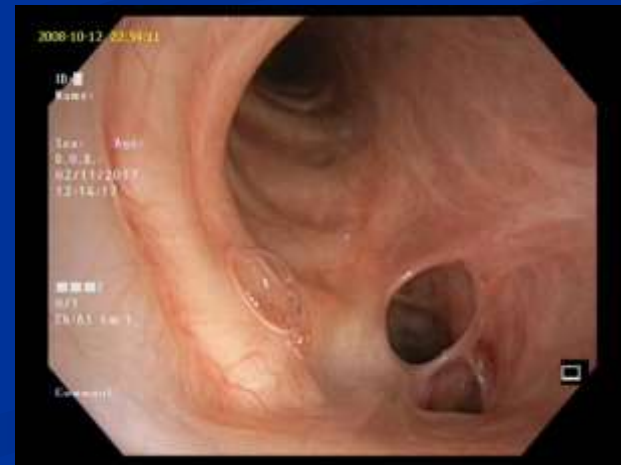
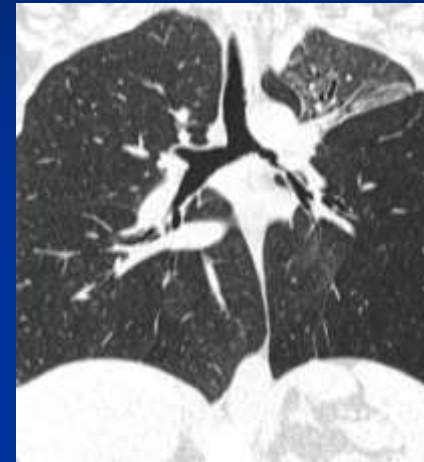
Post Traumatic Main Bronchial Stenosis

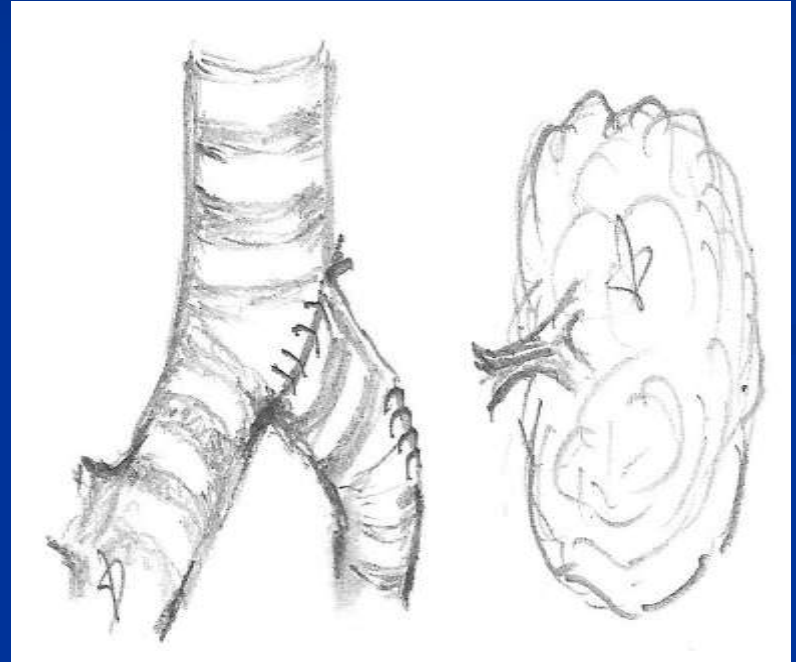
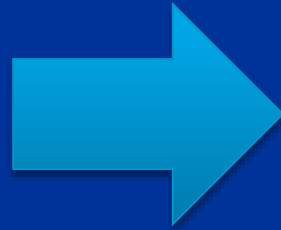
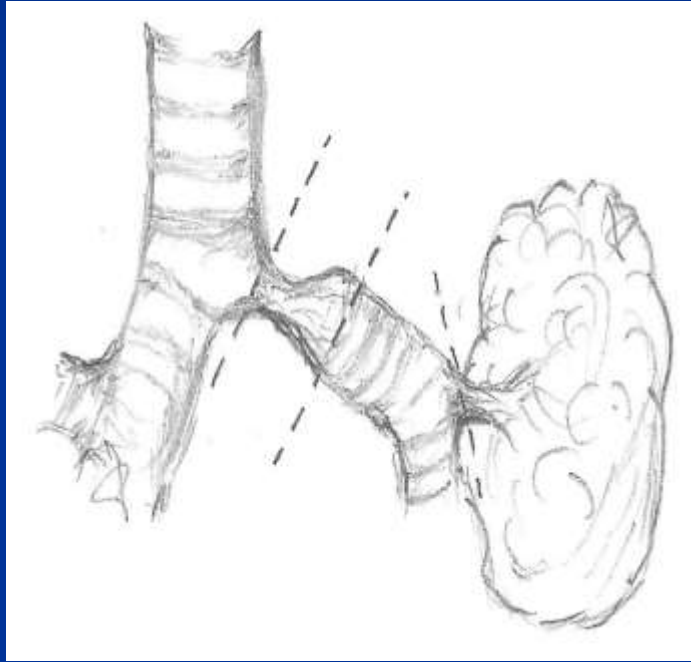


