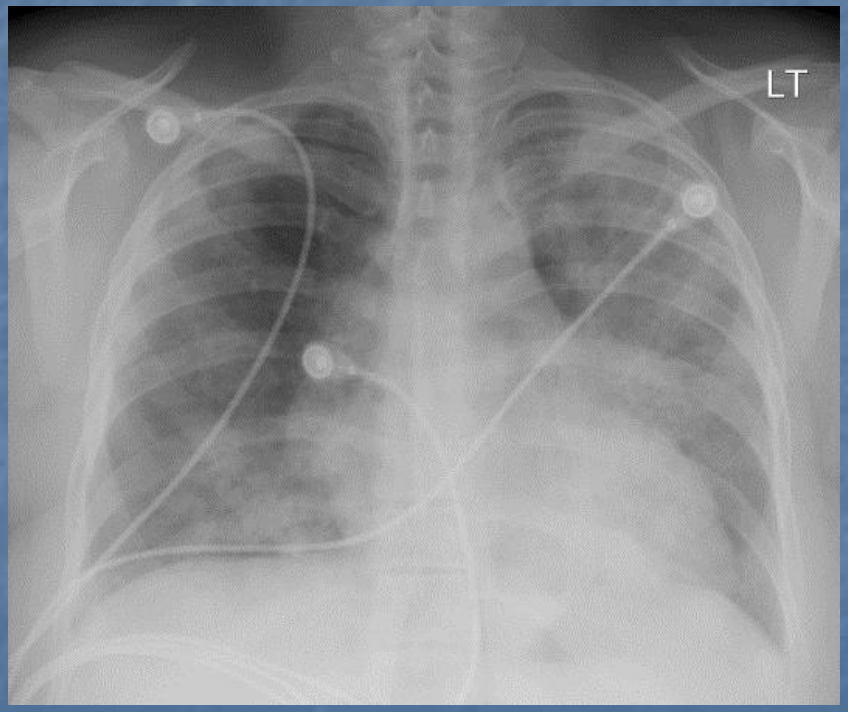
Part 2A: Bronchioloalveolar lavage, volume 1

Strategy and Planning

Execution



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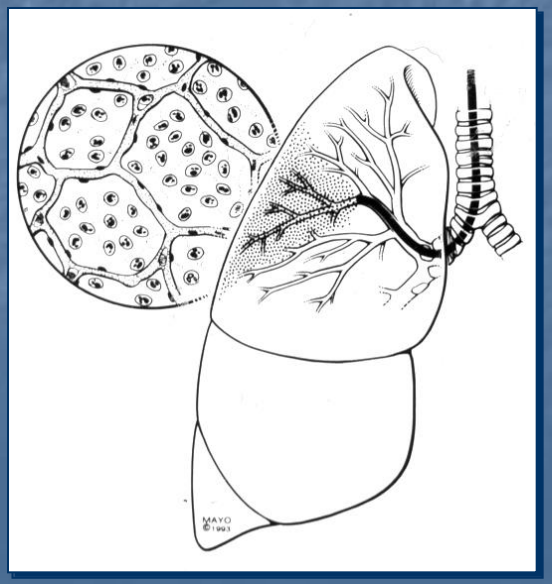
History

BAL

- Originally described in the 1970s
- Originally referred to as a "Liquid lung biopsy"
- A BAL samples the contents of millions of alveoli
  - Yield is therefore greatest for alveolar filling processes



This is NOT a bronchial wash !

BAL today

- Performed routinely in patients with pulmonary infiltrates of presumed infectious etiology.
- Performed also in patients with history or suspicion of neoplasm.
- Performed for other alveolar filling processes
  - Alveolar proteinosis
  - Alveolar hemorrhage
  - Fat embolism and lipoid pneumonia

Training is essential in order to

- Learn proper techniques and indications
- Avoid procedure-related complications.
- Learn to protect the equipment and the patient
  - To maximize fluid return
  - To avoid scope-related trauma
  - To avoid excess patient discomfort (cough, anxiety, shortness of breath).

