

**CURRENT PLACE OF
BRONCHOSCOPY
IN THE DIAGNOSIS OF PULMONARY
DISEASES**

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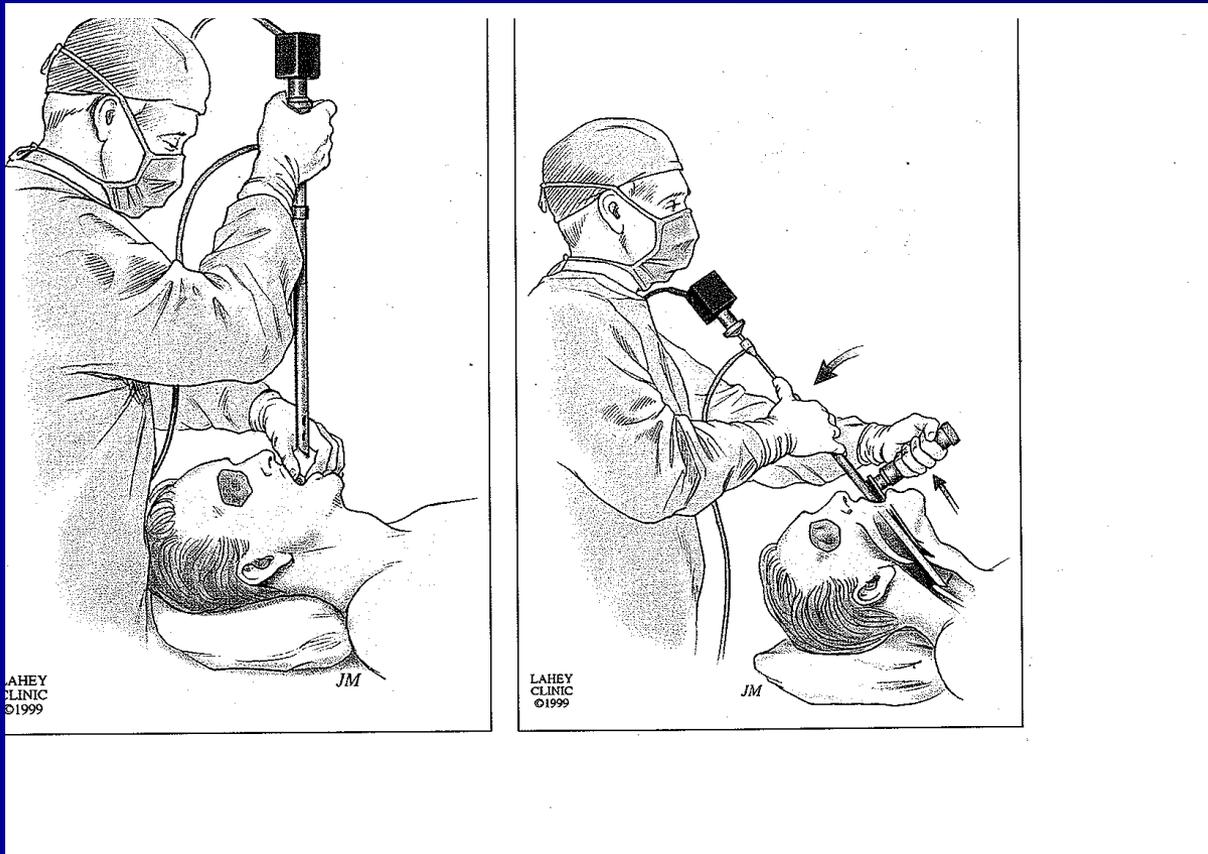
father of bronchoscopy

- **1897** – removal of a rabbit bone from the right main bronchus in a Schwarzwald lumberman
- *"I think I've made an important discovery... bronchoscopy will be essential not only for removal of foreign bodies and evaluation of bronchial disease, but also for diagnosis and treatment of pulmonary diseases."* - Heidelberg congress, **1898**

One of the earliest bronchoscopies



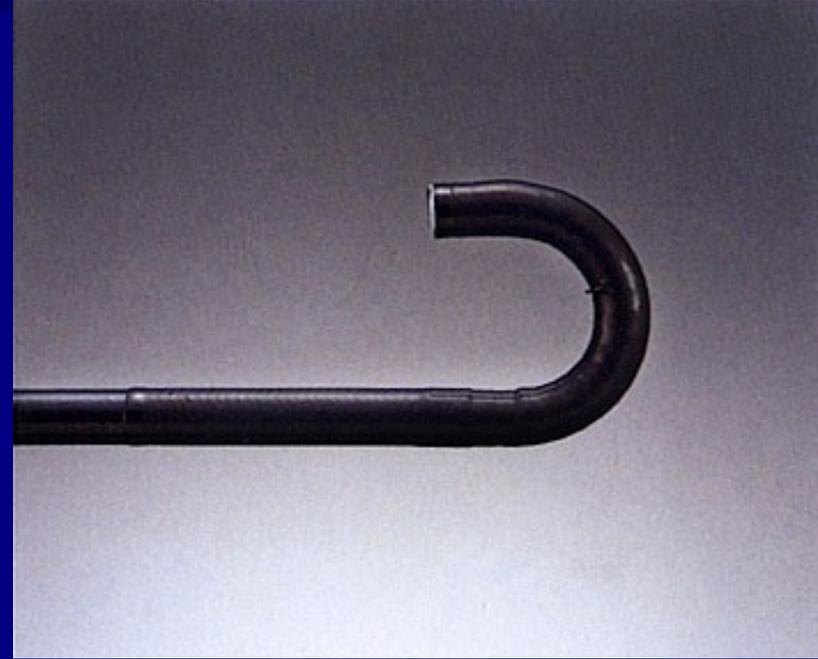
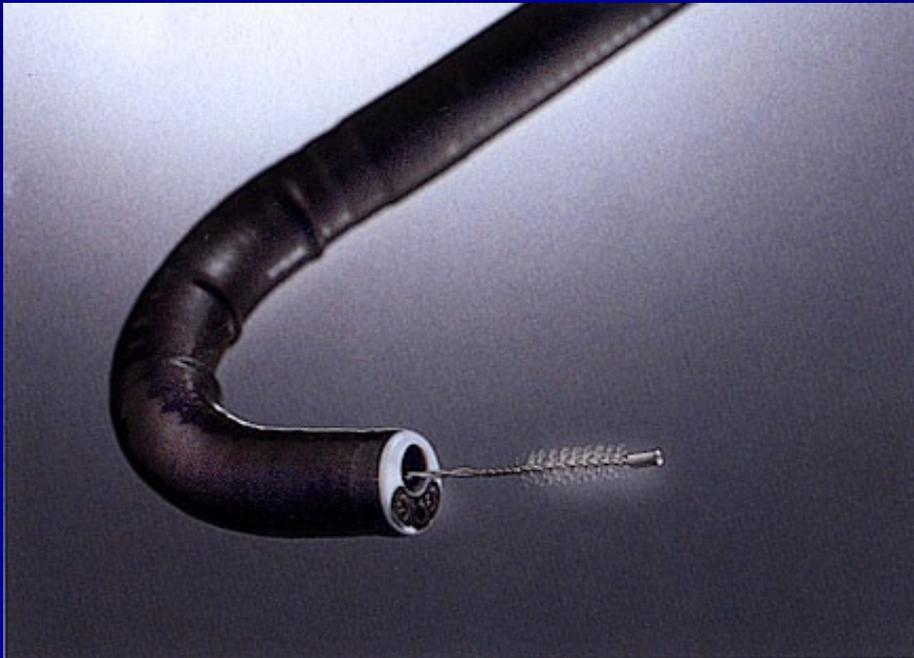
RIGID BRONCHOSCOPY



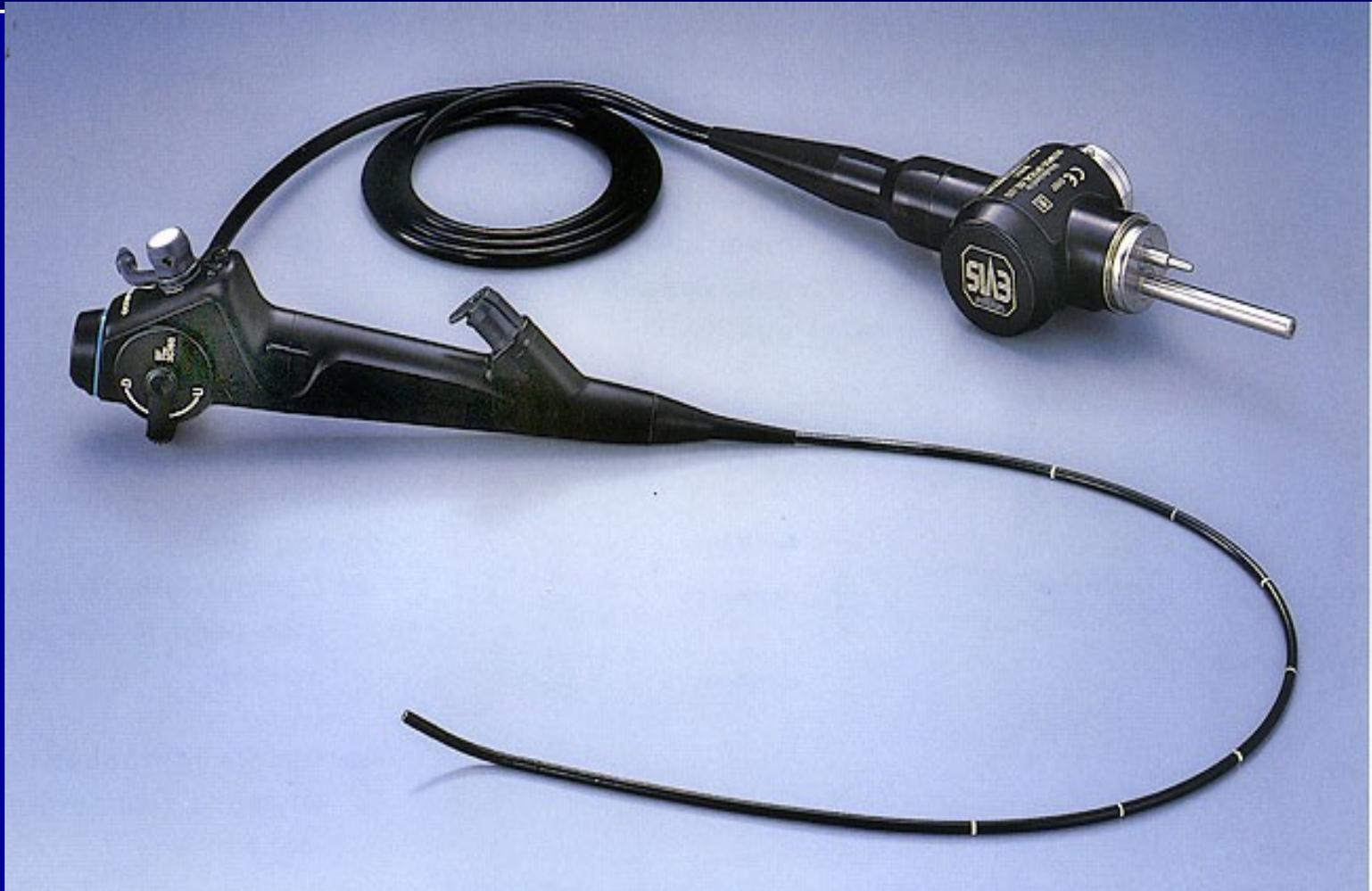
FLEXIBLE BRONCHOSKOPE with a protruding forceps



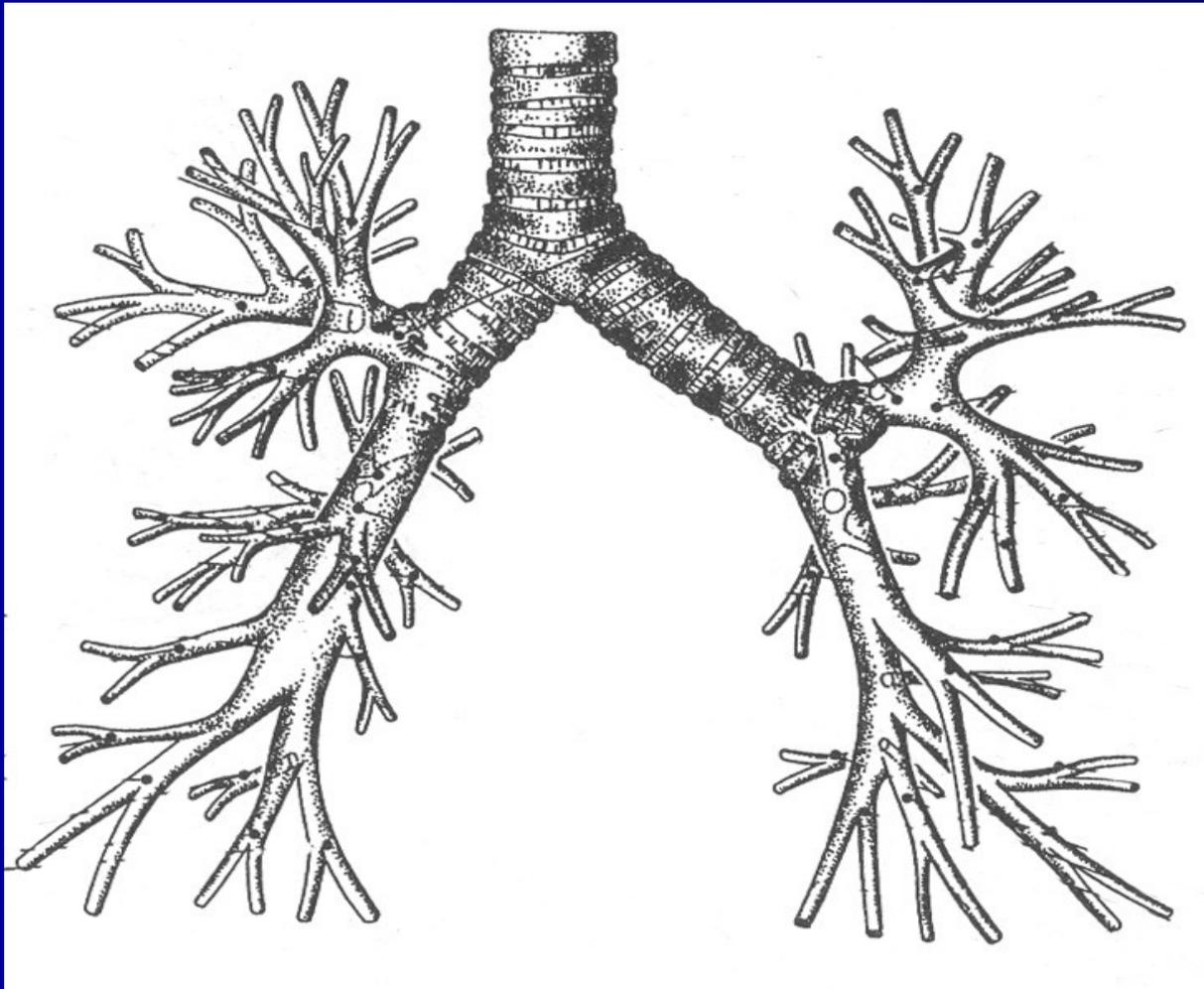
THE TIP OF THE FLEXIBLE BRONCHOSCOPE with protruding brush



VIDEOBRONCHOSCOPE



BRONCHIAL BRANCHING



DIAGNOSTIC BRONCHOSCOPY

- Establishing **diagnosis in primary and secondary tumours**, treatment decisions
- Diagnosis of **infectious complications**
- Diagnosis of **interstitial pulmonary diseases** and **sarcoidosis**
- Diagnosis of treatment complications
- Differential diagnosis of COPD and asthma (under certain circumstances)
- Symptoms with unknown etiology – cough, dyspnea, unilateral auscultatory finding, hemoptysis...
- Suspect trauma or communication

CONTRAINDICATIONS of DIAGNOSTIC BRONCHOSCOPY

- Critical state of the patient – knowledge of etiology would neither help proper treatment nor delay death
- Bleeding not manageable with relevant treatment
- Recent myocardial infarction
- Severe or recent heart rhythm disorders
- Hypoxemia $<6\text{kPa}$ despite oxygen treatment

RELATIVE CONTRAINDICATIONS OF BRONCHOSCOPY

- Bronchial obstruction, bronchial hyperreactivity, unstable angina pectoris, uremia

In polymorbid patients, continuity with acute labs, cardiology, ICU, inhalation, monitoring, availability of necessary drugs and tools is essential.