30 days postop



Bronchial Stenosis after Tuberculosis

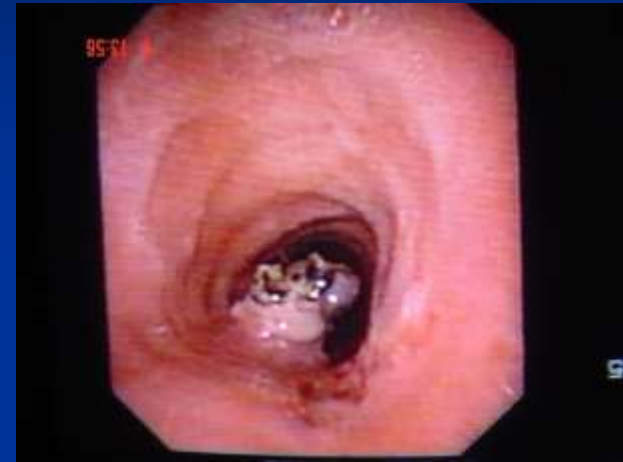




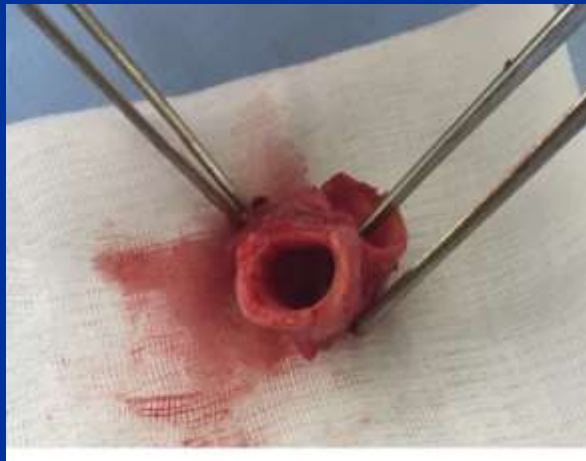
Tracheal Hemangioma

1. After bronchoscopic resection

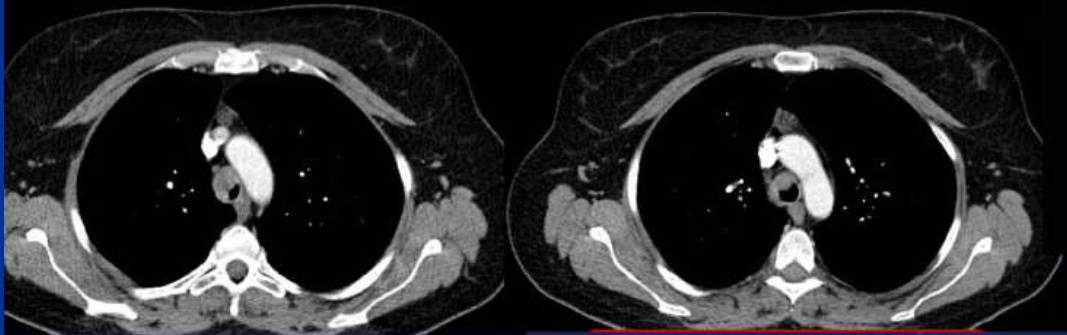
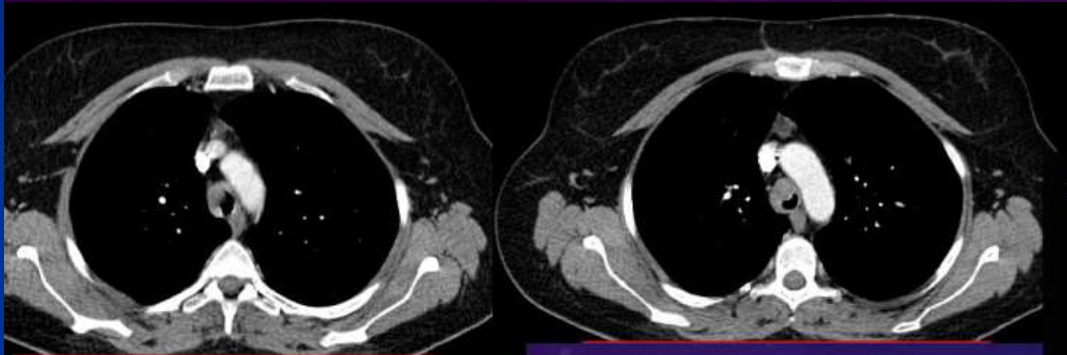
2. After surgical resection



Metachronous NSCLC of Carina 5 Years after Left Pneumonectomy



Distal chystic adenoma



2007-9-23 17:26:50

44223
B.A.M.

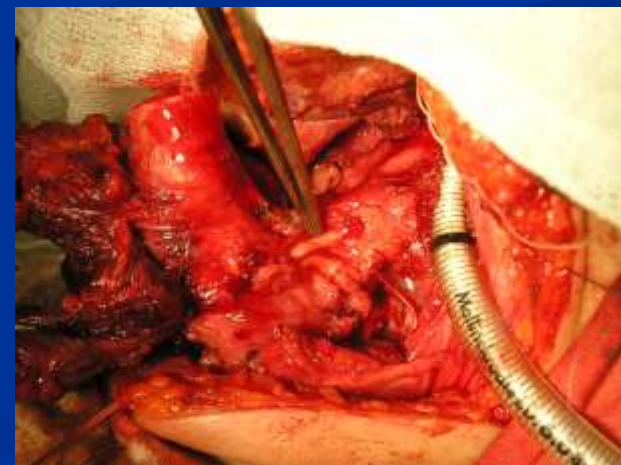
CARC. ADENOID. TR.
Γ 39
19/12/1976
11/10/2016
14:08:18

0/1
EhiA1 Cm/1

DN A.M.



Thyroid Cancer Invading The Trachea



Tracheal Metastasis After Lung Resection for NSCLC



Anesthesia: Ventilatory challenges

- **Trachea: main way in achieving normal ventilation during anesthesia**
- **Tracheal stenosis prevent ventilation during anesthesia induction**
- **Tracheal resection temporary prevent ventilation through ETT inserted between the vocal cords**
- **Equipement and special skills of the medical team**

Preoperative anesthetic evaluation

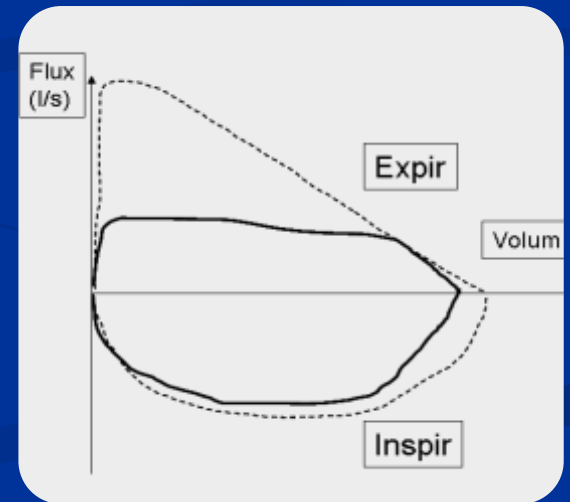
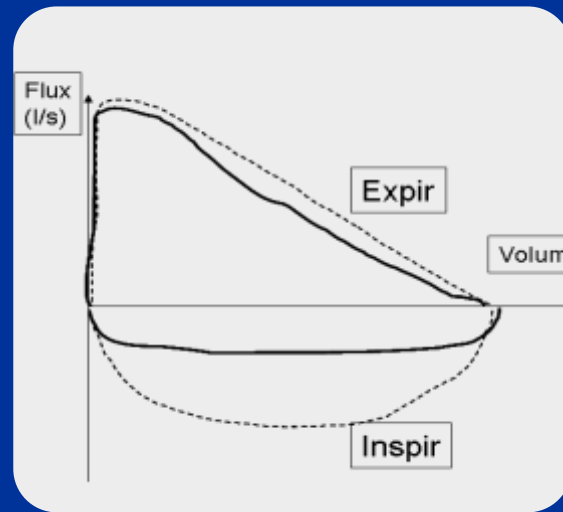
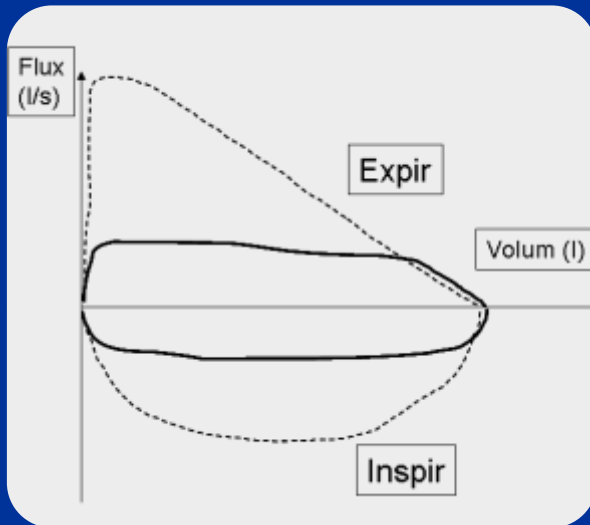
- Respiratory (spirometry, pletismography, blood gases, flux volum curves, etc)
- Imagistic (Rx pulmonary, CT with reconstruction, MRI, Bronchoscopy)
- Cardio-vascular (current or more complex if pathology present or suspected)