Greatest yield for BAL in patients with

- Peripheral Malignancy
- Infection (Pneumocystis in HIV 96-98%)
- Alveolar proteinosis, alveolar hemorrhage
- Fat embolism and Lipoid pneumonia
- Silicosis/berylliosis/asbestos
- Eosinophilic lung disease

Indications for BAL

- Research applications
  - Characteristic cellular patterns in numerous diseases (asthma, ARDS)
  - Several ILD have distinct findings on BAL
  - Well-defined cellular patterns for smokers, former smokers, and nonsmokers

Contraindications to BAL

- No contraindications, but
  - BAL-induced hypoxemia may last several hours
  - And may exacerbate respiratory insufficiency
  - Caution also in ventilated patients (minimize time in the airway)
  - In unstable patients with severe hypoxemia, large volume BAL may be enough to prompt need for intubation.

BAL Techniques vary

- Location should be recorded in procedure note
  - Increased yield in gravity dependent areas
  - Target involved segment in focal disease
  - RML and lingula are also preferred sites
- Wedge the scope in the target segment
  - Suction channel should be in the airway lumen, not against the wall
  - Confirmed by slight airway wall collapse with gentle suction
  - Fluid instillation gently dilates segmental airway

Bronchoalveolar lavage
Bronchioloalveolar lavage

Video of BAL Example

BAL technique

- Saline instillation (room temperature)
  - Small aliquots (20-60 each) via syringe
  - More than 100 cc total per segment sampled
  - Usually done after biopsy or brushing to increase cellular content of BAL sample for diagnosis of infection or malignancy
  - In ILD, changes in cell population of recovered fluid occurred only after at least 120 cc is instilled.

Am Rev Respir Dis 1985;132:390-392
Am Rev Respir Dis 1982;126:611-616

Example of gravity bag technique for BAL

Saline solution is hung, and bag is squeezed to gently deliver saline into target segment

BAL Techniques

- Fluid recovery via suction channel
  - Hand suction into syringe, Gravity flow into a dependent container, or Gentle wall suction into a specimen container
  - Optimal dwell time unknown
  - Some use slow deep inspiration with instillation and slow exhalation with recovery
- Recovery better with larger instilled volumes
  - First aliquot often recover < 20% of volume
  - Subsequent aliquots recover 40-70% of volume
  - Aliquots are usually pooled together often excluding the first aliquot (may contain mostly bronchial cells)

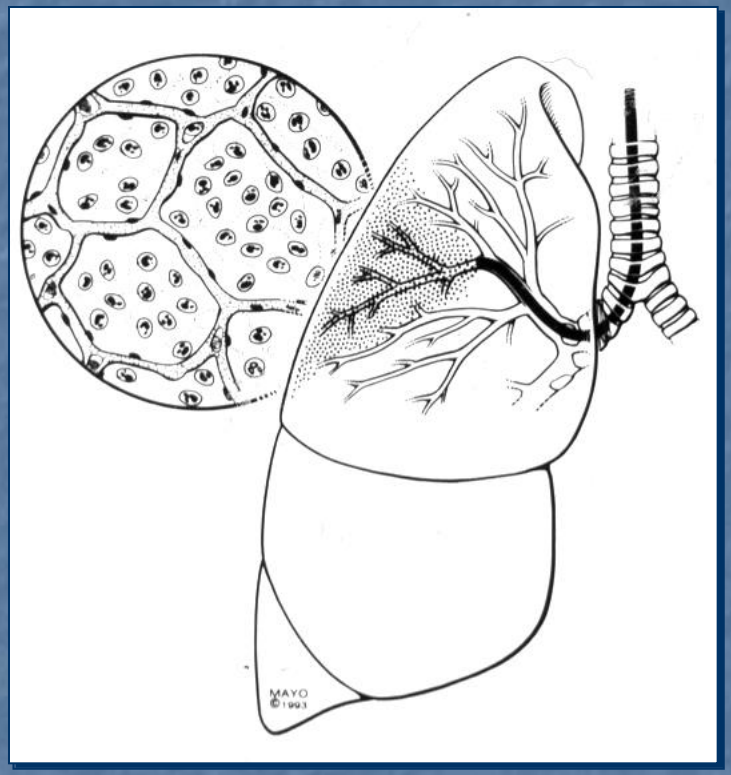
Q9: Bronchoalveolar Lavage Fluid return is usually greatest in smokers

