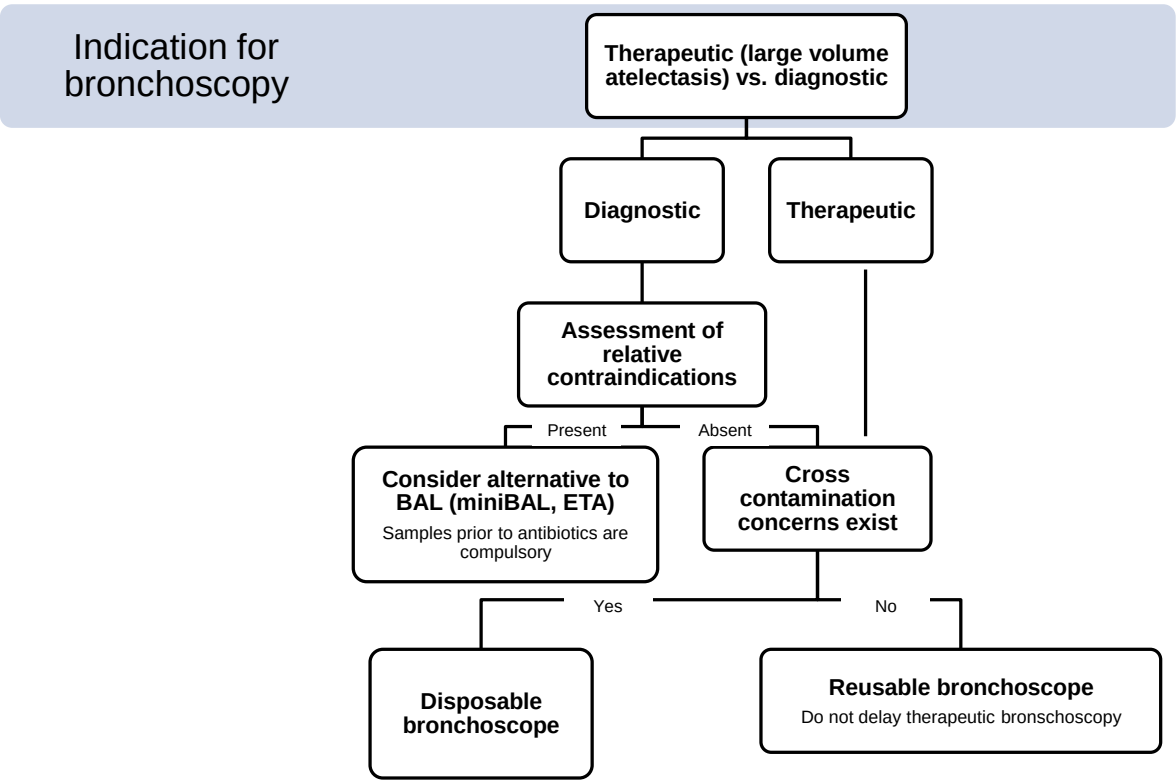
Bronchoscopy in Critical Care

Summary flow chart



Terminology

AHRF – Acute hypoxaemic respiratory failure
ARDS – Acute respiratory distress syndrome
BAL – Broncho-alveolar lavage
CAP – Community acquired pneumonia
ETA – Endotracheal aspirate
miniBAL – low volume catheter directed broncho-alveolar lavage. MiniBAL is a tradename, but the procedure is commonly abbreviated thus. There is little published experience on the change in risk:benefit for miniBAL compared to BAL.
VAP – Ventilator-associated pneumonia

Introduction

Bronchoscopy is a vital therapeutic and diagnostic technique in critical care. It is generally safe but not without risks. Therapeutic bronchoscopy for atelectasis almost always results in patient improvement [1,2]. Diagnostic bronchoscopy for suspected pneumonia leads to a change in management in approximately 50% of cases[2]. BAL is the clear reference standard for VAP[3], with ETA culture more likely to represent upper airway colonisation. According to European guidelines BAL is recommended over ETA for the diagnosis of VAP in well selected patients due to proven or expected improvements in antimicrobial stewardship[4]. Other guidelines recommend the opposite based on the same evidence base, which has never demonstrated a mortality benefit [5,6]. The following guideline is based on available international recommendations, other literature, and local constraints. It is a guideline only and only applies to patients receiving invasive mechanical ventilation.