Flux-volumes curves in tracheal stenosis

a/ Fix obstruction

b/ Extratoracic obstruction

c/ Intratoracic obstruction



Patient monitoring

- ASA recommended: ECG, Pulsoximetry, NIV AT, capnography
- Acido-basic equilibrium and blood gases: arterial cateter

PaO₂

PaCO₂

Blood Ph

- *More complex if indicated (central catheter, echocardiography)*
- **Fibrobronhoscropy**

Anesthesia

PLANNING IS ESSENTIAL

- **Patient:** *type of lesions, symptoms, co-morbidities, preoperative assessment*
- *Severity (degree) of stenosis*
- **Surgical:** *resection proposed, patient position*
- **Anesthetic: ventilatory strategy**
 - Initial bronchoscopic dilatation? Emergency?
 - Sequence of intubation. ETT type
 - HFJV possible or probable
 - Risks and Vulnerabilities. Prevention

Two mandatory conditions

Needs available equipment and and medical skills



Choosing the most adequate the mode of ventilation

Anesthesiologist-surgeon-bronchoscopist co-op



How we do it?

Anesthesia

- General anesthesia
- Associated with loco-regional techniques (thoracic epidural, paravertebral block) in thoracotomies for lower trachea or carinal resections with pneumonectomy
- Choosing most adequate ventilation mode
CV, HFJV, successive modes, apnea periods(!)

Tracheal stenosis

- Ventilatory strategy varies depending on the level of the stenosis:
 - **INDUCTION**
 - **Mask preoxygenation**
 - Possible rigid bronchoscopic dilatation before ETI
 - Tracheostomy in tight tracheal stenosis (emergency, no time for bronchoscopic intervention!)
 - In lower tracheal stenosis: ETI above the stenosis with or without prior bronchoscopic dilatation)
- ! Colaps of superior airways during anesthetic induction: pharmacologic, tracheomalacia or tumoral compression!**

High and medium tracheal stenosis: first step

Avoid muscle relaxants if possible!

1. **Transstenotic intubation** with ETT
flexometalic, long and with diameter 4 - 6mm