FALSE. In smokers, BAL fluid return is less than in nonsmokers (in whom one might expect to retrieve about 40-60 percent of the fluid instilled).

- Techniques that help maximize fluid return include
  - Instructing the patient to breathe deeply during fluid instillation and during suctioning
  - Wedging the bronchoscope deep inside the segmental bronchus
  - Using suction pressures less than 120 cm H_2O (using manual suction rather than wall suction for example)

BAL fluid return is also enhanced by

- Targeting the middle lobe or the lingula in case of diffuse disease
- Preferential selection of nondependent abnormal areas in case of localized disease

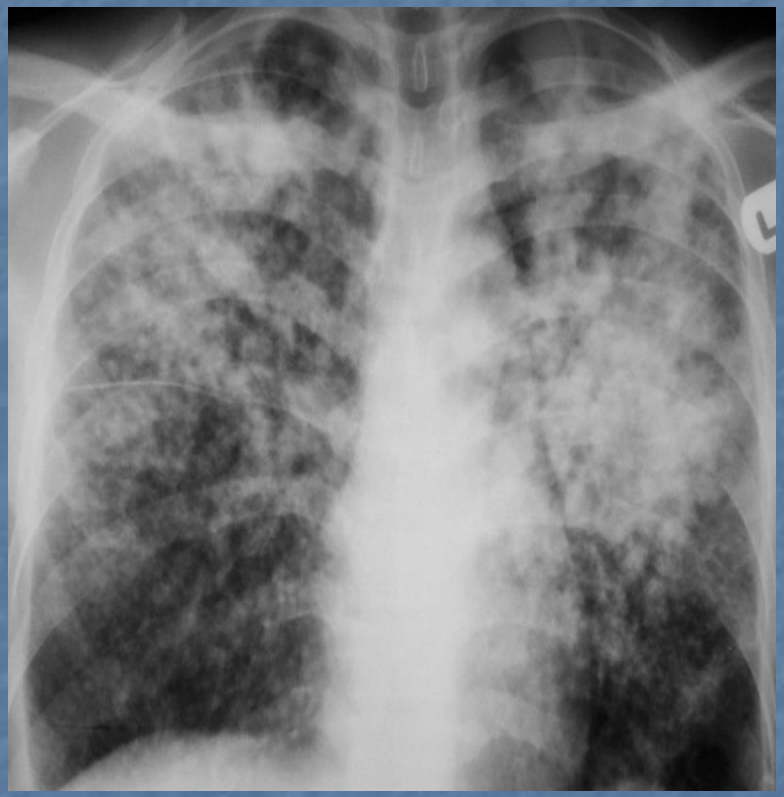


BAL fluid return video

Diagnostic yield for BAL

- Characteristic cellular patterns in numerous diseases
  - Several ILD have distinct findings on BAL
  - Well-defined cellular patterns for smokers, former smokers, and nonsmokers
- More specific yields in:
  - Malignancy
  - Infection (Pneumocystis in HIV 96-98%)
  - Hemorrhage
  - Alveolar proteinosis
  - Fat embolism
  - Lipoid pneumonia
  - Silicosis/berylliosis/asbestos
  - Eosinophilic lung disease
  - Others