Measures recommended when performing bronchoscopy

- Heart rhythm monitoring with a cardiac monitor
- Continual monitoring of oxygen saturation using pulse oximeter
- Coagulation status – prior to therapeutic procedures and biopsy

CHOICE OF BRONCHOSCOPE – RIGID x FLEXIBLE

- Diagnostic bronchoscopy – mostly flexible
- Character of the x-ray finding (suspicion of lymph node involvement) – rigid bronchoscopy
- A larger sample necessary – rigid
- Bronchoscopist, nurse, rigid instrument set available, sufficient experience (number of procedures), anaesthetist available, ICU bed available

CHOICE OF BRONCHOSCOPE – **RIGID x FLEXIBLE**

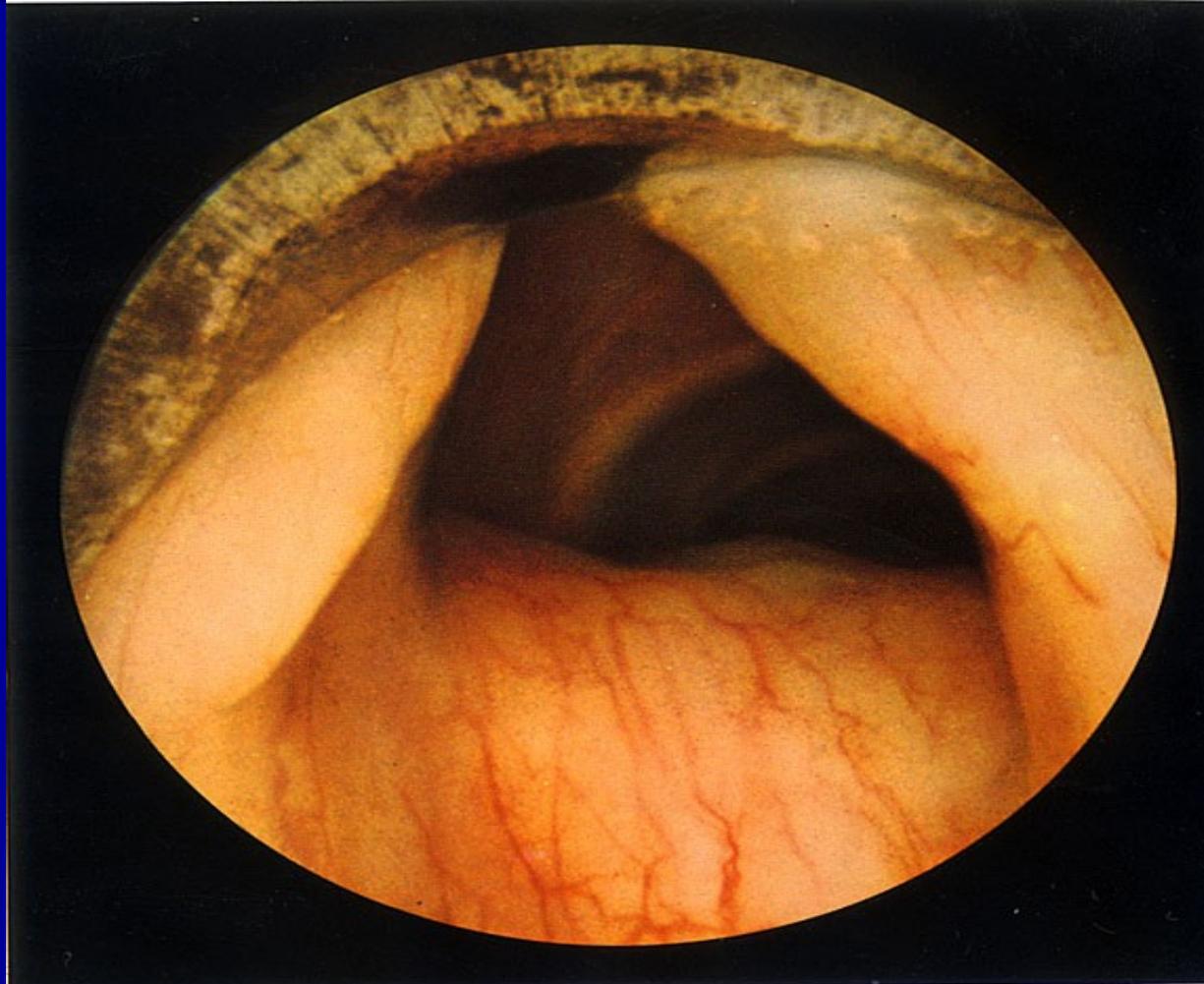
- Therapeutic bronchoscopy – rigid
- Rigid bronchoscopy – patient positioning in recumbent position
- Flexible – recumbent or sitting depending on the usage and the planned procedure)

Bronchoscopist, nurse, rigid instruments set available, sufficient experience with rigid bronchoscopy (number of procedures), anaesthetist available, ICU bed available

MATERIAL SAMPLING DURING RIGID BRONCHOSCOPY

- **Forceps biopsy** – larger amount of material
- **Transbronchial needle aspiration** from lymph nodes and lesions outside the airway wall
- **Lavage**

RIGID BRONCHOSCOPE ADVANCING THROUGH THE GLOTTIS BETWEEN THE VOCAL CORDS



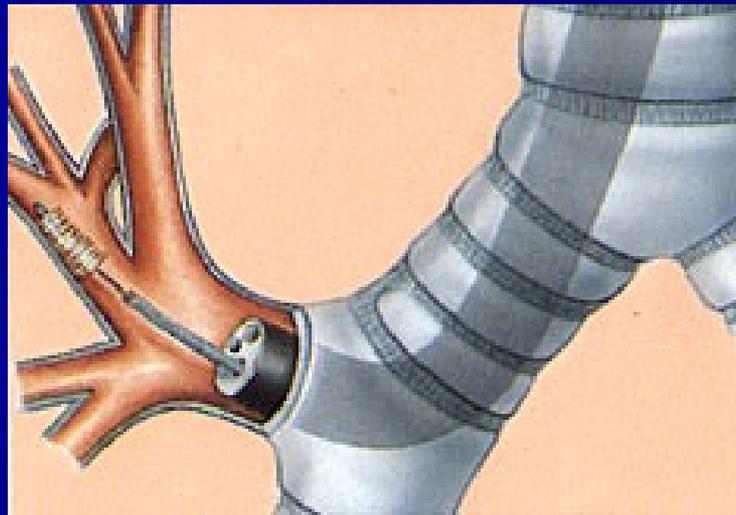
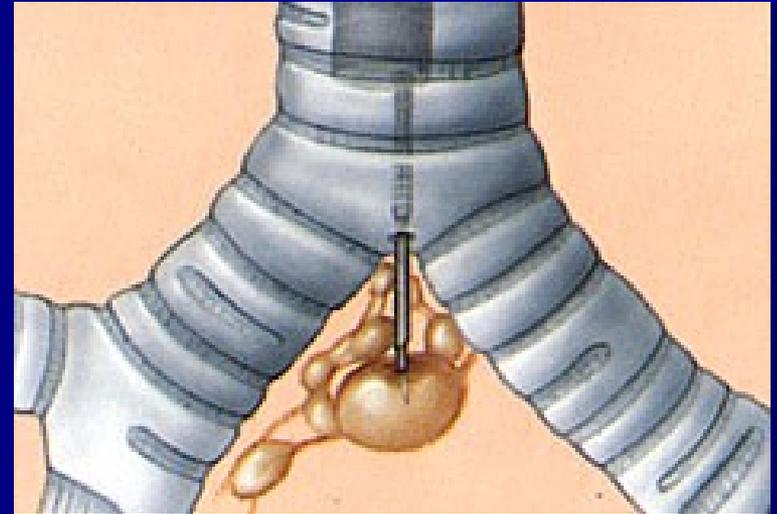
SAMPLING OF MATERIAL IN THE COURSE OF FLEXIBLE BRONCHOSCOPY

- ❑ **Forceps biopsy (excision)** – endobronchial growth, mucosal infiltration
- ❑ **Transbronchial lung biopsy** – from the periphery of bronchial tree, under radiography guidance, multiple samples
- ❑ **Cryobiopsy**
- ❑ **Brush biopsy (brushing, abrasion)**
- ❑ **Transbronchial puncture** – extramural pressure – lymph nodes, other pathologic process
- ❑ **Sufficient accessories, mobile x-ray, topical radiographic documentation (electronic...)**

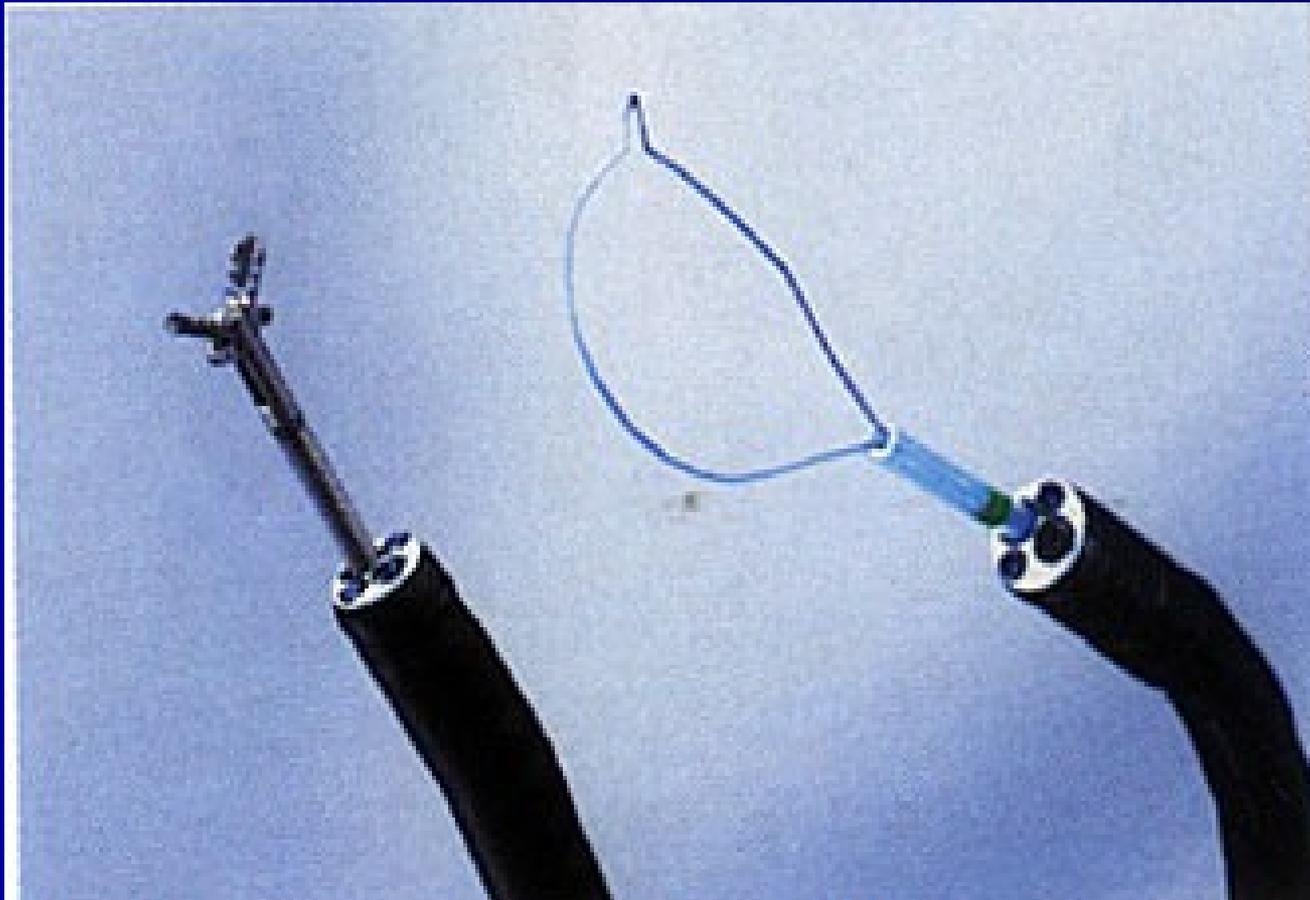
SAMPLING OF MATERIAL IN THE COURSE OF FLEXIBLE BRONCHOSCOPY

- ❑ Punction of the tumour
- ❑ Aspiration with plastic catheter
- ❑ Bronchial lavage (10 - 20 ml) – optionally after brush abrasion
- ❑ Bronchoalveolar lavage – optionally following brush abrasion (150 ml and more)
- ❑ Accessories, laboratory background, knowledge of the procedure and interpretation

SAMPLING OF MATERIAL IN THE COURSE OF FLEXIBLE BRONCHOSCOPY IN A SETTING OF SUSPICION OF CANCER



THE TIP OF FLEXIBLE BRONCHOSCOPE with ACCESSORIES (FORCEPS, LOOP SNARE)



INDICATION OF DIAGNOSTIC BRONCHOSCOPY ON SUSPICION OF LUNG CANCER

- Persistent cough, change in the character of cough
- Stridor
- Unexplained unilateral auscultatory finding
- Pathological finding on chest radiograph
- Persistent pneumothorax

Cooperating pulmonologist, general practitioner, internist, surgeon, intensivist...