or

2. High frequency jet ventilation (HFJV) with the
catether through ***ETT above the stenosis***

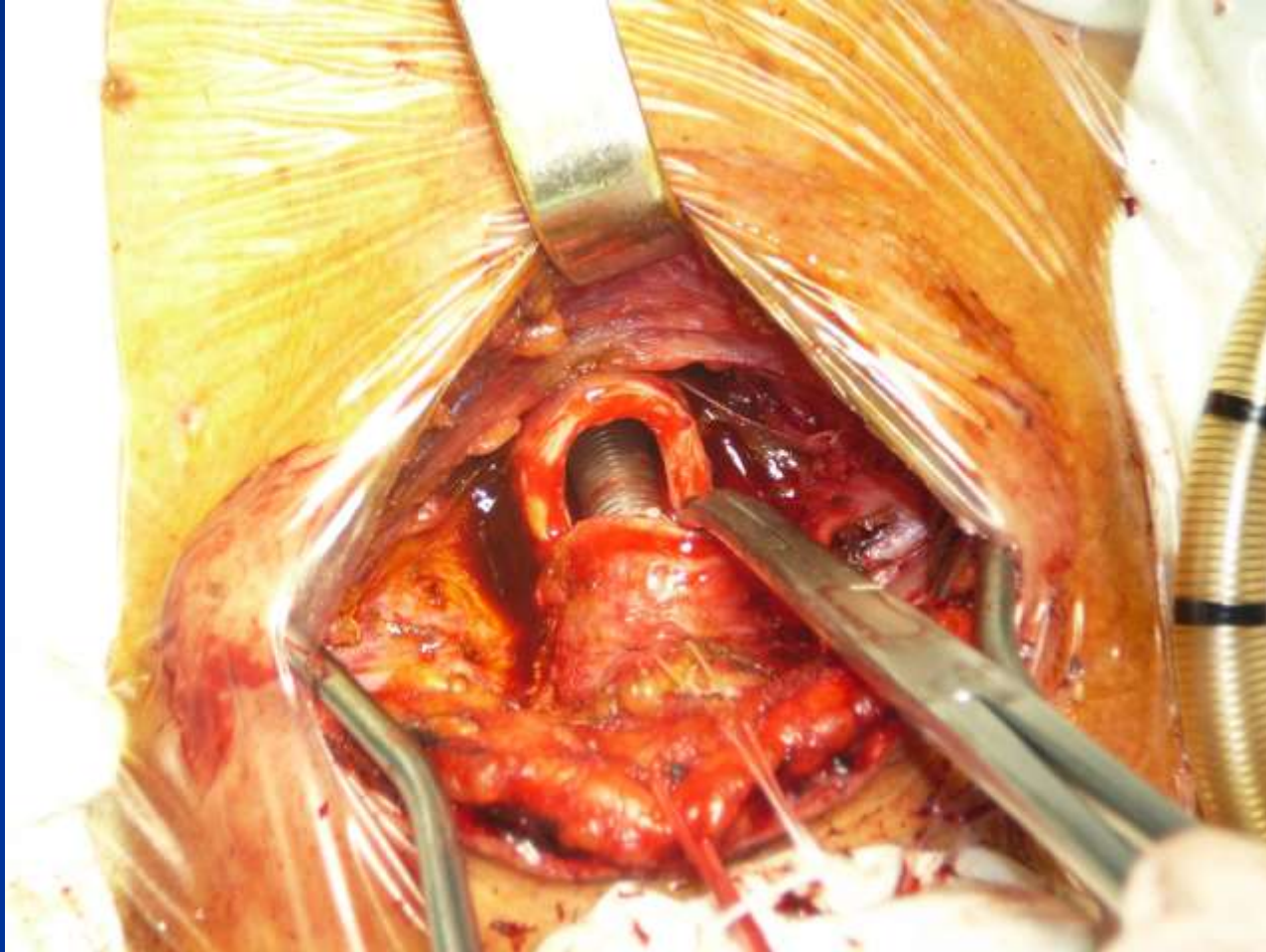
or

3. **Tracheosthomy**

or

4. Laryngeal mask? (rare)

1. Transstenotic intubation with ETT flexometalic, long and with diameter $> 6\text{mm}$



2. High frequency jet ventilation (HFJV) with the catheter through proximal ETT above the stenosis

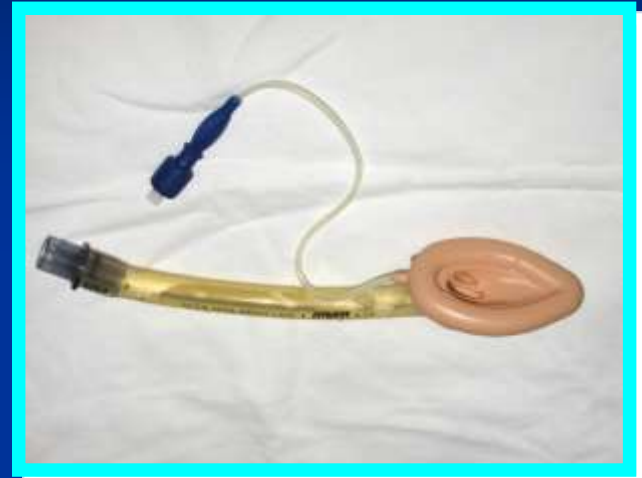


3. Tracheostomy



4. Laryngeal mask (LMA)

- Tigh and long stenosis
- Usually extrinsic stenosis (eg thyroid)
- Ventilation without ETT



Akai T et al, Laryngeal mask and tracheal stenosis, Anesthesiology, 1993 (letter)

Intra-anesthetic ventilation: second step

**Continue surgery with ventilation through the
transstenotic flexometalic ETT**

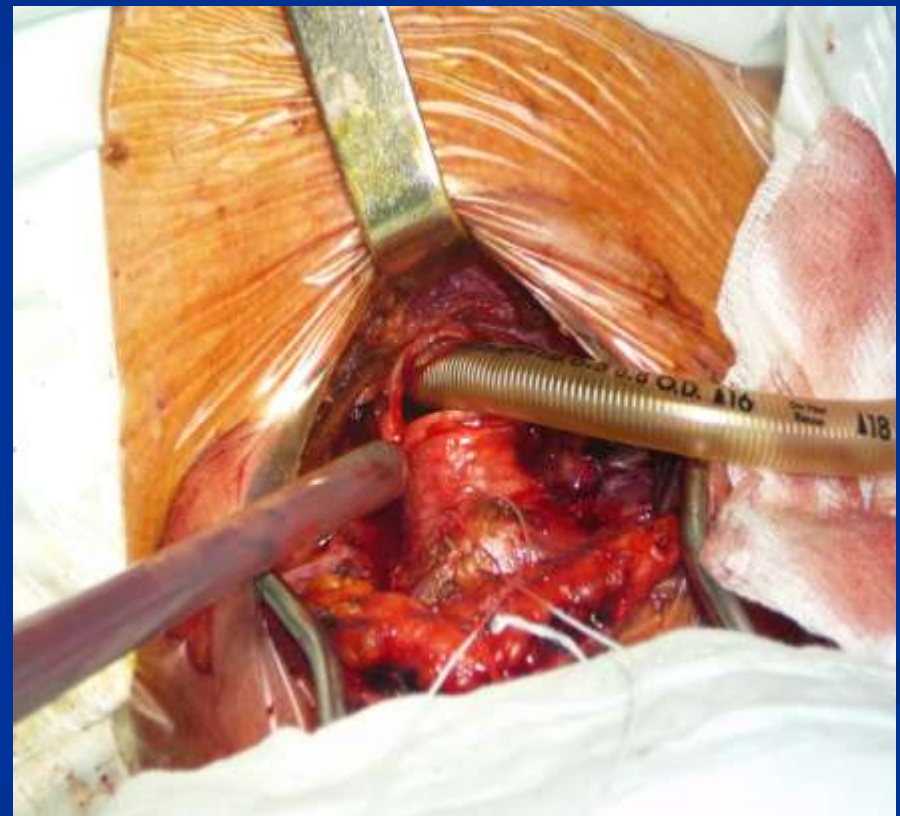
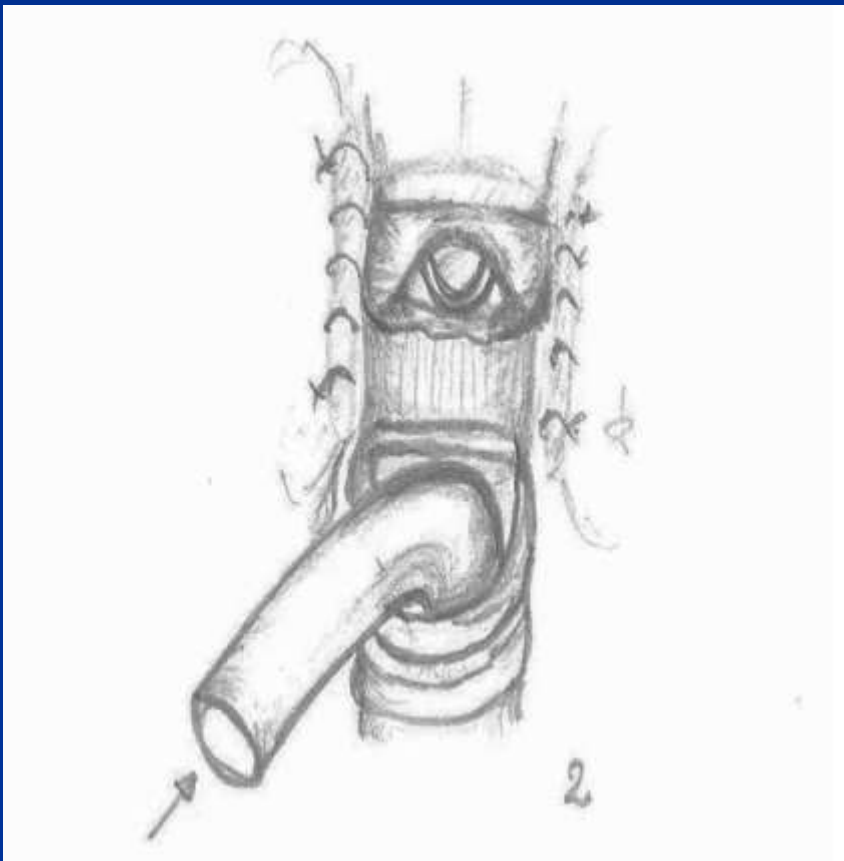
or