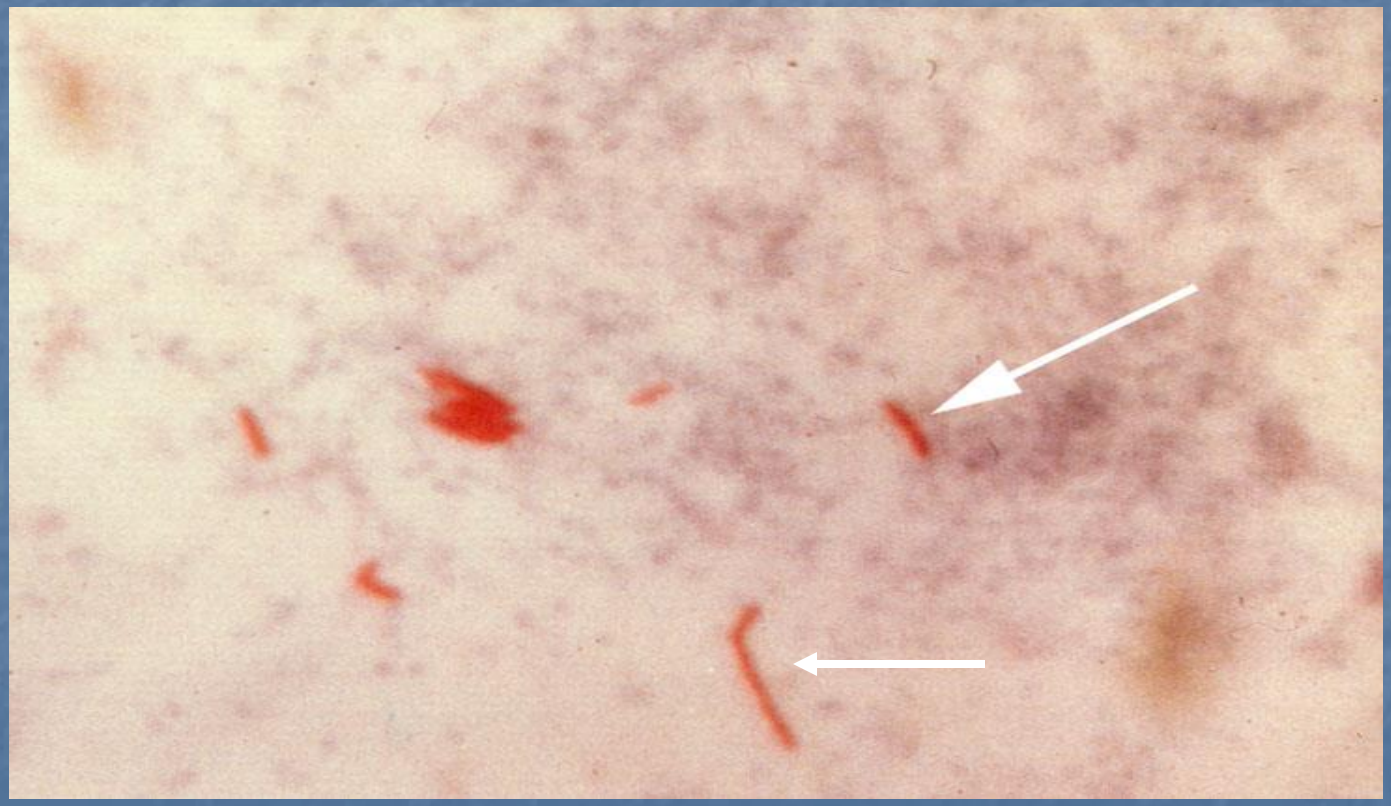
Q9: Bronchoscopy with BAL is superior to sputum induction to rule out Tuberculosis



FALSE. Induced sputum is equivalent to bronchoscopy with BAL for routine evaluation of suspected TB.