Indications for bronchoscopy

Therapeutic	Diagnostic	Procedural
Atelectasis	Suspected VAP	Tracheostomy
Foreign body removal[£]	CAP where diagnostic doubt exists[&]	Double lumen tube insertion
Management of haemoptysis[$]	Suspected *Aspergillus* spp. pneumonia*	Bronchial biopsy[$]
	Non-resolving AHRF/ARDS	Transbronchial lung biopsy[$]

* *Aspergillus* pneumonia is the commonest undiagnosed pulmonary infection in critical care, especially after a long period of ventilation, periods of immunosuppression, or use of broad-spectrum antibiotics. In the absence of respiratory sample microscopy or culture, BAL galactomannan or BAL *Aspergillus* specific lateral flow (OLM diagnostics) are the only available tests for pulmonary *Aspergillus* infection which have acceptable test characteristics. ETA samples are not adequate. Appropriate samples could be obtained by miniBAL.

[&] The pre-test probability of CAP is high. Any organisms detected in ETA or other samples are likely to be causative. Deeper samples are generally not required unless a causative organism has not been found

[£] Rigid bronchoscopy is the preferred technique. Whether rigid or flexible, the procedure should be carried out by thoracic surgical or respiratory specialist.

[$]Recommended and carried out by respiratory or thoracic specialist

Suspected VAP

There is no agreed definition for suspected VAP. The following criteria are often used. It is not necessary for all to be present to suspect VAP.

- Deterioration in oxygenation after a period of stability
- Invasive airway device at any point in the preceding 48 hours
- Chest examination findings consistent with infection
- New or change in purulent airway secretions
- Systemic features of infection
- Radiological changes consistent with infection

Contra-indications for bronchoscopy

The only absolute contraindication to bronchoscopy is refusal of consent from a patient with capacity.

There are no relative contraindications to life threatening lobar/whole lung atelectasis due to proximal mucus plugging. Atelectasis of the small airways is best managed through manipulation of ventilator settings and chest physiotherapy.

There are several relative contraindications to diagnostic bronchoscopy. Studies that have investigated BAL vs. ETA have not specified precise contra-indications, instead deferring to clinician judgement. Therefore, local clinicians should use their own judgement, but for VAP diagnosis in normal circumstances BAL should be avoided if any of the following are present.

Respiratory	Cardiovascular	Neuro	Haematological	Other
Fio2 > 0.6	New uncontrolled arrhythmias	Measured ICP >= 20 mmHg	Platelets <20 x 10^9/L	Small ETT
PEEP > 8 cmH_2O	Uncontrolled shock	Suspected raised ICP	Therapeutic anticoagulation	
Known mPAP >= 55mHg	MAP < 60 mmHg		Coagulation screen consistent with therapeutic anticoagulation	
Acute severe asthma exacerbation	Dynamic vasoactive drug requirement			
	Active cardiac ischaemia			

If BAL is not undertaken, then miniBAL or ETA should be performed *before* the administration of antibiotics.

Special circumstances

Where diagnostic BAL might be overall beneficial despite presence of one or more relative contra-indications include:

- Suspected *Aspergillus* pneumonia with negative microscopy and culture of endo-tracheal aspirate.
- Failure to resolve respiratory failure.

Recommended procedure

Selection of bronchoscope

It is highly recommended that a bronchoscope which is more than 2 mm smaller than the internal diameter of the indwelling ETT is selected, except for short duration urgent suction bronchoscopy for significant atelectasis. Failure to do so will result in reductions in minute ventilation and increases in intrinsic PEEP[7] which may cause barotrauma[8,9]. A working channel of 1.5 mm is sufficient for BAL but a larger working channel is recommended for urgent therapeutic bronchoscopy.

Specific infectious considerations

Bronchoscopes are semi-critical medical devices that undergo high level decontamination. In general, this is adequate for prevention of transmission of infection. Worldwide, there have been isolated scenarios where transmission of infection via inadequately cleaned bronchoscopes has contributed to harm[10]. Worldwide, there are incidences where high-level decontamination has failed to clean reusable bronchoscopes adequately[11].

Disposable bronchoscopes are preferable where there is proven or high suspicion of highly resistant respiratory pathogen (for example, a scenario that necessitates side room isolation).