**Ventilation through distal intubation of
trachea or a main bronchus with a second
circuit ("cross-field") inserted by the surgeon**

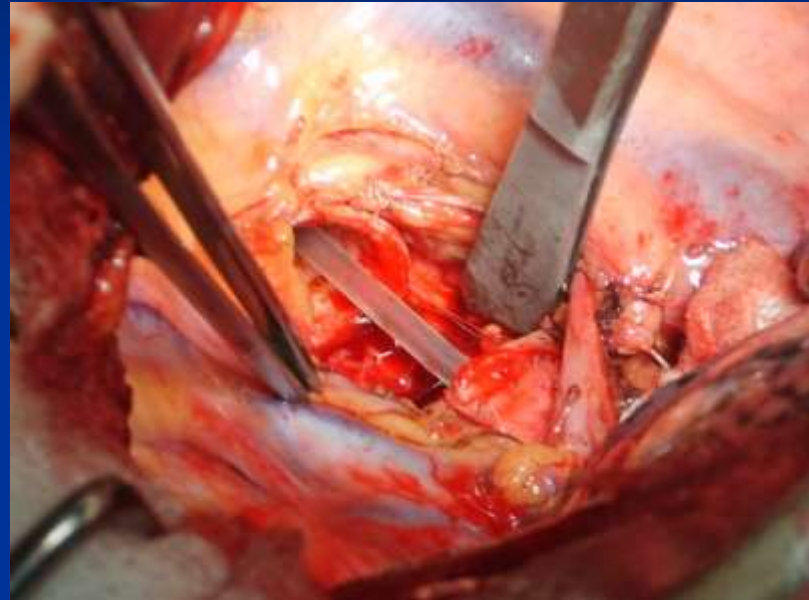
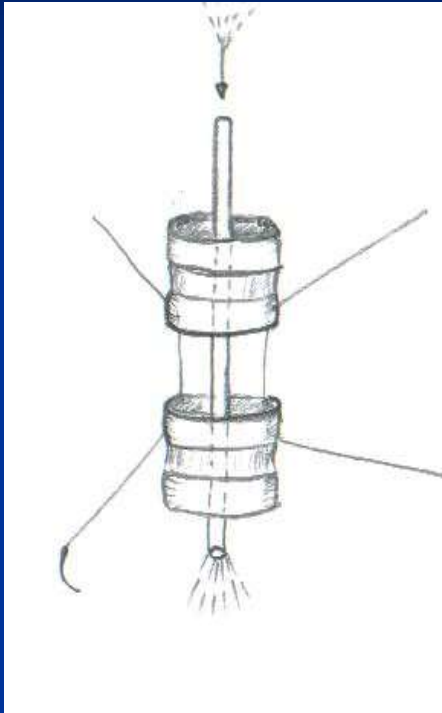
or

Continue surgery around the HFJV catheter

Ventilation through the distal intubation of trachea or a main bronchus with a second circuit (cross-field) inserted by the surgeon



Or continue surgery...