- Anderson et al
  - Patients unable to expectorate or sputum negative. 3% saline followed by bronchoscopy. 26 had TB, 20 cases positive on sputum, 19 cases positive on bronchoscopy. Sensitivity: 73% bronchoscopy, 77% sputum.
- Conde et al
  - 143 patients with confirmed TB. Diagnosis based on Single sputum induction in 66%, BAL 72%. This was Regardless of HIV status.
- Saglam et al
  - HIV negative patients with suspected TB. Initially smear negative. Sputum induction smear positive 47%, culture positive 63%. Bronchoscopy smear positive in 53% and culture positive in 67%.
- McWilliams et al
  - Prospective study. Patients initially smear negative, 3 sputum inductions, if negative then bronchoscopy with BAL. 42 cases of TB. 27 TB patients went through all phases. 96% were positive on induced sputum. 52% positive on bronchoscopy with BAL. Only 1 positive using bronchoscopy alone. 13 positive with sputum induction alone and 13 were positive using both modalities.

Induced sputum versus BAL for detection of Acid Fast Bacilli Smear



AFB (shown in red) are tubercle bacilli

Induced Sputum vs BAL

- *Induced sputum vs BAL
  - sensitivity 34% vs 38%
  - specificity 100% vs 100%
  - positive predictive value 100% vs 100%
  - negative predictive value 53% vs 55%
    - These patients were able to participate in sputum induction.
    - Multiple (up to 3) induced sputum samples should be obtained

*Conde MB; Soares SL; Mello FC. Comparison of sputum induction with fiberoptic bronchoscopy in the diagnosis of tuberculosis: experience at an acquired immune deficiency syndrome reference center in Rio de Janeiro, Brazil; Am J Respir Crit Care Med 2000 Dec;162(6):2238-40.

Induced Sputum vs BAL

- Bronchoscopy should only be done after induced sputum x 3 are negative, or in patients unable to provide inducible sputum:
  - Risks to pt/staff
  - limited availability of bronchoscopy in developing countries

Michael Brown, Hansa Varia, Paul Bassett, Robert N. Davidson, Robert Wall and Geoffrey Pasvol. **Prospective study of sputum induction, gastric washing, and bronchoalveolar lavage for the diagnosis of pulmonary tuberculosis in patients who are unable to expectorate**. Clin Infect Dis. 2007 Jun 1;44(11):1415-20

BAL in Lung Cancer

- BAL: performed in setting of peripheral, endoscopically nonvisible lesions
  - Cytology positive in about 25% with peripheral lesions
  - Increases to 70% in patients with endoscopically visible lesions
  - Higher yield with infiltrates as opposed to nodules
  - Bronchoalveolar cell carcinoma: most readily identified primary lung cancer
    - Positive cytology approaching 90%
- Can also detect metastatic malignancy
  - Melanoma, soft tissue sarcoma, and malignancies of breast, GI, and pancreas.

BAL in immuno-suppressed patients

Diagnostic Yield	HIV	Stem cell transplants Chemotherapy	Solid organ Transplants	Other s	Total
Bacteria	202 (48%)	74 (20%)	45 (26%)	37 (37%)	358 **(34%)**
Mycobacteria	63 (15%)	0	0 (0%)	1 (1%)	64 **(6%)**
Aspergillus	1 (0.2%)	10 (3%)	6 (4%)	3 (3%)	20 **(2%)**
CMV	119 (28%)	45 (12%)	46 (27%)	23 (23%)	233 **(22%)**
Other viruses	37 (9%)	16 (4%)	23 (13%)	7 (7%)	83 **(8%)**
PCP	110 (26%)	13 (4%)	25 (15%)	8 (8%)	156 **(15%)**
Total BAL	420	374	173	99	1066

Joos L et al. Pulmonary infections diagnosed by BAL: A 12-year experience in 1066 immunocompromised patients. Respir Med. 2006

BAL – related complications and adverse events

- Hypoxemia
- Fever in 25-50 %
  - Usually resolves in a few hours and after administration of antipyretics.
- Increased density on chest radiograph or CT
- Crackles and alveolar infiltrates may last up to 24 hours
- Decrease in spirometry
- Pneumothorax
- Increased mean airway pressures (in ventilated patients)