INDICATION OF DIAGNOSTIC BRONCHOSCOPY ON SUSPICION OF LUNG CANCER

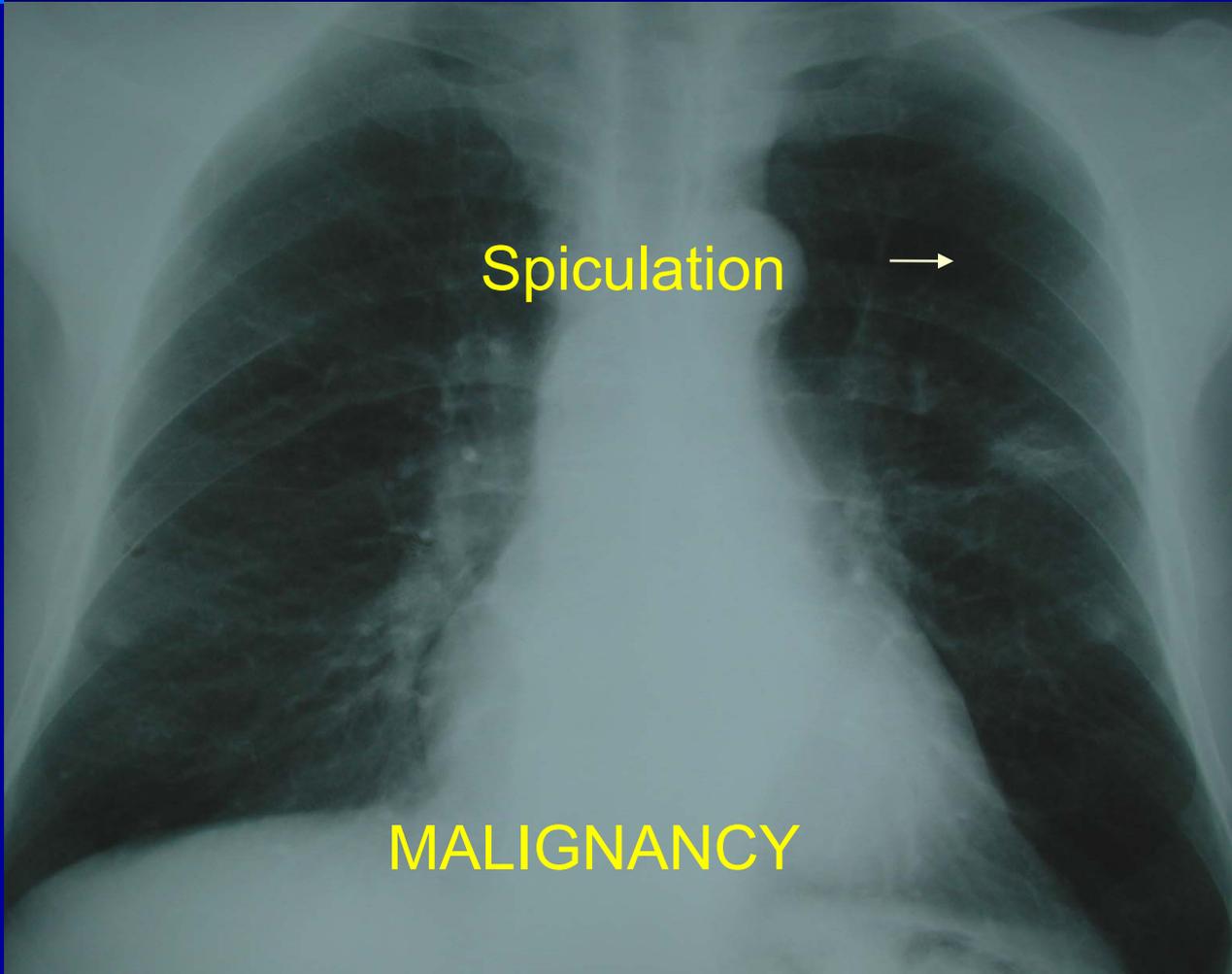
- Elevated diaphragm
- Hemoptysis
- Presence of malignant cells in sputum (chest radiograph being negative)
- Recurrent pneumonia in the same area

Cooperating pulmonologist, general practitioner, internist, surgeon, intensivist...

INDICATION OF DIAGNOSTIC BRONCHOSCOPY ON SUSPICION OF LUNG CANCER

- Superior vena cava syndrome
- Persistent hoarseness
- Persistent pain radiating into the upper extremity and neck
- New pulmonary symptomatology in the course of treatment
- Cooperating pulmonologist, general practitioner, internist, surgeon, intensivist...

PERIPHERAL TUMOUR



BRONCHIAL BRANCHING – NORMAL FINDING



SAMPLING OF MATERIAL IN CASE OF NORMAL ENDOSCOPIC FINDING IN A SETTING OF URGENT RADIOLOGIC SUSPICION OF CANCER

- **Brush abrasion** from the suspect area according to chest radiograph (lateral film indispensable, CT)
- **Aspiration**
- **Lavage**
- **BAL**
- **Radiologically guided transbronchial lung biopsy**
- **Transbronchial cryobiopsy**
- **EBUS**
- **Radial EBUS**
- **Acute radiodiagnostic examination (mobile x-ray)**

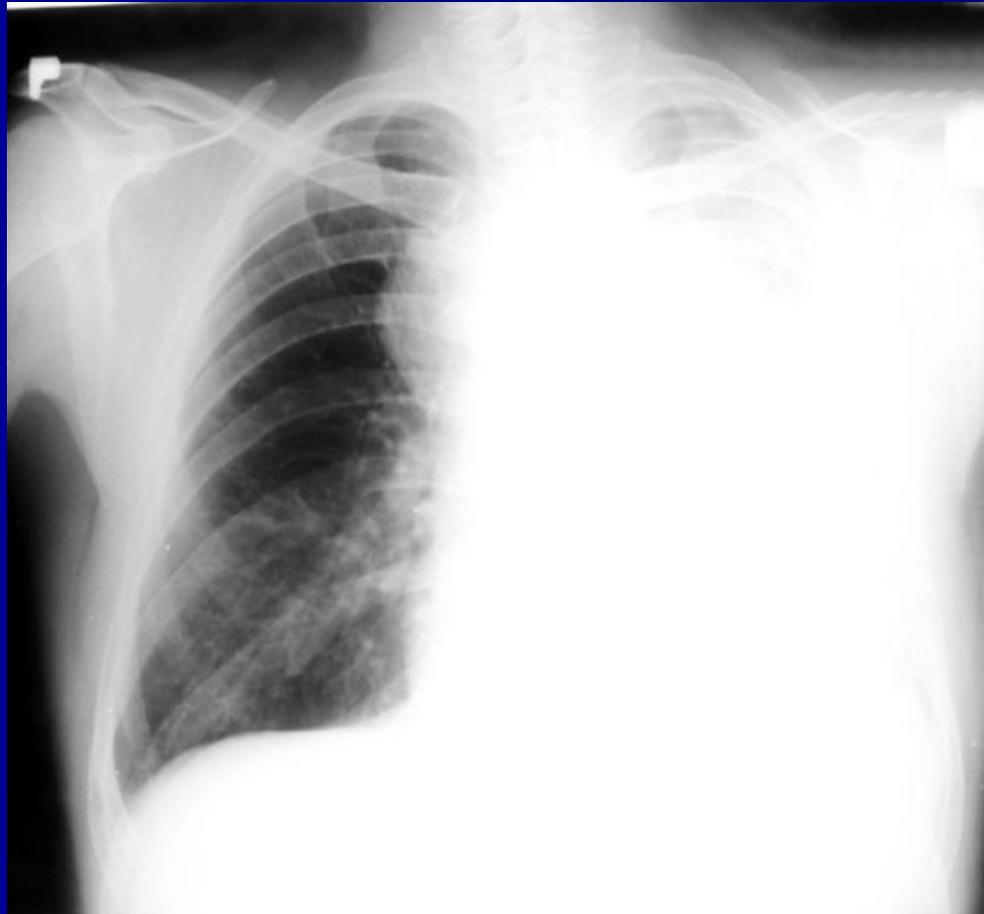
NSCLC (squamous cell carcinoma) of right lung's upper lobe



NSCLC (squamous cell carcinoma) of left lung's upper lobe



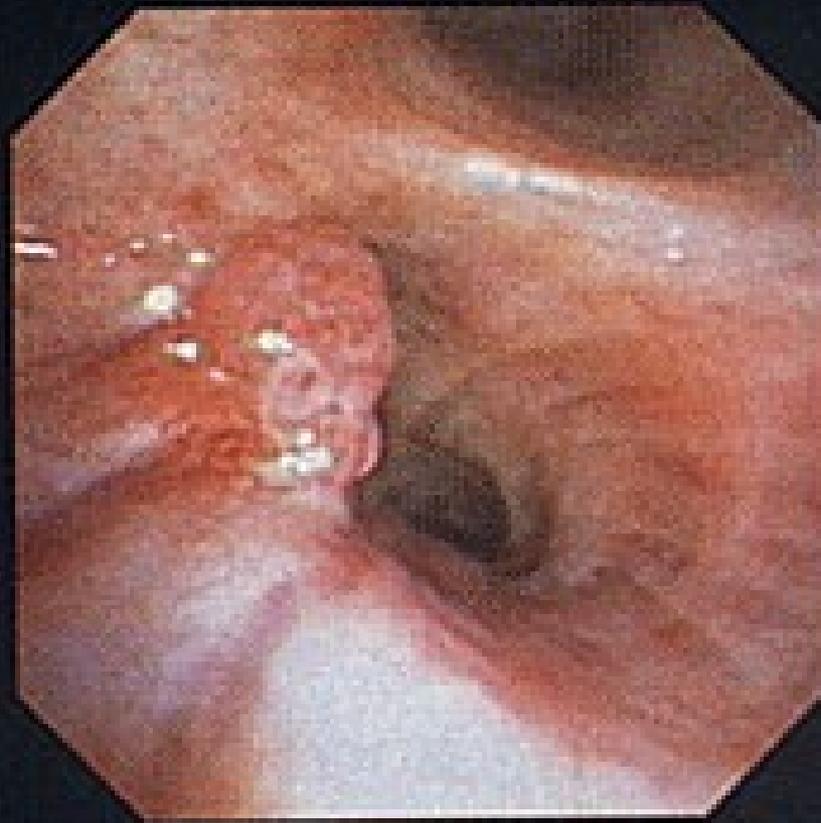
SMALL CELL CARCINOMA OF THE LEFT LUNG



BRONCHOSCOPIC SIGNS OF TUMOUR

- **Tumour formation** – puncture, excision, brushing, aspiration, lavage
- **Tumour granulation** – puncture, excision, brushing, aspiration, lavage
- **Circular, slot- or funnel-shaped bronchial stenosis** – puncture, attempt at excision, brushing, aspiration, lavage
- **Extramural compression of the airway** – transbronchial puncture
- Normal bronchoscopic finding