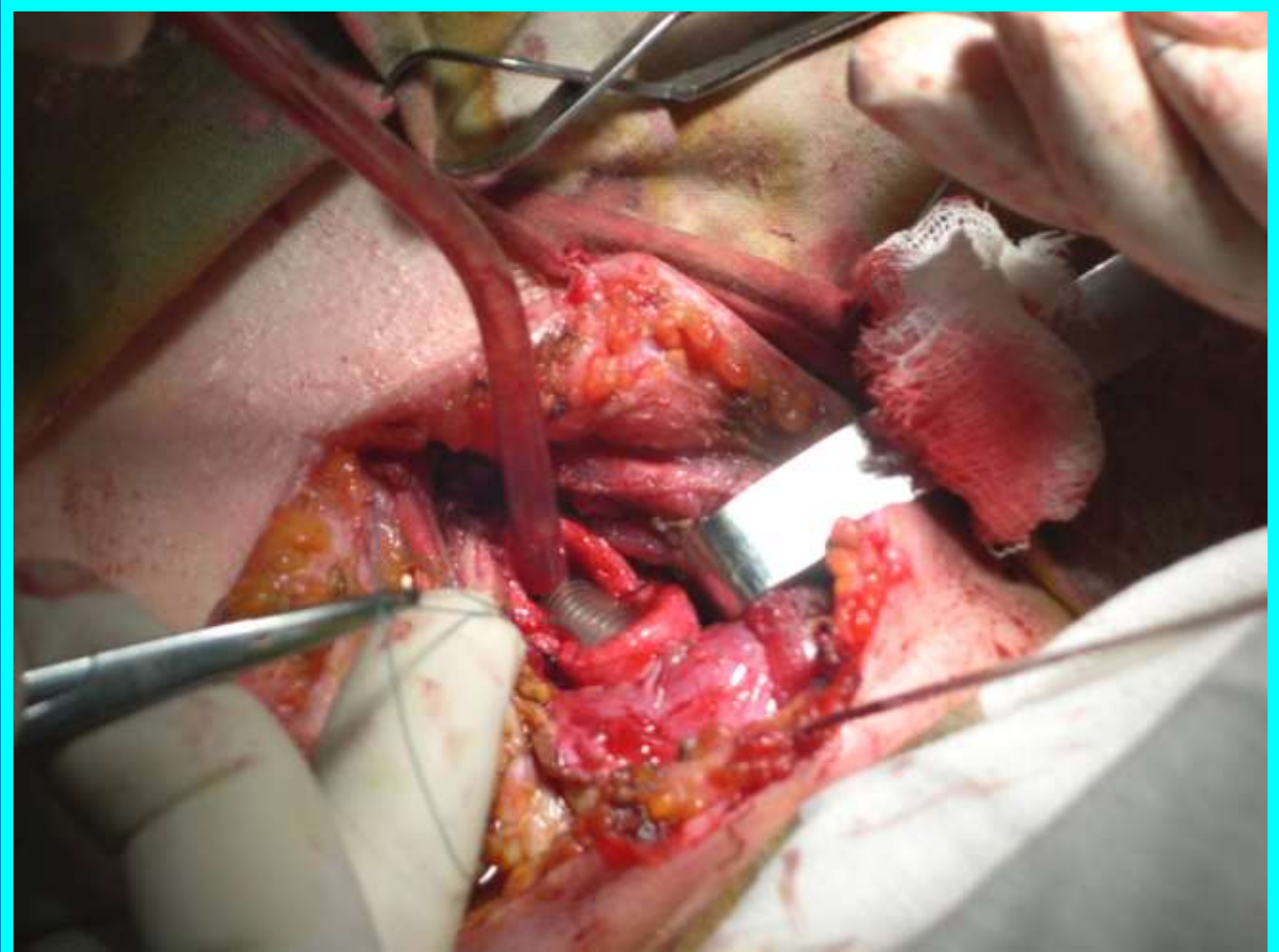


HFJV catheter through flexometallic ETT supra-stenotic inserted

HFJV

- HFJV catheter inserted through initial ETT
- Frequency de 100-140 RR/min
- General intravenous anesthesia
- After final tracheal anastomosis jet catheter is thrown out and ventilation continue with initial ETT

Third step: Ventilation through the oro-tracheal ETT (before end of surgery)



Post intubation stenosis surgical resection



Ioan Cordos, Radu Stoica, Ruxandra Ulmeanu 2006

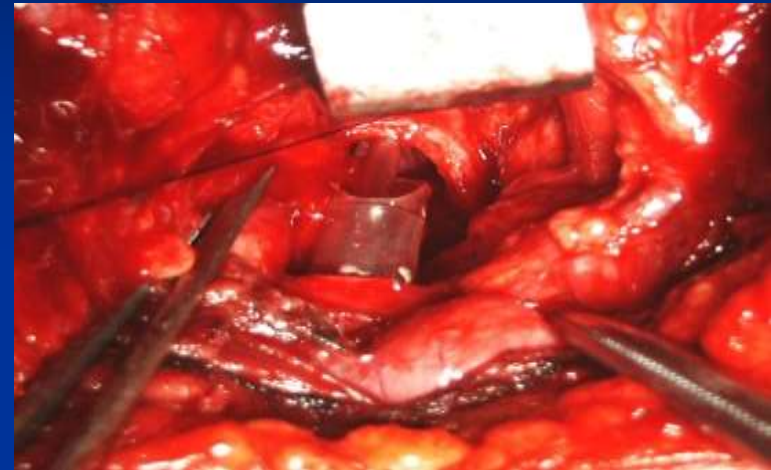


Ioan Cordos, Radu Stoica, Ruxandra Ulmeanu 2008

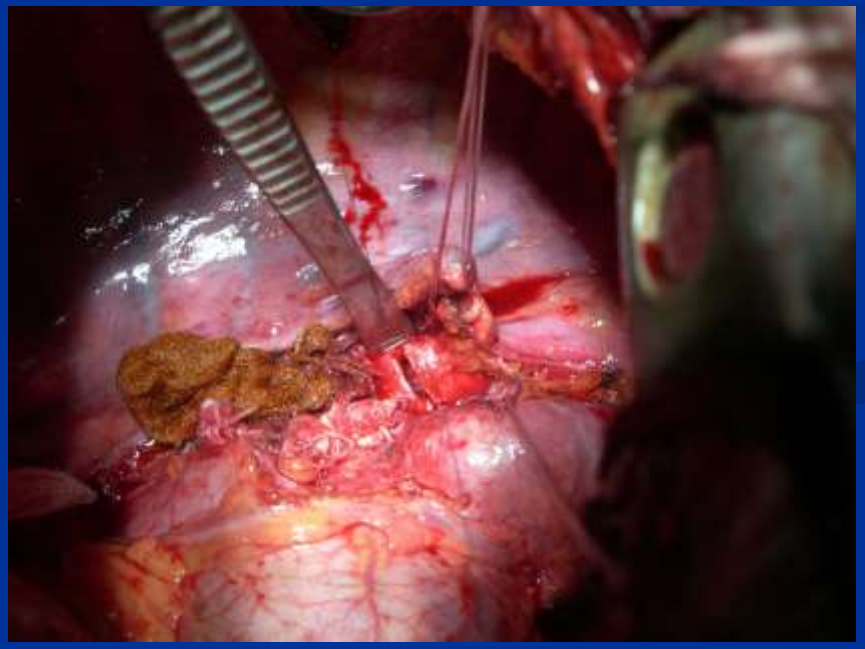
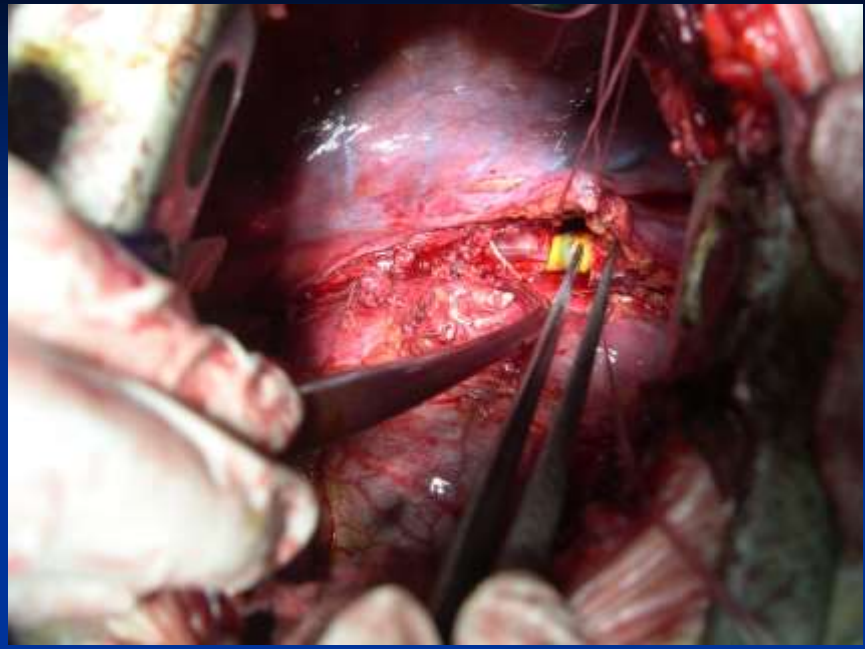
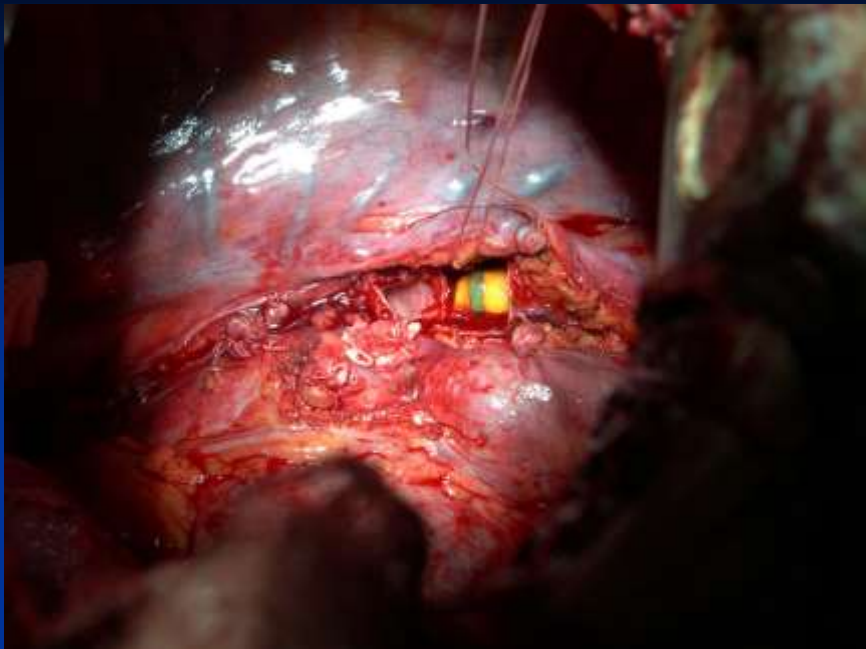
Distal Tracheea