Other complications of BAL

- BAL specific bleeding 0.7%[1]
- Complication rates similar to those of inspection flexible bronchoscopy
  - Mortality 0.01 -0.04%
  - Major complications < 1%
  - Fever, bleeding, infection, arrhythmia, respiratory depression, vagal reactions, pneumothorax, bronchospasm, bacteremia
  - Decrease in pa02 is common and worse when larger BAL volumes are used.
  - Small series of critically ill pneumonia patients experienced high fever with decreased MAP and pa02*

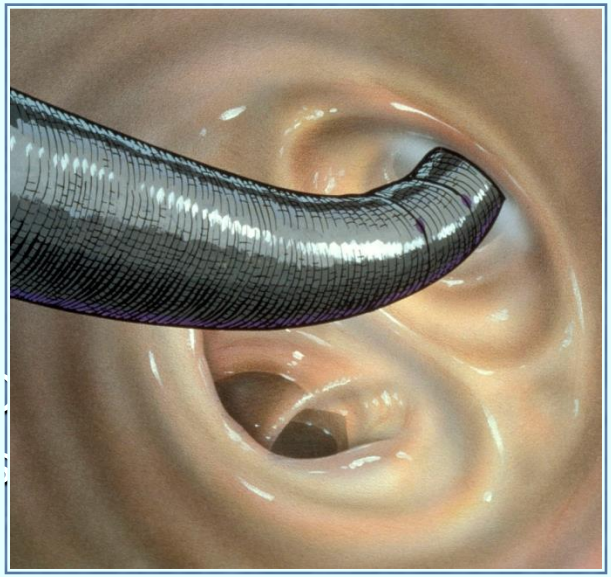
[1]CHEST 1981;80:268-271 BAL in ILD
*Intensive Care Med 1992;18:6

Safety of BAL

- Can usually be done safely in patients with asthma
- Numerous older studies showing safety in AIDS, ARDS, mechanical ventilation, thrombocytopenia.

Helpful Hints for performing BAL

- Avoid rapid "trumpet playing"
  - Instead, suction gently and slowly
  - Keep scope in the midline
  - Avoid cough
- Decreased recovery in
  - COPD (correlates with worsening FEV1/FVC
  - Advanced age, smokers versus nonsmokers
  - Mechanical ventilation
  - When scope is over-wedged
- Acknowledge an inadequate sample
  - Less than 10% of instilled volume
  - Greater than 2% columnar epithelial cells