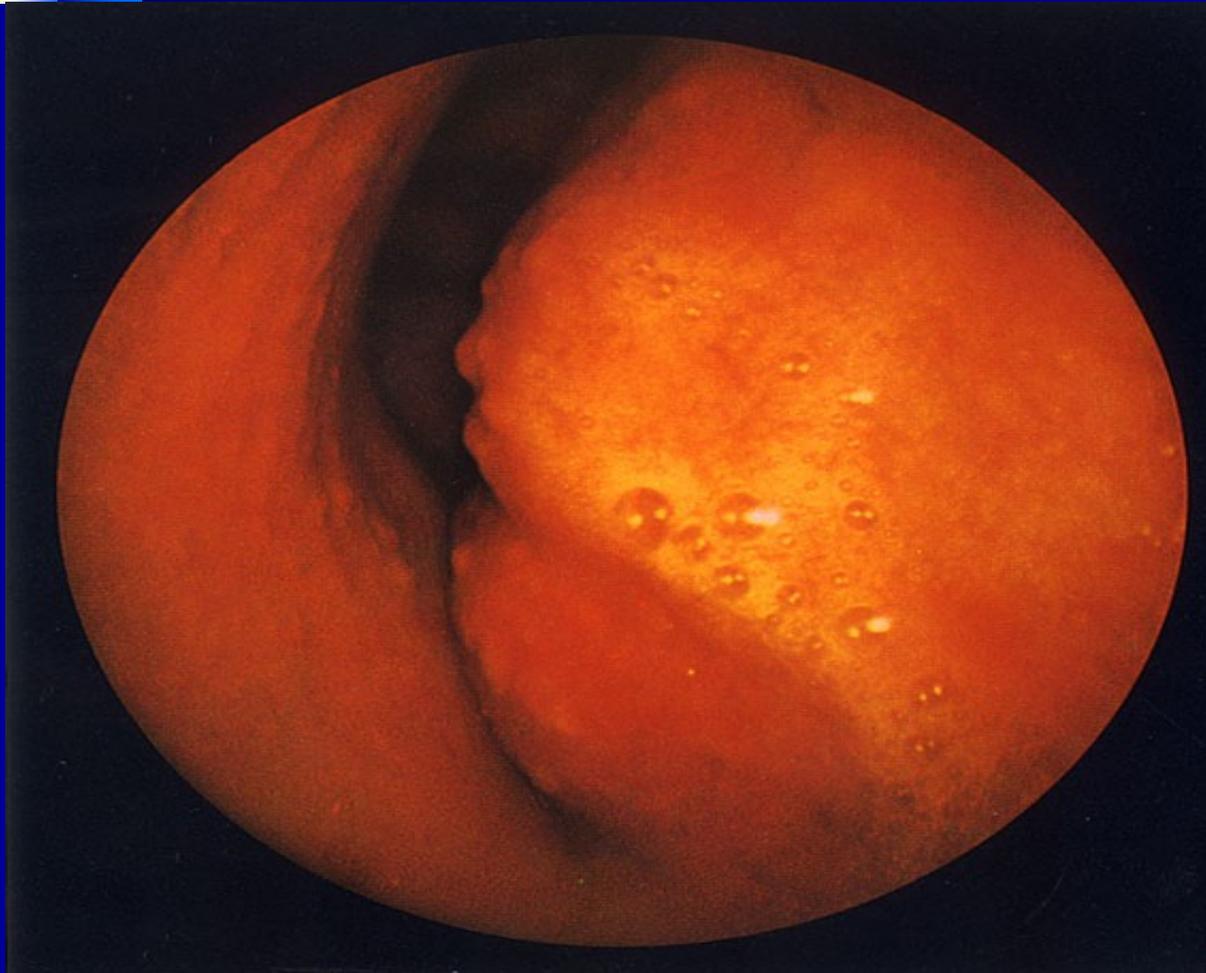
GRANULATION OF TUMOROUS ORIGIN



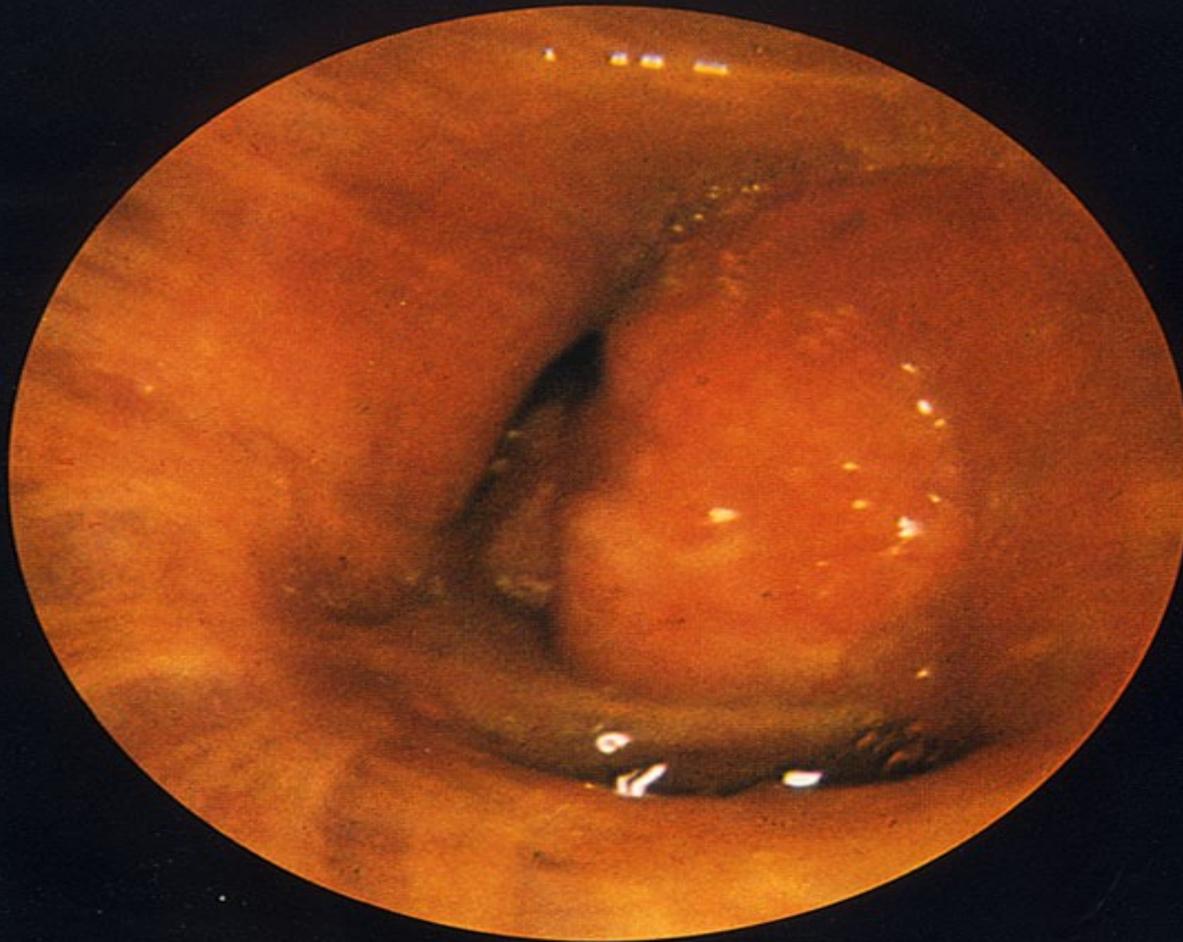
FORCEPS BIOPSY FOR HISTOLOGIC EVALUATION