1. Traheal resection proximal to the lesion: ETT (Left DLT?)
2. "Cross-field" left main bronchus intubation or
3. *Alternative HFJV! (until PPA ligature)*
4. Carinal resection and Pneumonectomy (short apnea period!)
5. Tracheal anasthosis to main right or left main bronchus (around HFJV catheter)
6. Ventilation through initial ETT
7. Extubation in OR in cervical approach

Resection with reconstruction of the carina (sequence of ventilation)



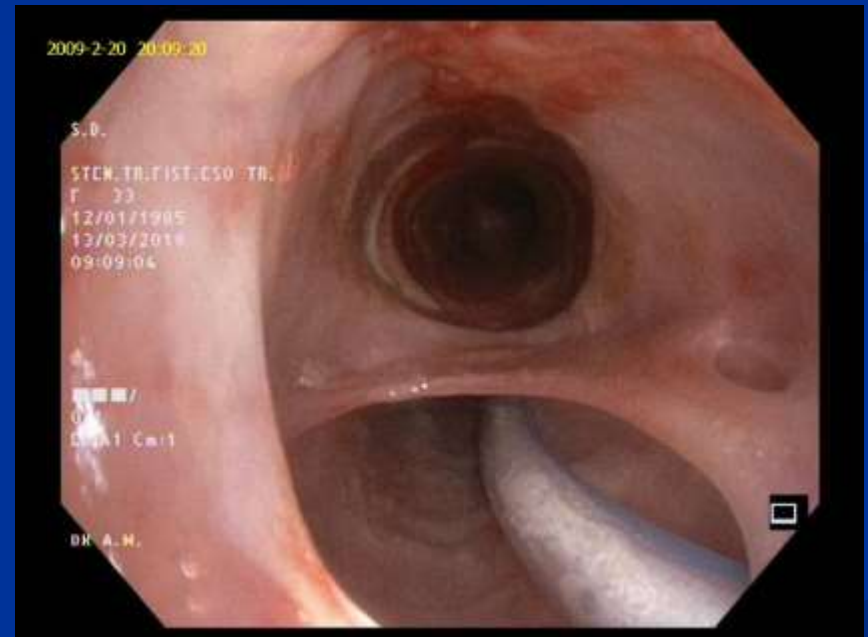
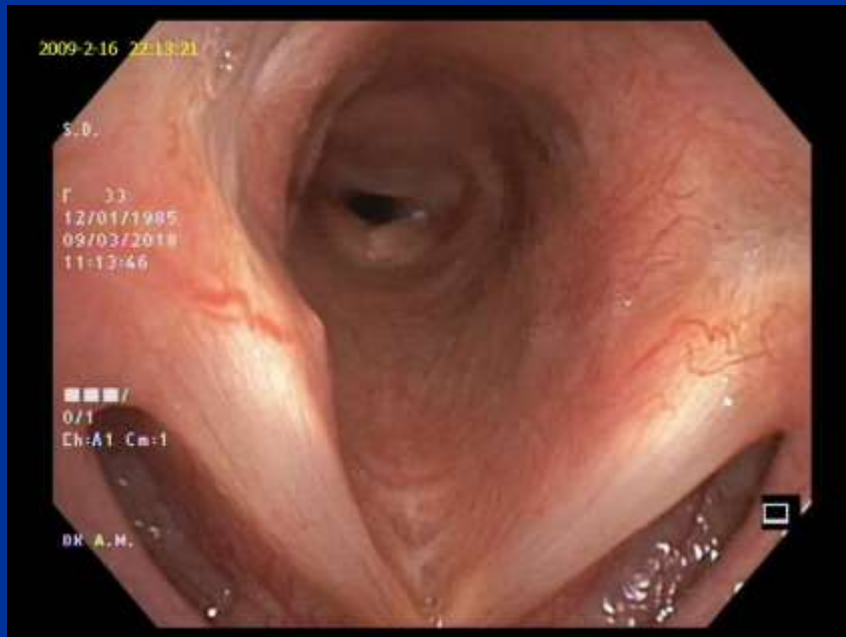
- Left selective intubation with DLT
- HFJV of the left lung through the DLT
- DLT ventilation with bronchial cuff in tracheal position