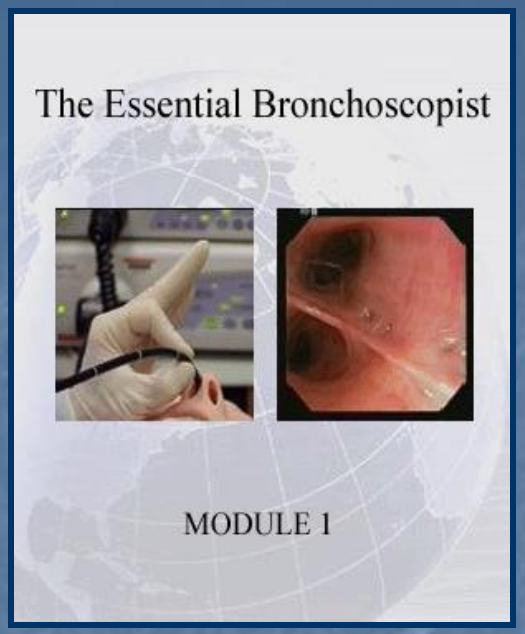
Good wedge where airway remains visible

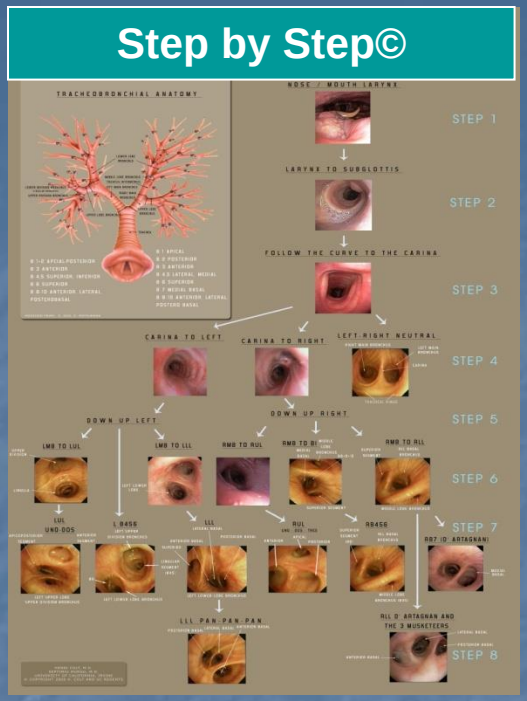
Am Rev Respir Dis 1985;132:254-260

More helpful hints for performing BAL

- Ask the patient to inhale, and even to hold one's breath during fluid instillation.
- Use conscious sedation to improve patient comfort.
- Carefully examine airway-computed tomography correlations to plan the procedure.
- Inform bronchoscopy assistants of procedure plan.
- Use instructions such as "traps on", "traps off" , to communicate about when to retrieve BAL specimen and communicate with assistants.
- Inform cytologist and microbiologists of indications for the procedure.

This presentation is part of a comprehensive curriculum for Flexible Bronchoscopy. Our goals are to help health care workers become better at what they do, and to decrease the burden of procedure-related training on patients.





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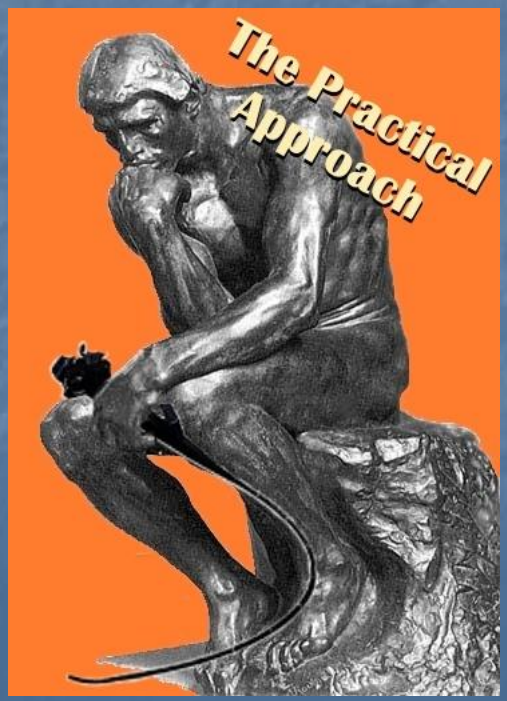

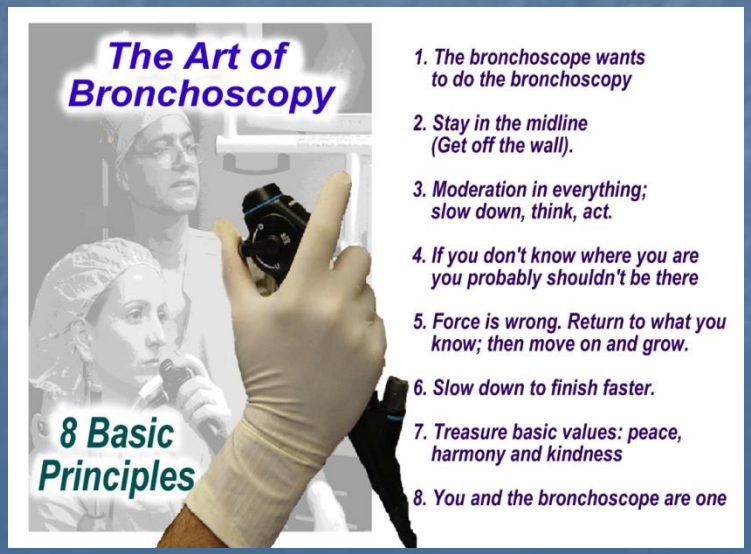

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Thank you

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