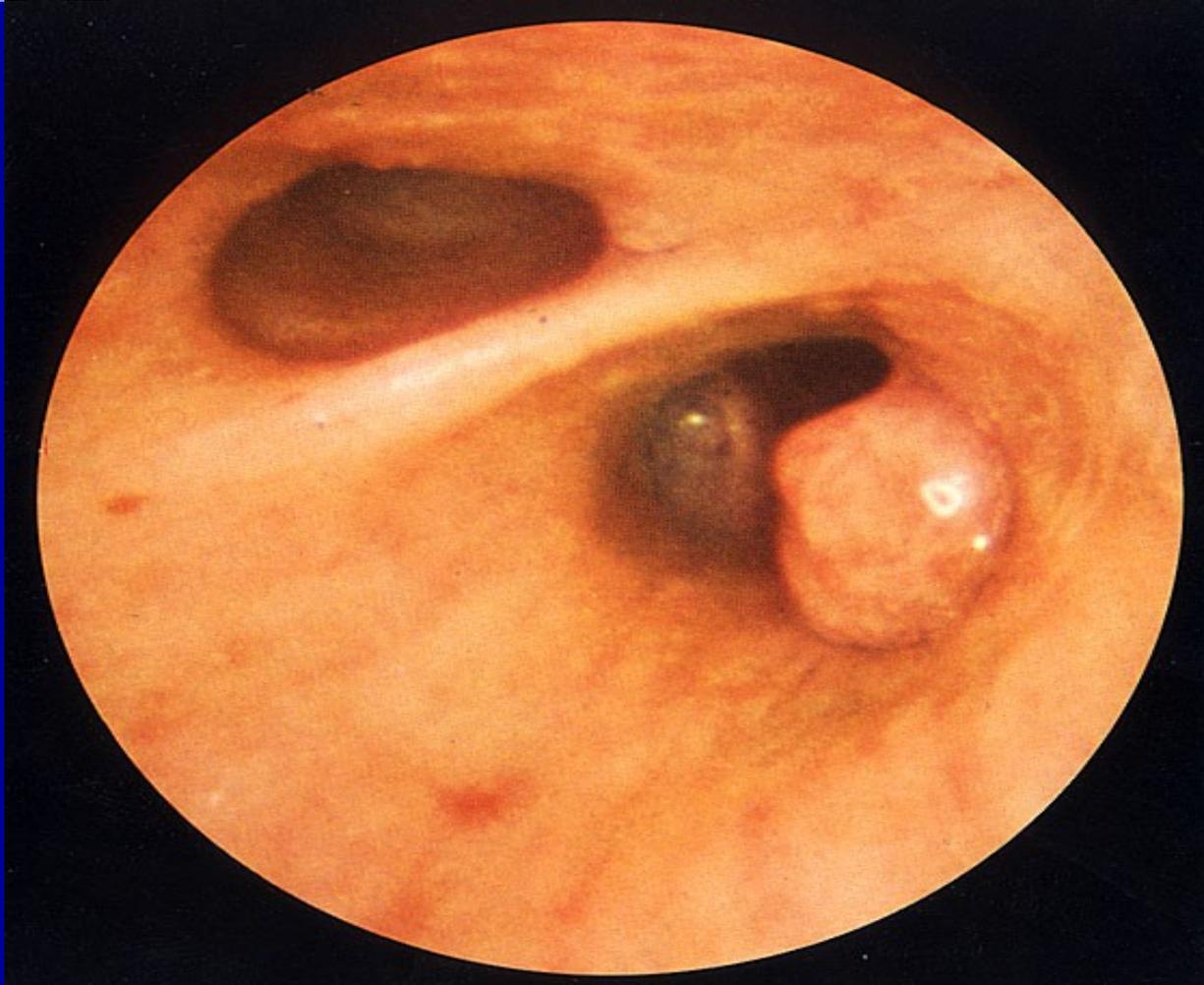
MOSTLY INDIRECT SIGNS OF TUMOUR



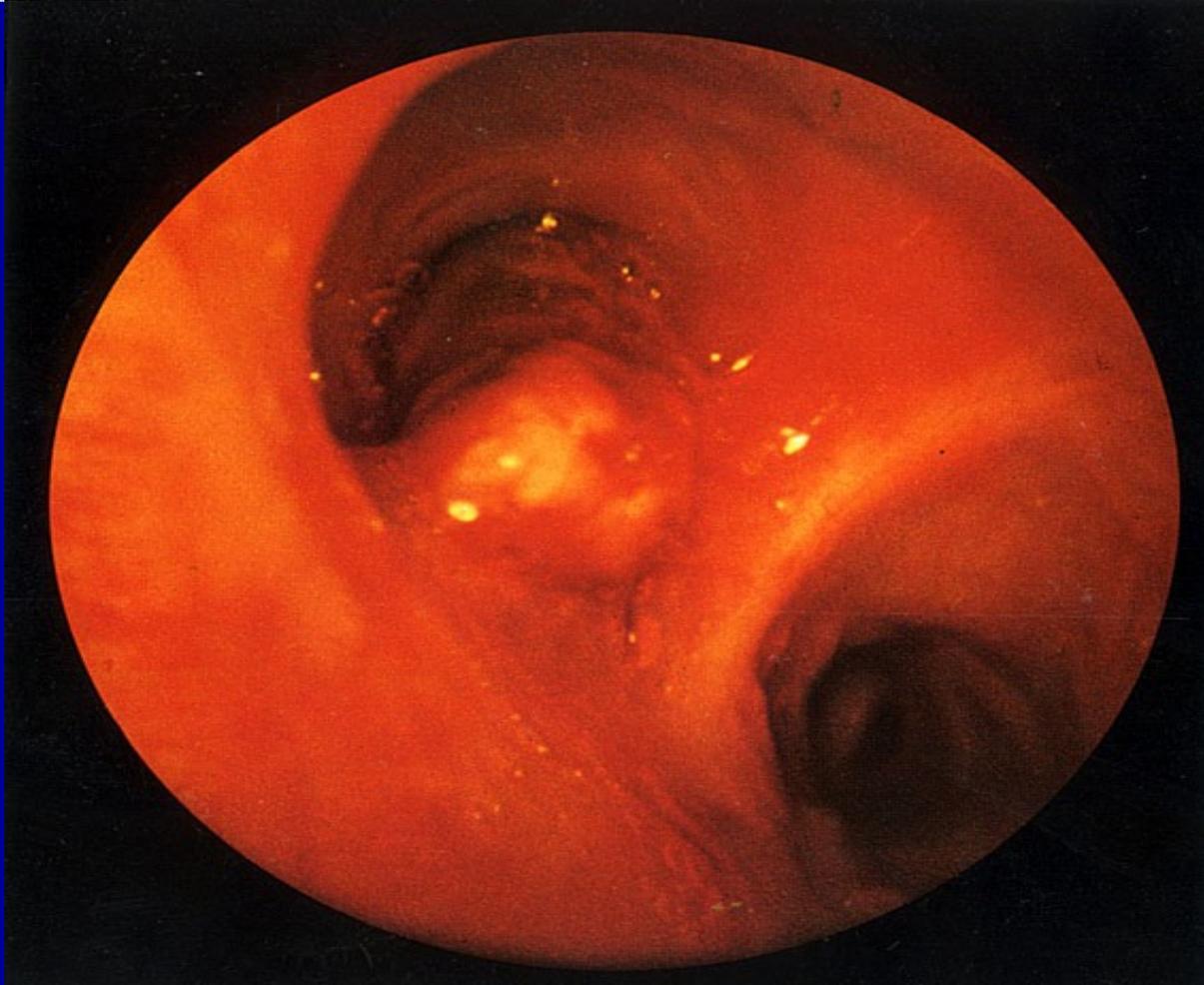
DIRECT AND INDIRECT SIGNS OF TUMOUR



DIRECT SIGNS OF TUMOUR



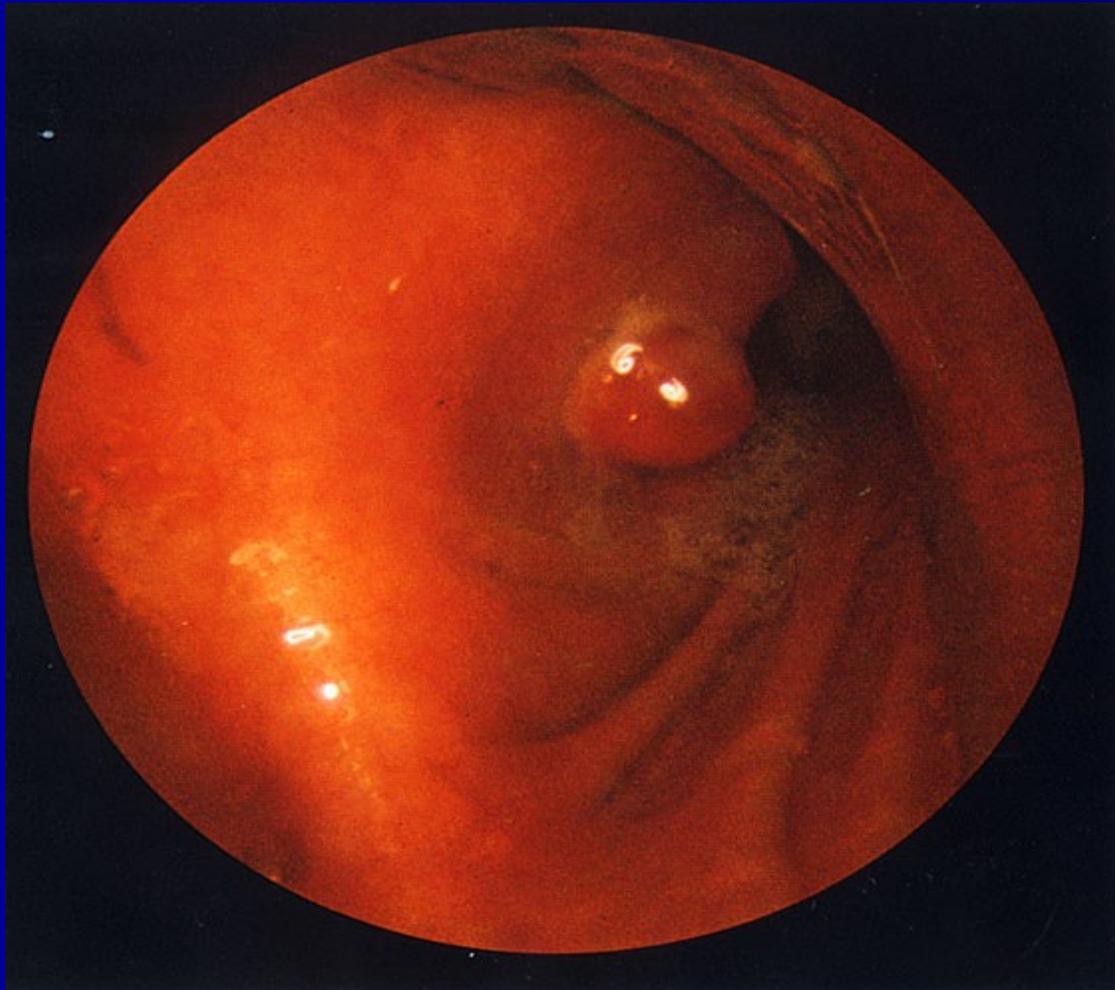
DIRECT SIGNS OF TUMOUR



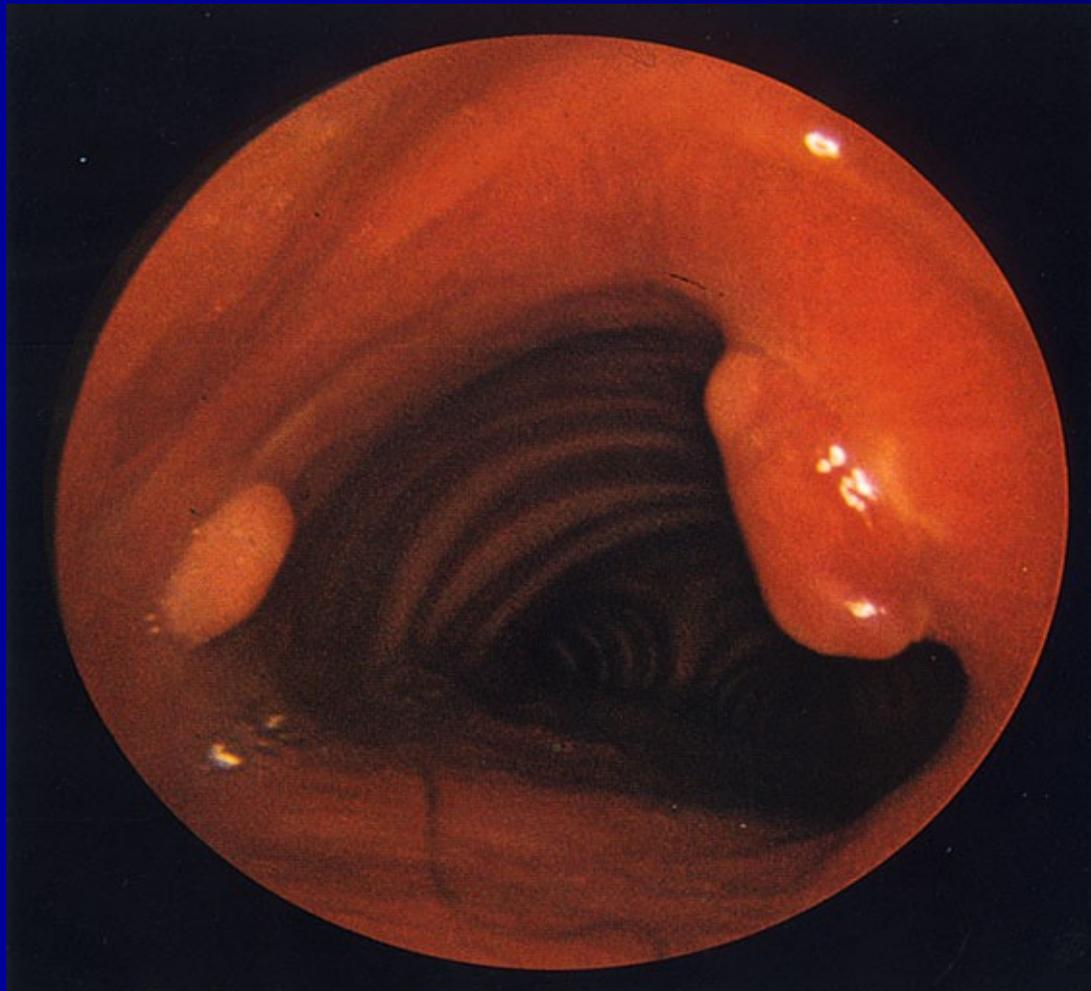
DIRECT SIGNS OF TUMOUR



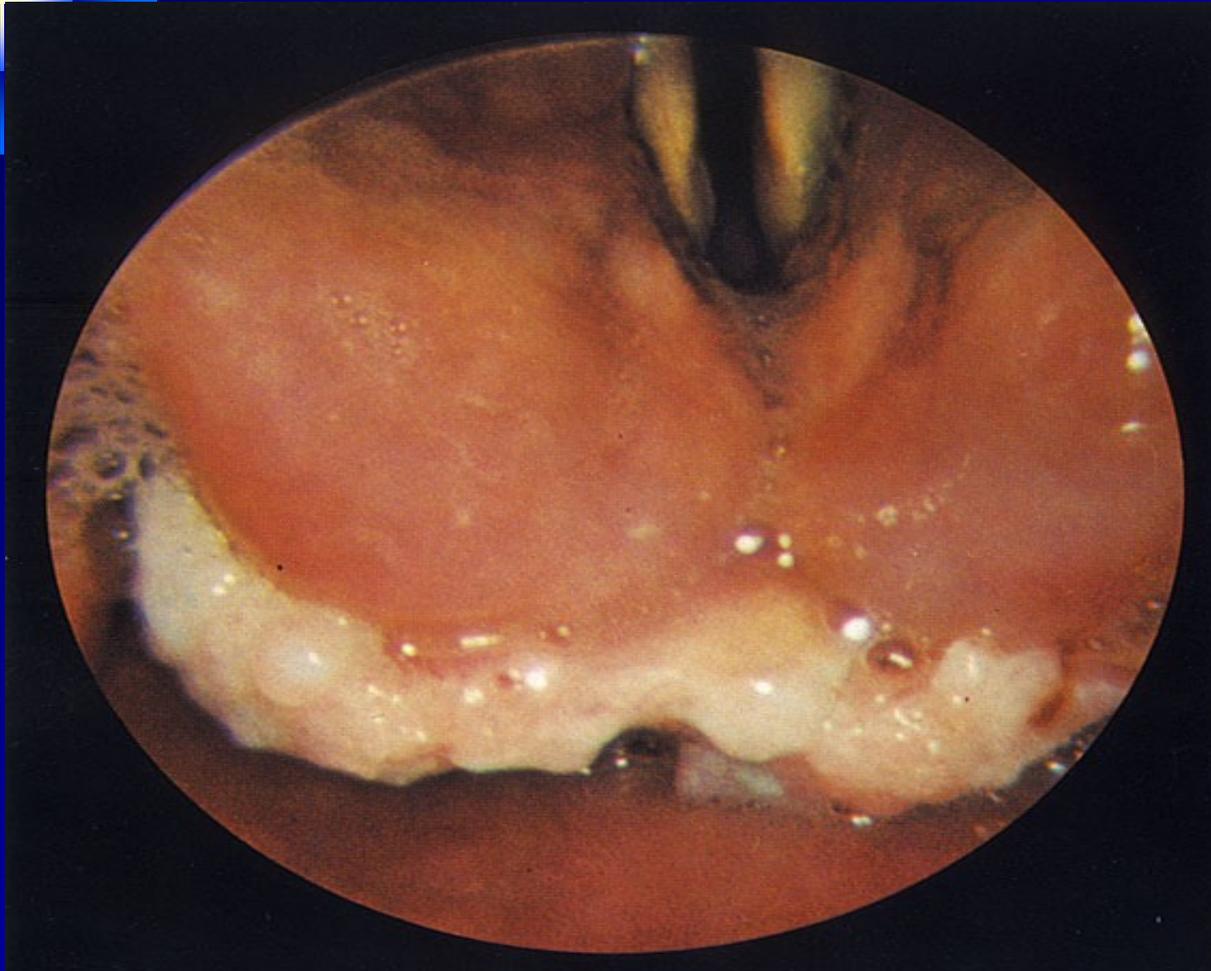
CARCINOID



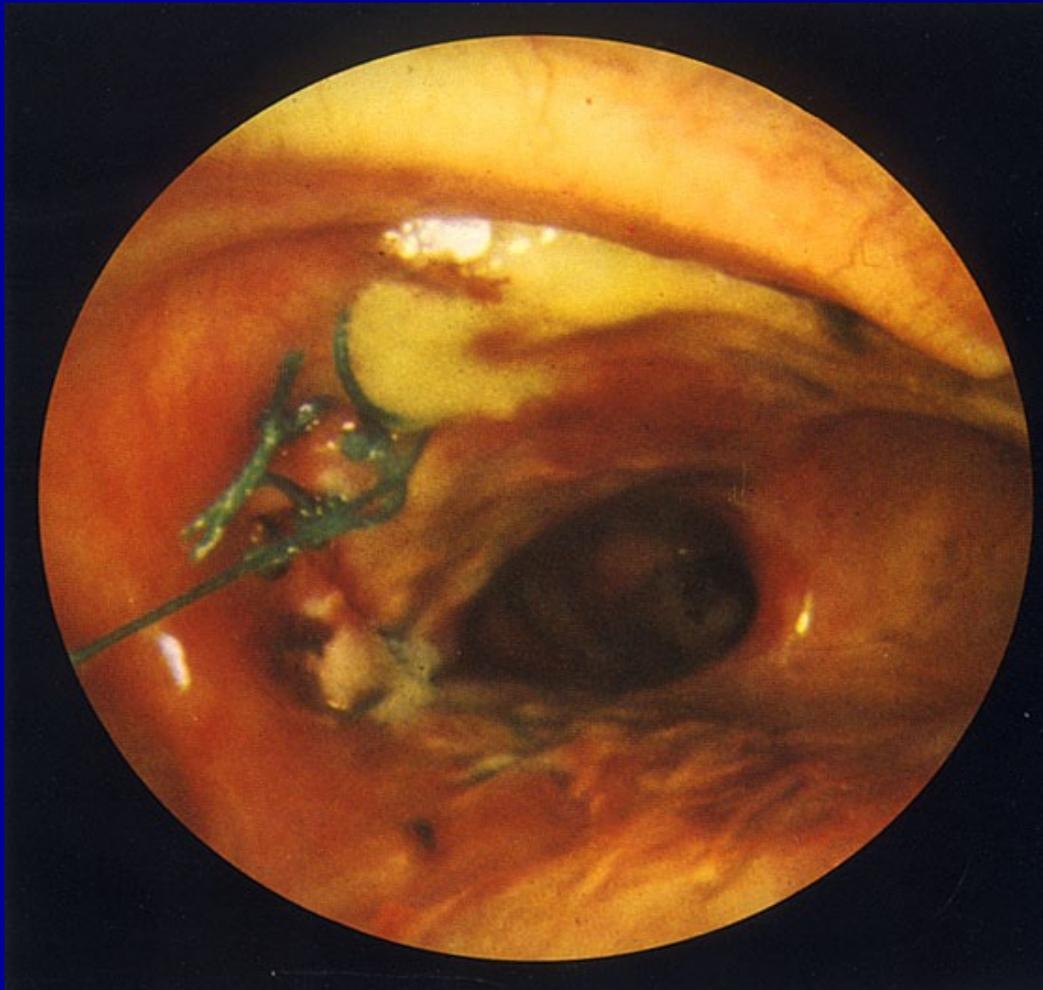
METASTASIS OF MELANOMA IN THE TRACHEA



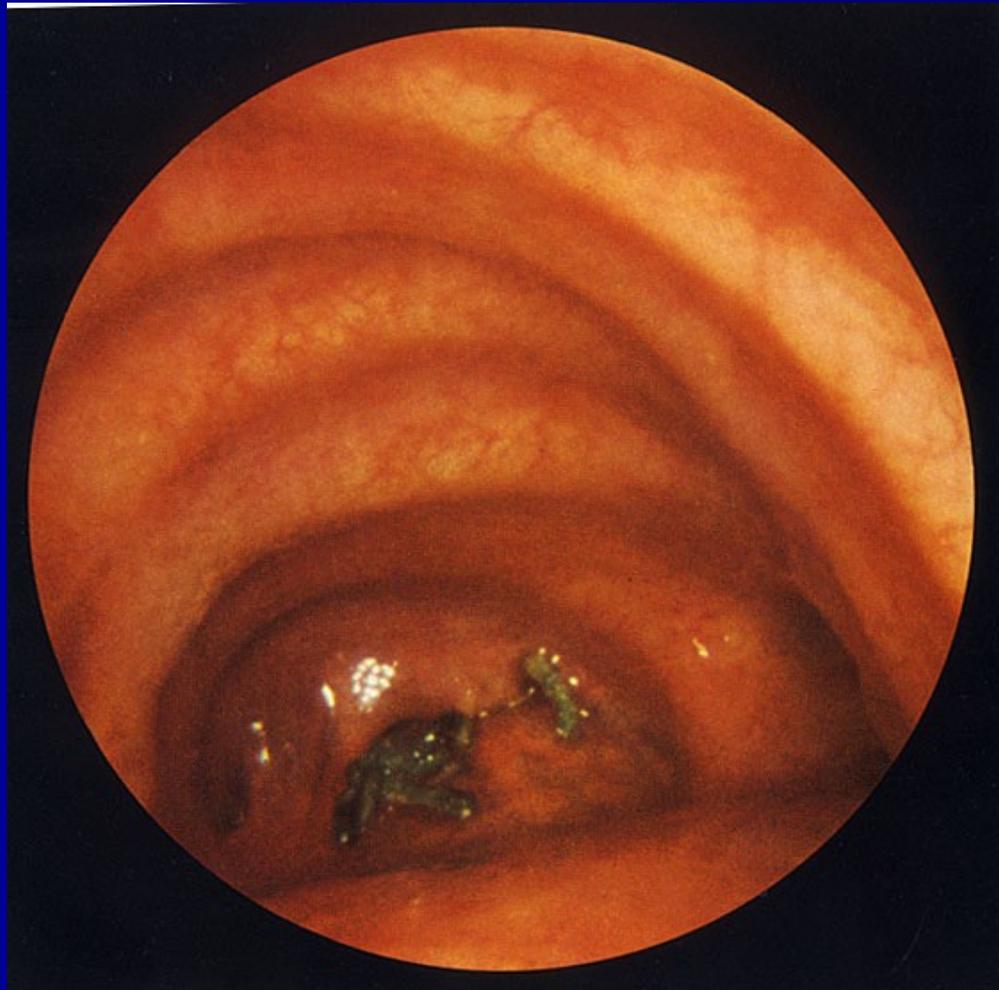
TUMOUR SIGNS ABOVE VOCAL CORDS



SEWING MATERIAL



SEWING MATERIAL



ASSESSMENT OF THE MATERIAL OBTAINED BY BRONCHOSCOPY IN PATIENTS WITH A SUSPICION OF MALIGNANCY

- Histologic evaluation – sample as large as possible, multiple samples
- Cytologic evaluation
- Molecular genetic testing
- Complex microbiologic assessment in case of infectious complications
- **Bronchologist, laboratory background, clinical cytology**