Eso-tracheal fistula. Tracheal resection 1

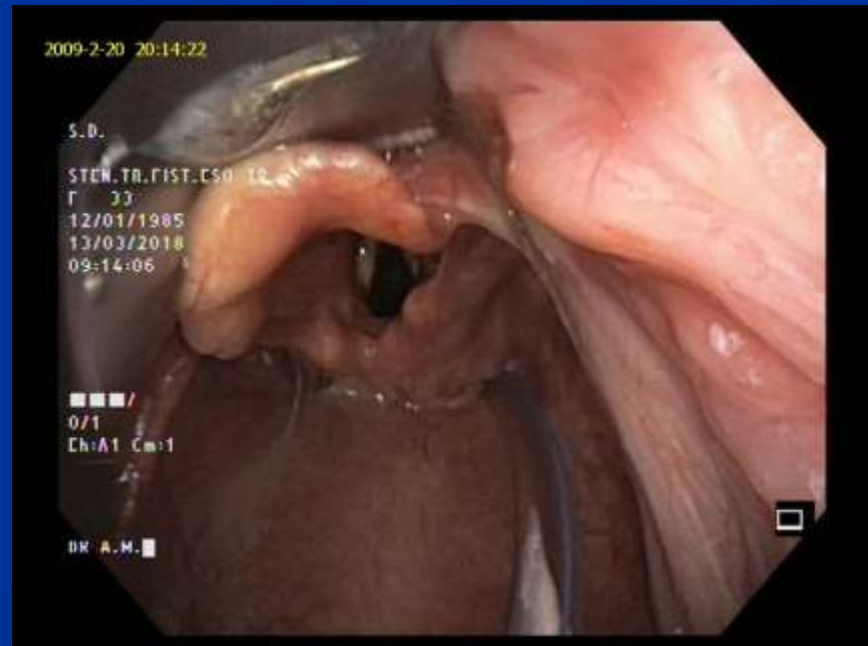
Subglottic stenosis

Eso-tracheal fistula



Eso-tracheal fistula. Tracheal resection 2

- Rigid bronchoscopy with widening of the stenosis (from 5mm to 9mm) on HFJV
- ETT above tracheostomy
- „Cross-field” ventilation distal to the fistula
- Finally: after tracheal resection, anastomosis and ventilation through the initial ETT



Eso-tracheal fistula. Tracheal resection 3

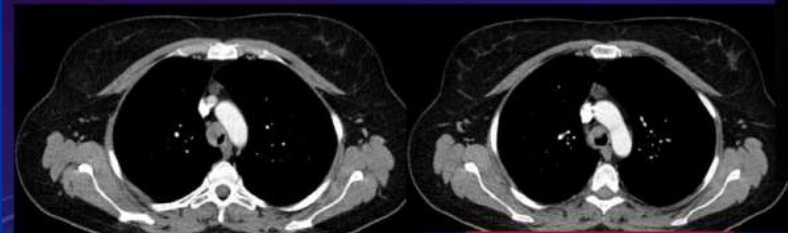
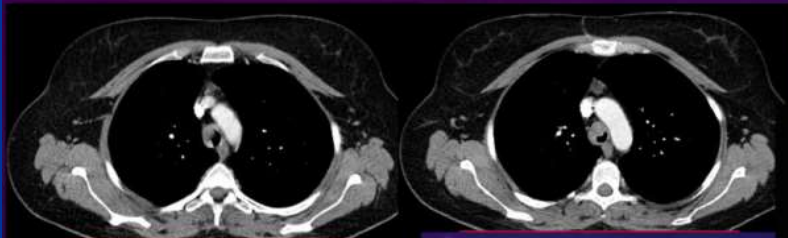
- Initial ventilation: tracheostomy
- Flexometalic oro-tracheal tube inserted above tracheostomy
- “Cross field ventilation”
- Finally: after tracheal resection , anasthomosis and ventilation through oro-tracheal tube

Lower tracheal and carinal resection

PATIENT DATA

- 39-year old patient
- Smoker and professional exposure to metal dust and toxic chemicals
- Admission for low effort dyspnea, cough, suffocation fear.
- Normal FVC value with reduced FEV1 shows airway obstruction
- Lower tracheal stenosis, last 6 cartilages above the carina
- Endoluminal **tracheal mass** with large base of implantation, between cartilages 3 and 5 above the carina
- Post-op HP findings show tracheal adenoid cystic carcinoma

CT AND BRONCHOSCOPIC ASPECTS



2007.9.23 19:26:30

44223
B.A.M.

CARC. ADENOID TB.
F 39
19/12/1976
19/10/2016
14:08:18

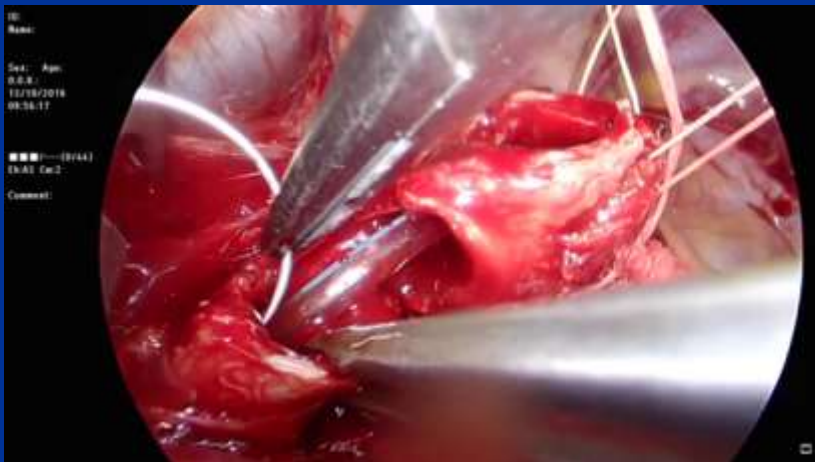
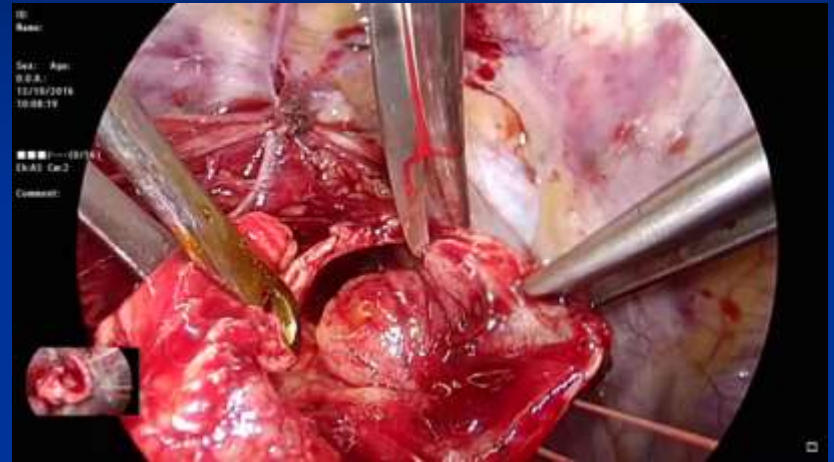
醫師/

O/T

CK/AT, Ca 1

DR. A.M. 醫





The more distant the stenoses are...

Difficulties and ventilation challenges are greater!!

Results

“...Resection and reconstruction of trachea in the hand of a competent surgeon has good results in more than 93% of cases, with a rate of recurrence of 3,9% and a mortality rate of 2,4%...”

(Wain JC, Chest Surg Clin N Am. 2003 13(2):231-46)

Take away...



- Be well prepared: logistics and skills...
- Most important challenges: ventilation in any moment and hipoxemia...



- Try to recover from anesthesia in the OR

And...

Don't forget: it's a team work with perfect coordonation!