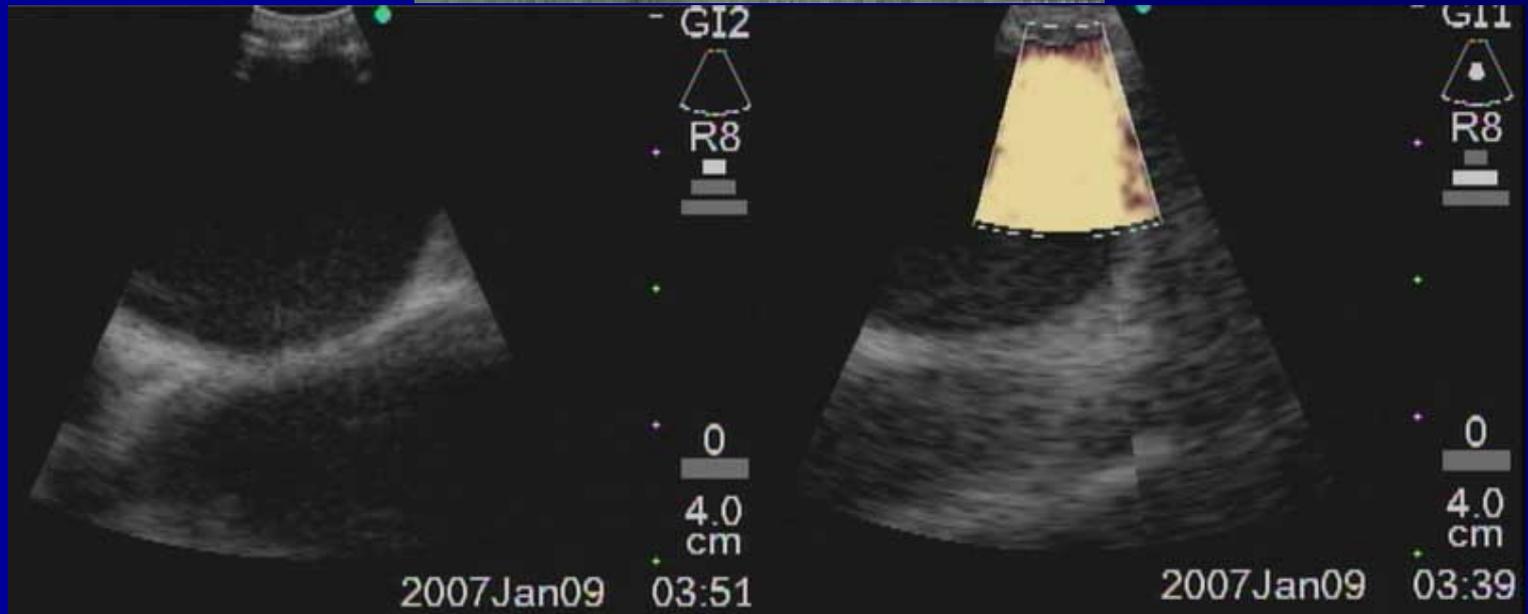
Further methods to assess tumour's size and morphologic type

- CT guided transparietal needle biopsy
- Thoracoscopy (mostly VATS), mediastinoscopy, pleural fluid analysis, open thoracic surgery
- Sputum cytology – morphologic diagnosis is essential for further course of action – to treat or not to treat?

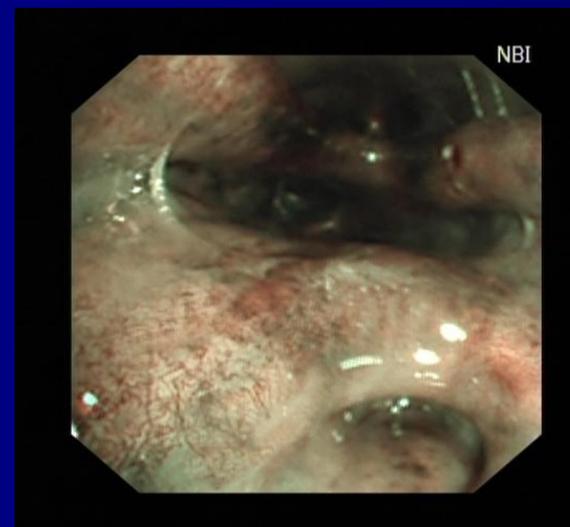
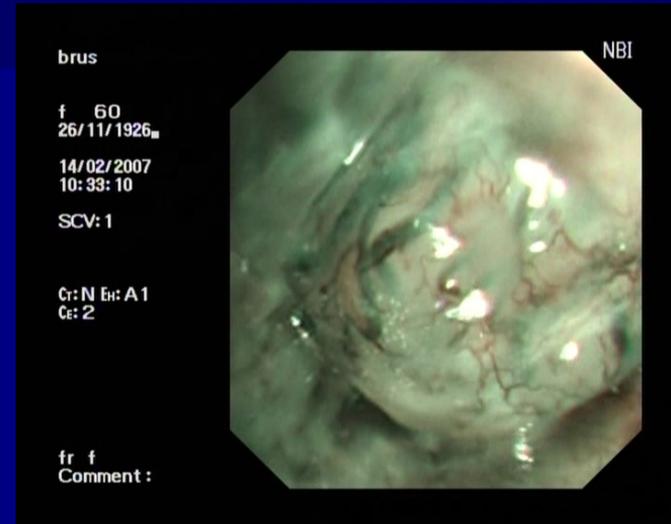
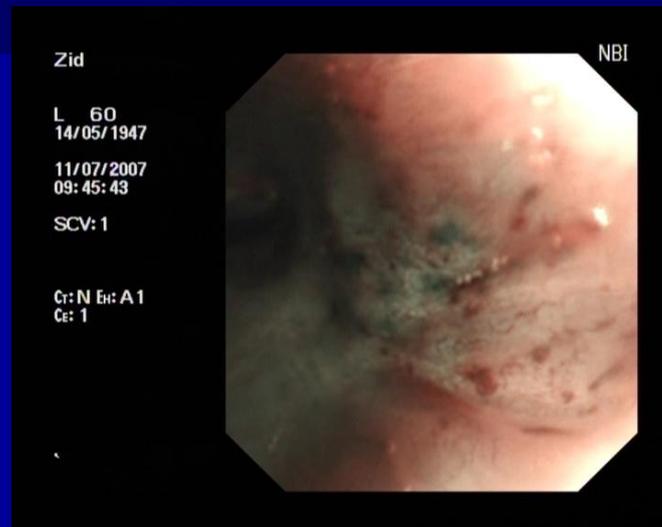
Other bronchoscopic diagnostic methods

- **EBUS** (endobronchial ultrasound)
- Autofluorescence bronchoscopy
- NBI (narrow band imaging)
- Multidimensional bronchoscopy
- Videobronchoscope with full HD (full high definition)
- Confocal microscopy (Cellvizio)

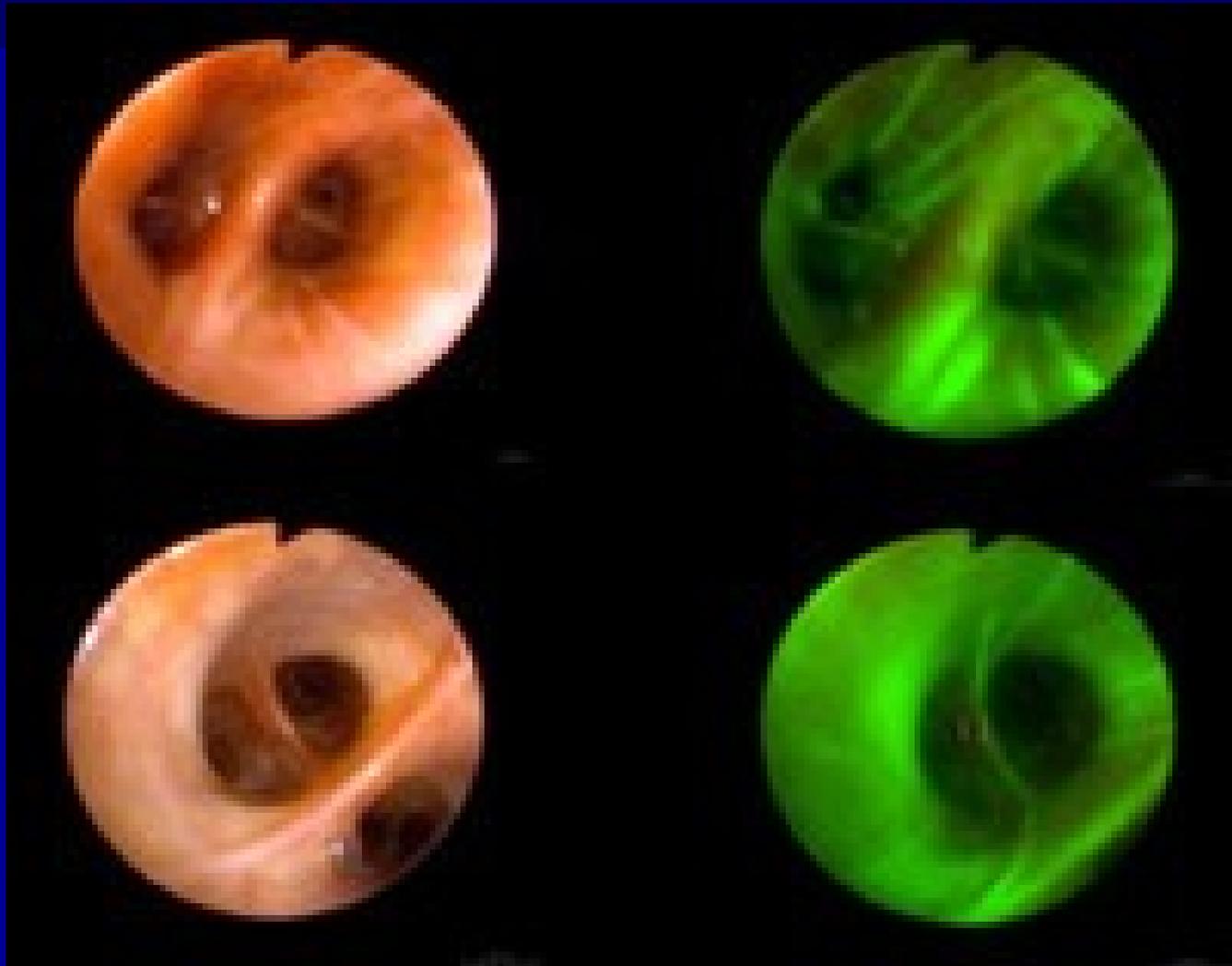
EBUS



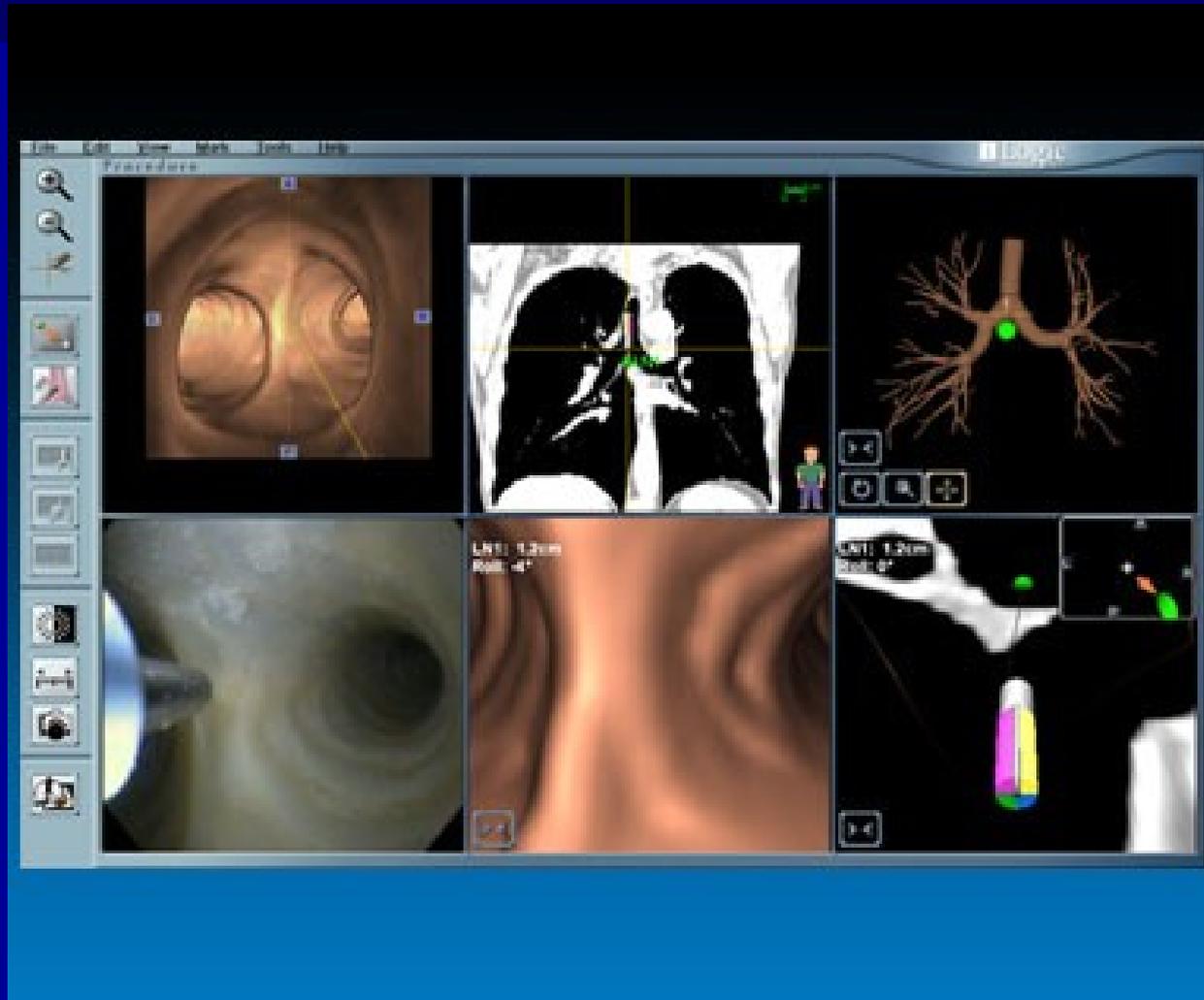
NBI



Autofluorescence bronchoscopy



CT-guided bronchoscopy



TUMOUR MARKERS IN LUNG CANCER and their significance

- Determining and monitoring of tumour markers plays a role in **treated patients** (dynamics), rarely in differential diagnosis.
- CEA – *NSCLC*
- TPA – tissue polypeptide antigen – *NSCLC*
- CYFRA – 21 – 1 – *NSCLC*
- SCC Ag – *NSCLC*
- NSE – *SCLC*
- Pro GRP – *SCLC*

BRONCHOALVEOLAR LAVAGE

- **Technique for the acquisition of bronchoalveolar lavage fluid (BALF) and its cellular and non-cellular elements from lower airways and alveoli**
- Unlike the instillation of saline with reverse aspiration of a small portion of the instilled fluid into large airways

BRONCHOALVEOLAR LAVAGE

- **Valuable examination technique for determination of etiology in a number of pulmonary diseases**
- Safe, repeatable, suitable for monitoring of disease activity and response to treatment
- Adequate treatment can be initiated based on timely BAL and complex BALF analysis

BRONCHOALVEOLAR LAVAGE

- General indications: **interstitial processes or diffuse pulmonary processes** (their diagnosis, monitoring of the course of disease and treatment)
- **Inflammatory lung diseases, peripheral pulmonary lesions, lesions of unknown etiology, diagnosis of lung disease in immunocompromised patients** (AIDS patients, post-transplant patients, patients treated with corticosteroids and immunosuppressants, oncologic patients on intensive chemotherapy and radiotherapy)

BRONCHOALVEOLAR LAVAGE

- Special indication: suspicion of pulmonary lesion in **immunocompromised patients**
- In these patients, determining the etiology of the pulmonary lesion and initiation of adequate treatment can be life saving

Saline instillation (lavage, one of the portions of bronchoalveolar lavage)



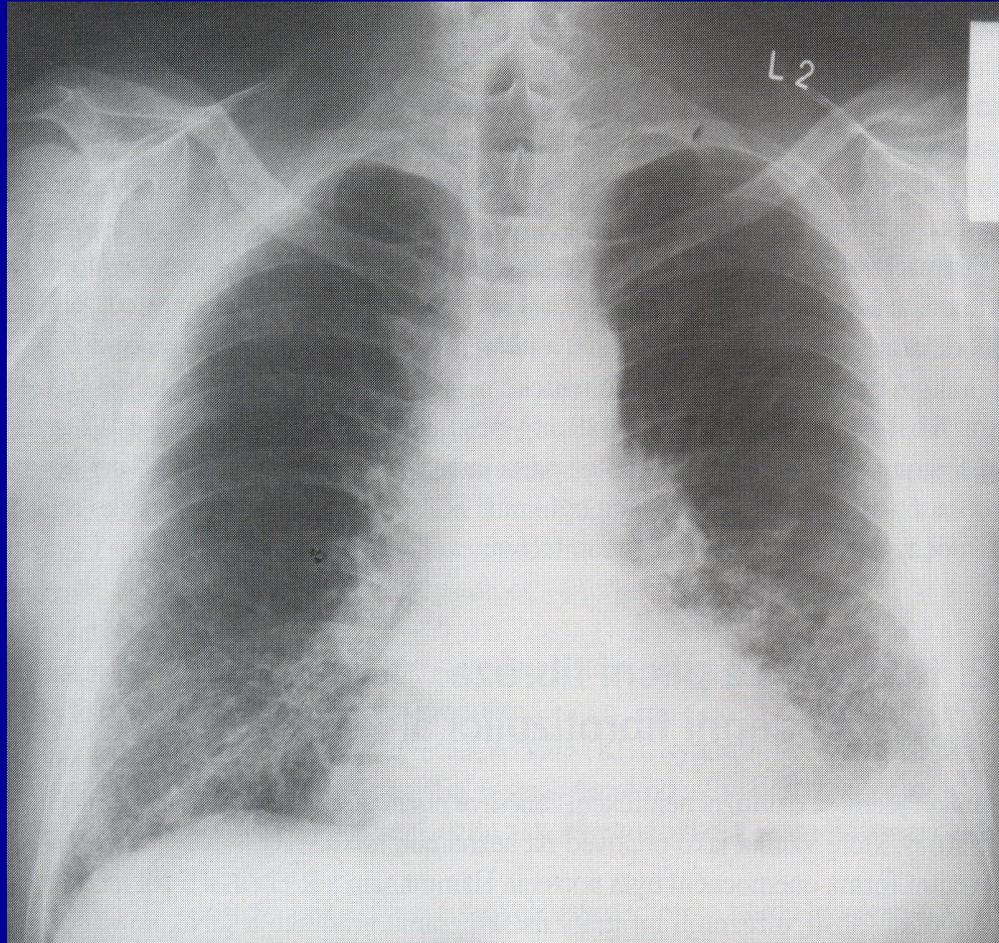
Saline instillation

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INTERSTITIAL PULMONARY FIBROSIS



POSTRADIATION FIBROSIS



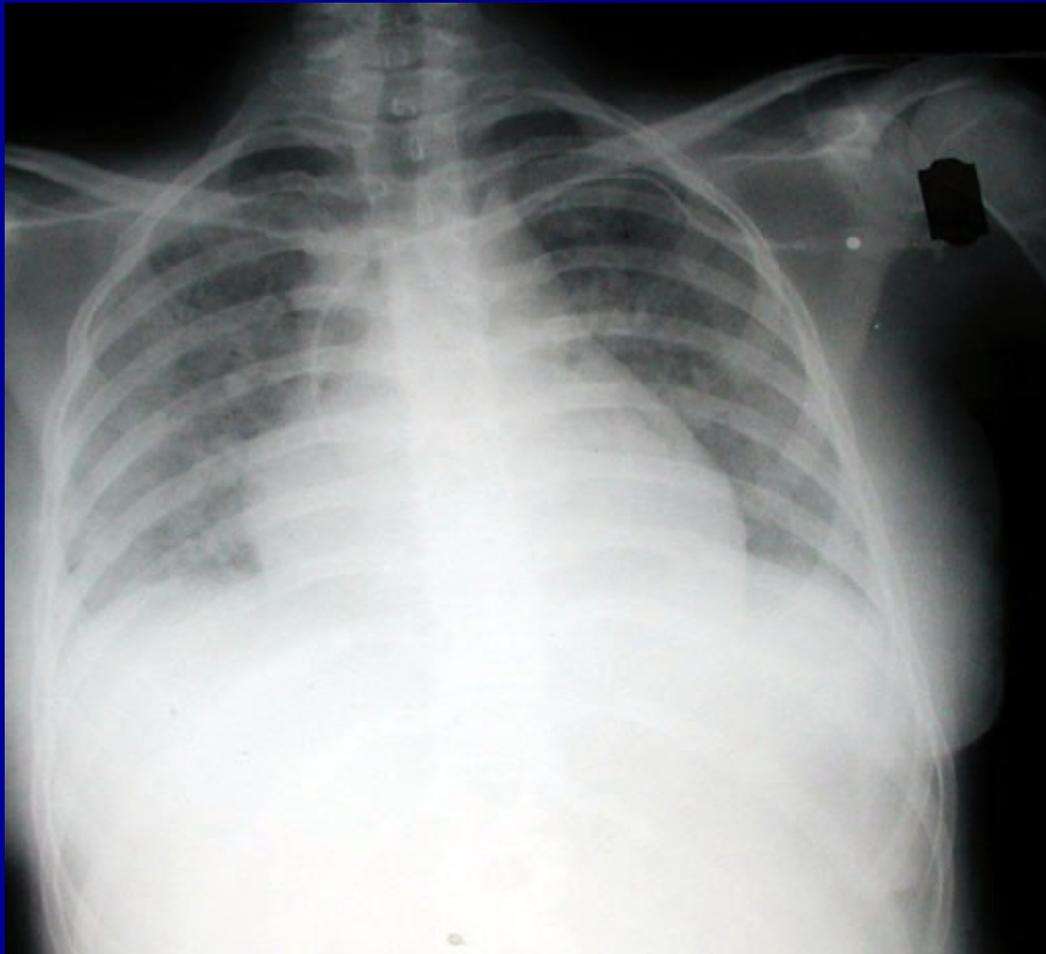
MATERIAL SAMPLING IN SUSPECT INFECTIOUS COMPLICATION

- **Bronchoalveolar lavage** and complex microbiologic examination of the bronchoalveolar lavage fluid (bacteria, mycobacteria, yeasts and fungi, viruses, *Pneumocystis jirovecii*)
- **Cytology of BALF** including the differential count
- **X-ray guided transbronchial lung biopsy**, transbronchial cryobiopsy
- **Timely delivery to the lab, range of diagnostic methods** (availability of molecular diagnostics), knowledge of diagnostic options, interpretation of results

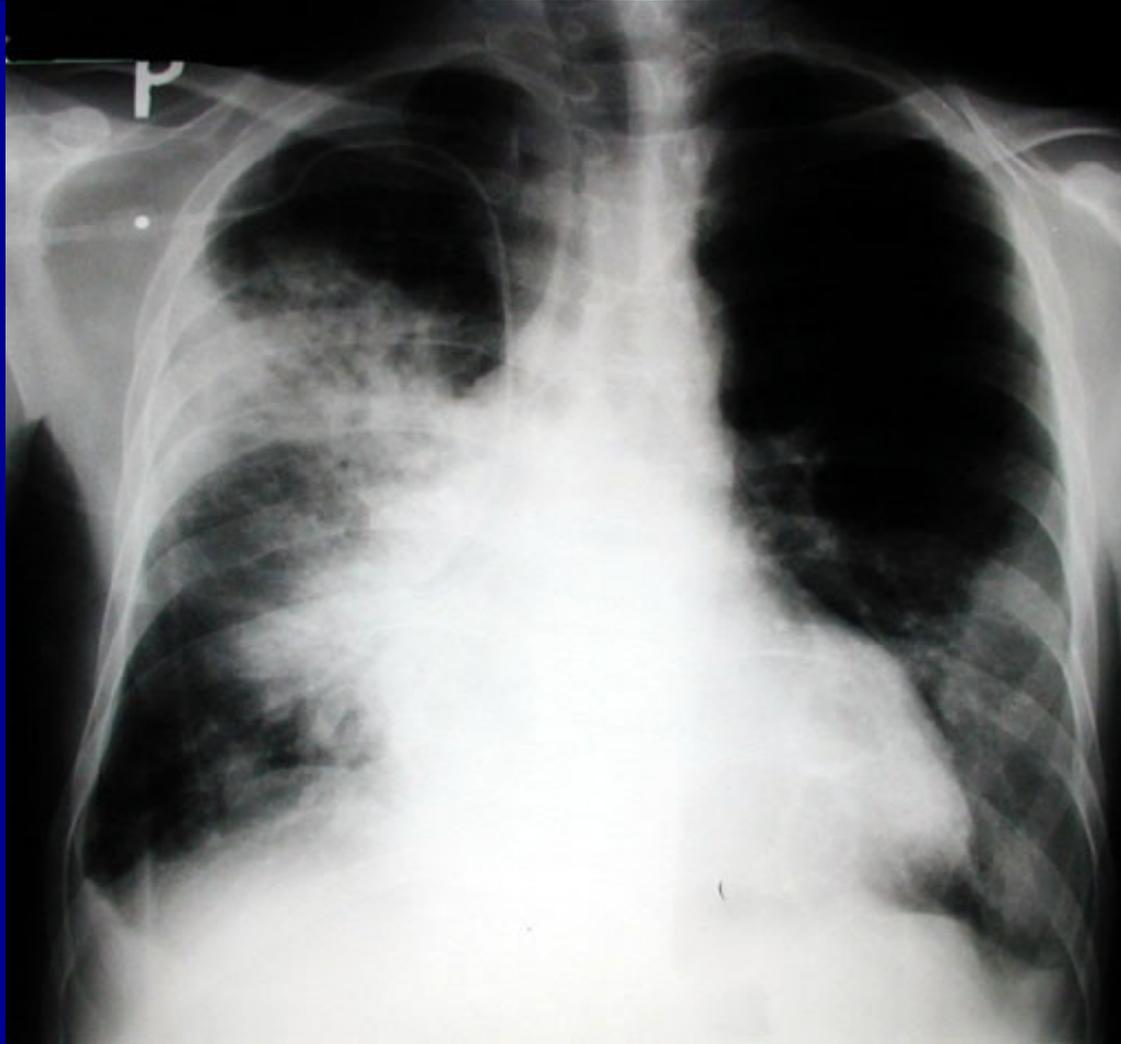
PNEUMOCOCCAL PNEUMONIA



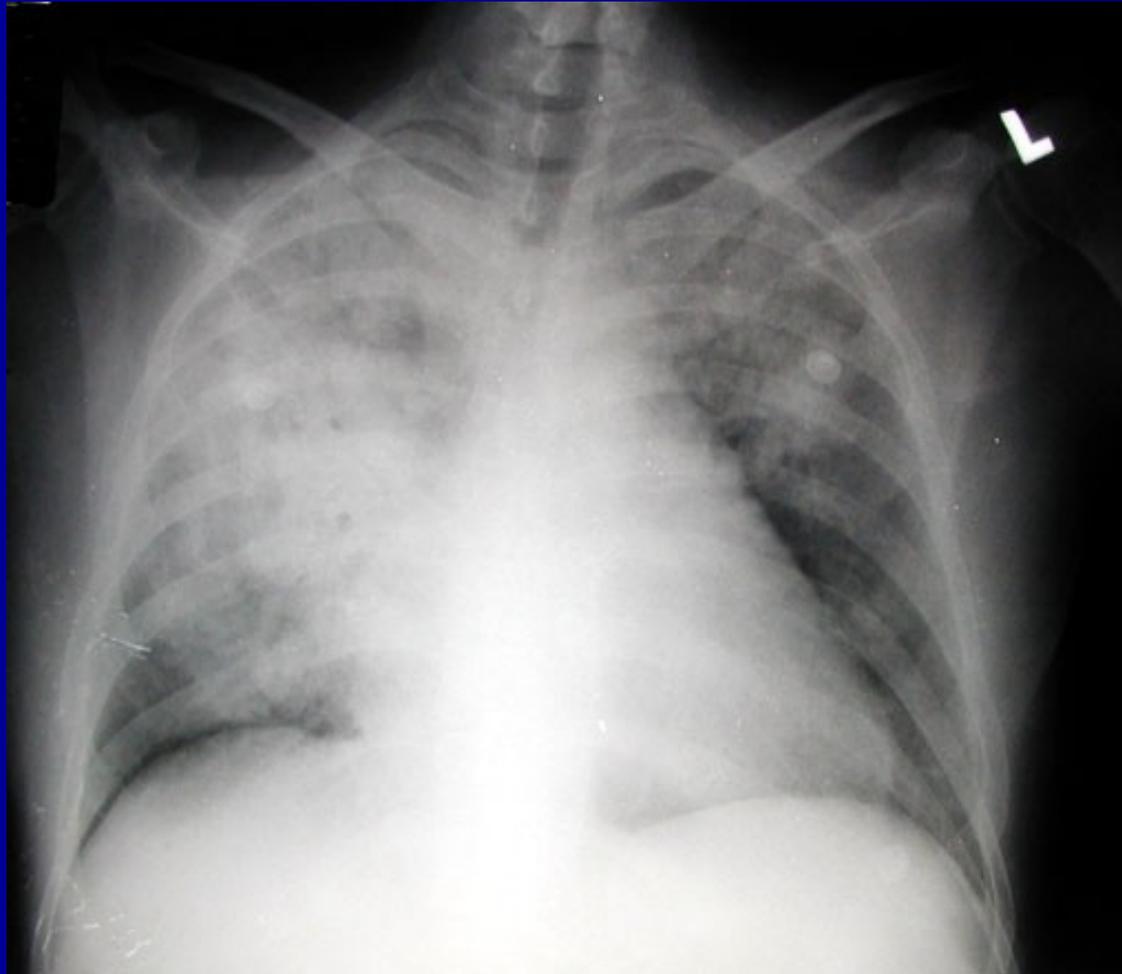
PNEUMOCYSTIS PNEUMONIA



LEGIONELLA PNEUMONIA IN IMMUNOCOMPROMISED HOST



LEGIONELLA PNEUMONIA



Aims of endobronchial treatment

(Bartoň, Endobronchiální léčba laserem, in Kolek a kol., 2002)

- Ventilatory function improvement
- Irritant cough alleviation/supression
- Repeat hemoptysis suppression
- Creating options for other therapeutic procedures
- Quality of life improvement
- Life prolongation

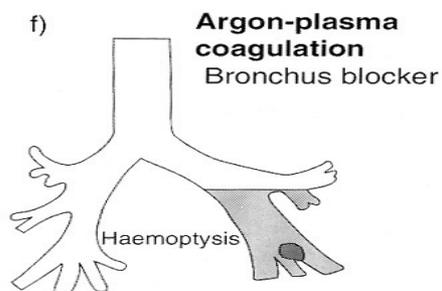
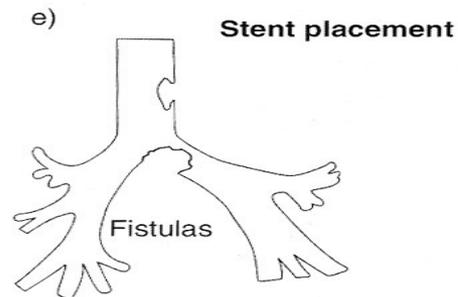
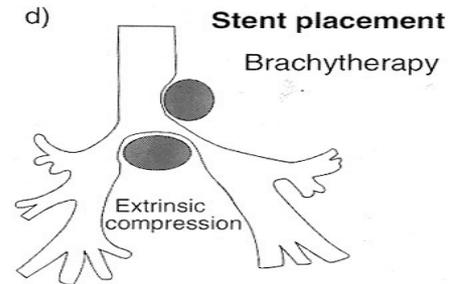
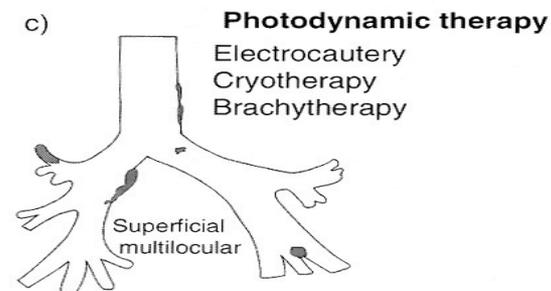
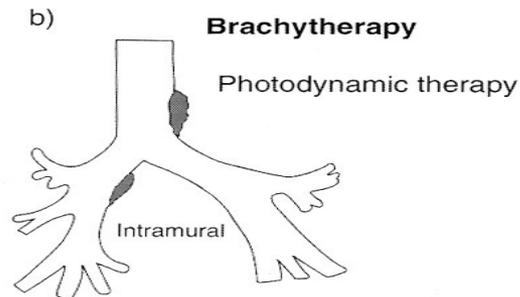
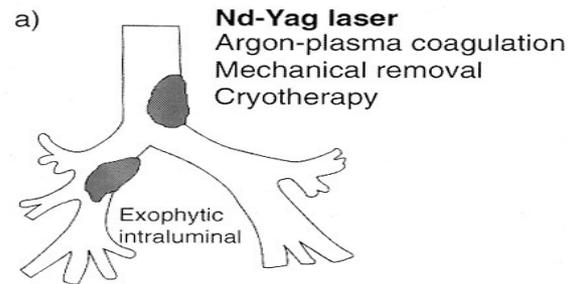
Indications to endobronchial treatment (symptoms)

(Freitag et al., Interventional bronchoscopic procedures, ERS, 2001)

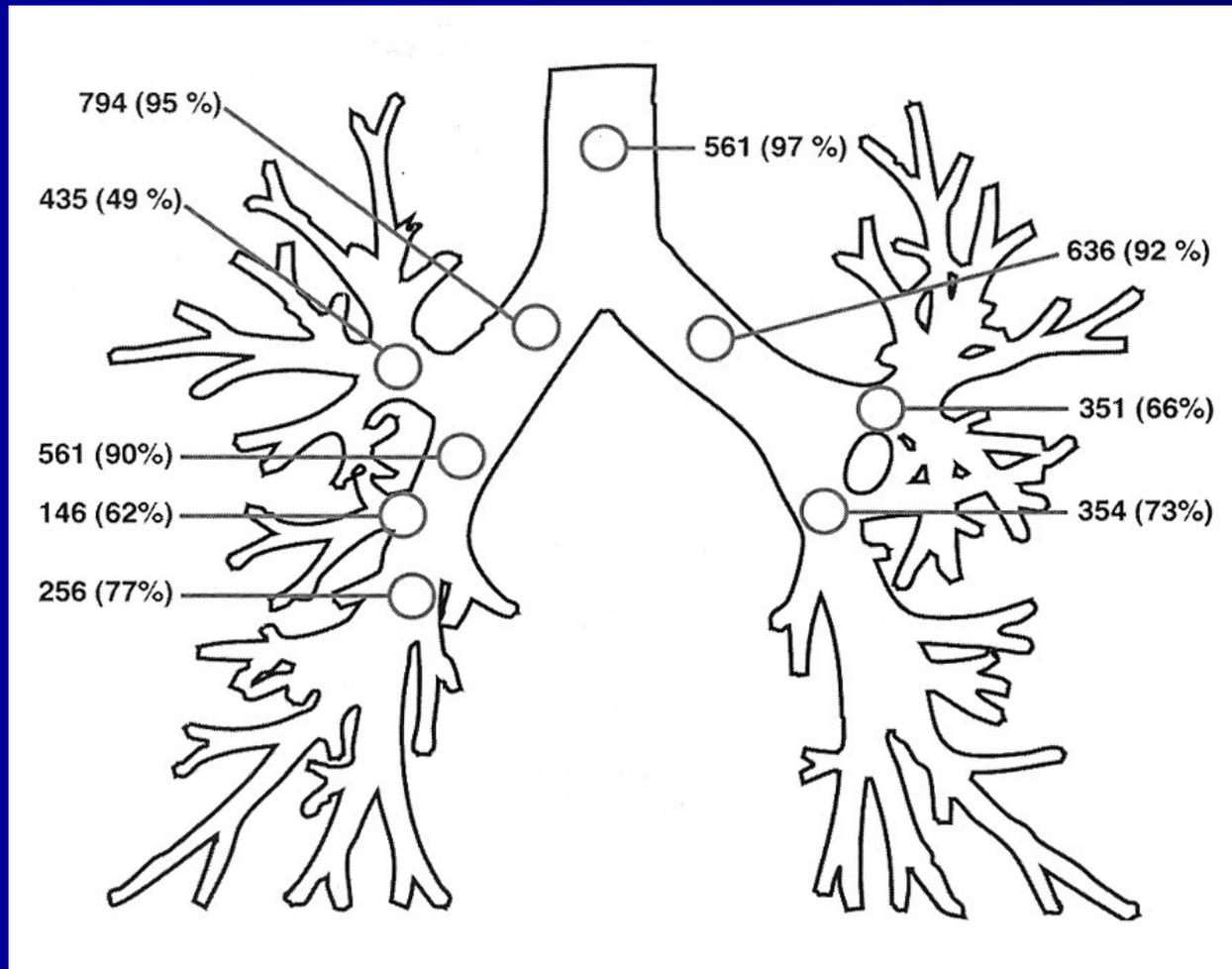
- Dyspnea at rest
- Exercise dyspnea
- Cough
- Hemoptysis
- Recurrent pneumonia

Endobronchial lesions and indication for the use of different types of procedures

(Freitag et al., Interventional bronchoscopic procedures, ERS, 2001)



Location of endobronchial lesions and the success rate after the first proceeding *(Cavaliere et al., CHEST, 1988)*



Endobronchial options

- Using the flexible bronchoscope (in analgosedation)
- Using the rigid instrument set (in general anesthesia or very deep analgosedation)
- Rigid instrument set and flexible bronchoscope combined (in general anesthesia or very deep analgosedation)

FLEXIBLE BRONCHOCOPY

ASSETS

(Cavaliere et al., CHEST, 1988)

- Widely used technique ('everybody can do it')
- Outpatient option possible
- Cheaper

FLEXIBLE BRONCHOSCOPY

DRAWBACKS

(Cavaliere et al., CHEST, 1988)

- Discomfort for the patient
- Dilation impossible with the tip of the bronchoscope, larger forceps cannot be used
- Thin working channel to handle complications
- Placing stents difficult without previous dilation with the rigid set

Advantages of JET VENTILATION

(Studer et al., in: Interventional Bronchoscopy, 2000)

- Good visibility, ample space for procedures
- Small risk of laser ignition
- Airways dilation
- Effective ventilation
- Support of mucociliary clearance

Drawbacks of JET VENTILATION

(Studer et al., in: Interventional Bronchoscopy, 2000)

- CO₂ removal difficult
- CO₂ monitoring difficult
- Blood gas exchange difficult to predict
- Risk of pulmonary barotrauma
- Risk of aspiration
- Expensive

Complications of endobronchial treatment

(Studer et al., in: Interventional bronchoscopy, 2000)

- Hypoxemia (O₂ saturation < 90%)
- CO₂ retention (> 6 kPa)
- Major bleeding
- Pneumothorax
- Death (0.45 - 3.2%)

Postero-anterior chest radiograph before and after repeat laser procedures



LIMITS OF NOVEL DIAGNOSTIC BRONCHOSCOPIC METHODS

- ❑ Endobronchial examination using ultrasound (EBUS = endobronchial ultrasound) – mainly in diagnosis of mediastinal lesions adjacent to bronchi
- ❑ **Autofluorescence bronchoscopy** – to detect subtle mucosal changes not apparent in 'white-light' bronchoscopy
- ❑ **NBI (narrow-band imaging)** to detect early lung cancer, to determine the exact location for bronchoscopic sampling...
- ❑ **Virtual bronchoscopy** – radiodiagnostic (CT) technique that produces high-resolution images of the tracheobronchial tree
- ❑ **Adequate equipment, more physicians should master the technique (illness, official journeys, vacation...)**

LIMITS of THERAPEUTIC BRONCHOSCOPY

- Bronchial secretion aspiration
- Hemostasis – iced saline, Remestyp, Exacyl
- Foreign body extraction

Equipment, everyday service (24/7 if possible), sufficient number of bronchoscopists and nurses, sufficiency in bronchoscopes, interdisciplinary cooperation...

THERAPEUTIC BRONCHOSCOPY – LIMITS

- **Brachytherapy** – where the bronchial orifice is narrowed by an extramural tumour
- **Balloon dilation**
- **Dilation using the rigid bronchoscope's tubus**
- **Electrocauterization**
- **Laser**
- **Cryotherapy**
- **Photodynamic treatment?**
- **Stents**

- **Knowledge of the method, availability, equipment, everyday service (24/7 if possible), sufficient number of bronchoscopists and nurses, a good supply of bronchoscopes, interdisciplinary cooperation...**

CONCLUSION

- Bronchoscopy is of crucial importance in **diagnosis and therapeutic decisions**
- Diagnostic bronchoscopy **has a central place in intensive medicine, oncology, diagnosis of infections, interstitial lung processes and sarcoidosis**
- For bronchoscopy's yield and efficacy, rapid availability of inter-specialty cooperation (pathologist, cytologist, radiologist, anesthetist, microbiologist, molecular geneticist) is essential
- The education of bronchoscopists, sufficient number of bronchoscopists, adequate knowledge of bronchoscopic methods...

REFERENCES

- 1. Bolliger C.T., Mathur P.N.: *Interventional Bronchoscopy*. Basel, Karger, 2000, 297 s.
- 2. Bolliger C.T., Mathur P.N. (chairmen): *ERS/ATS statement on interventional pulmonology*. *Eur Respir J* 19, 2002, 356-373.
- 3. Kolek V. a kol.: *Bronchologie pro zdravotní sestry*. Brno, IDVPZ v Brně, 2002, 212 s.

REFERENCES

- 4. Mayer J., Skřičková J., Vorlíček J.: Plicní postižení u imunokompromitovaných nemocných. Diferenciální diagnostika a využití bronchoalveolární laváže. Brno, IDVPZ Brno, 1995, 511 s.
- 5. Prakash U.B.S (editor): Bronchoscopy. New York, Raven Press, 1994, 547 s.

REFERENCES

- 6. Strausz J.: Pulmonary Endoscopy and Biopsy Techniques. Sheffield. European Respiratory Society Journals Ltd. Publications Office, 1998, 269 s.
- 7. Zavala D.C.: Bronchoscopy, Lung Biopsy and Other Procedures. In: Murray J.F. and Nadel J.A.: Textbook of Respiratory Medicine. Philadelphia, W.B. Saunders company, 1988, 562-596.