Available bronchoscopes for critical care bronchoscopy in NHS Lothian

Correct at the time of publication. Only bronchoscopes with a working channel are listed

	Manufacturer	External diameter (mm)	Diameter of working channel (mm)	Recommended minimum ETT internal diameter (mm)*
Ward 118/116 Royal Infirmary of Edinburgh				
To arrange a reusable bronchoscope please communicate with the pod NIC who will arrange for the CSW to prepare the scope and stack.				
Reusable bronchoscopes	Storz	6.5	3	8.5
	Storz	4.1	1.5	6.5
Disposable bronchoscope	Ambu aScope 4 Large (Orange)	5.8	2.8	8.0
	Ambu aScope 4 Slim (Grey)	3.8	1.2	6.0
Ward 111 Royal Infirmary of Edinburgh				
To arrange a reusable bronchoscope please communicate with the pod NIC who will arrange for the CSW to prepare the scope and stack.				
Disposable bronchoscope	Ambu aScope 4 Large (Orange)	5.8	2.8	8.0
St John's Hospital Intensive Care Unit				
To arrange a reusable bronchoscope please communicate with the NIC who arrange for the theatre ODP to prepare the scope and stack				
Reusable bronchoscopes	Olympus	6.0	2.8	8.0
Disposable bronchoscopes	Ambu aScope 4 Large (Orange)	5.8	2.8	8.0
	Ambu aScope 4 (Green)	5.0	2.2	7.0
	Ambu aScope 4 Slim (Grey)	3.8	1.2	6.0
Ward 20 Western General Hospital				
To arrange a reusable bronchoscope please communicate with the NIC who will arrange for the CSW to prepare the scope and stack.				
Disposable bronchoscope	Ambu aScope 4 Large (Orange)	5.8	2.8	8.0
	Ambu aScope 4 Slim (Grey)	3.8	1.2	6.0

* - Internal diameter regardless of whether SACETT or standard ETT

Personnel

- Bed space nurse
- Bronchoscopy operator
    - Adequately competent for the procedure
    - Non consultant grade doctors should be directly or indirectly supervised by a clearly identified consultant
    - Also responsible for peri-procedural patient care unless this task is delegated
- Member of staff from junior medical tier
    - To assist with bronchoscopy procedures
    - Where larger bronchoscopes are used in smaller ETT it is likely that a member of the team will have to maintain traction/counter traction on the ETT as the bronchoscope is advanced or retracted.

Peri-procedural care of the patient

- Ensure adequate ongoing anaesthesia and neuro-muscular blockade
- Use clinical endpoints to maintain adequate anaesthesia. BIS is not currently recommended in critically ill patients.
- Volume controlled ventilation mode (consider adjusting pressure alarms/disabling autoflow)
- Pre-oxygenate and ensure FiO2 1.0 with PIFR <60L/min
- Change to a sterile catheter mount

Procedure preparation for diagnostic BAL

- Review chest radiology and choose segment to be lavaged as below:
    1. Segment involved on radiology
    2. If 1. difficult to determine, then choose segment where pus seen at bronchoscopy
    3. If pus not seen then lavage posterior segment of right lower lobe
- **Perform only one diagnostic lavage because**
    - This reduces complications
    - Subsequent samples will be contaminated anyway
- Equipment required:
    - Sterile tray – decant sterile saline from 1L bottle
    - 20ml syringes x 2
    - At least three large sterile suction traps
    - Perform leak test if using resuable Storz bronchoscope
    - Don appropriate airway PPE
    - Scrub, don gown and sterile gloves

Bronchoscopy for diagnostic BAL

- Do not use local anaesthetic, it is bactericidal
- Attach sterile suction trap to bronchoscope and suction tubing
- Maintaining sterility, pass scope down ETT to desired area of lung avoiding use of suction
- Wedge the scope in a sub-segment and apply gentle suction – visualised lung should collapse
- Inject 20ml sterile saline, aspirate and discard this sample
- Keeping scope wedged in same position, change suction trap
- Inject 20ml aliquots of saline to a maximum total of 120mls (stop if resistance to injection). Syringes can be reused whilst injecting saline.
- Allow sample to rest for 10-20 seconds
- Keeping suction trap upright, gently suction BAL fluid into trap (NB/ average return is <20% - cadence suctioning can help improve return)

- Remove trap and seal with sterile top. If more lavage continues to be returned continue to gather this same BAL in a new trap.
- Visualise the rest of bronchial tree and perform further sampling if appropriate
- Consider pausing the procedure if SpO_2 falls below a pre-specified threshold (typically 92%) by removing the bronchoscope and sealing the ventilator circuit
- Consider abandoning the procedure if hypoxia fails to recover to pre-procedure values within 5 minutes.
- Document procedure in Trak EPR. The short code /icubronch is available for your convenience.

Samples

- You should have one or two suction traps containing BAL.
- Identify the appropriate Trak order set plus additional requests – see sampling guidelines on the intranet or critcare.net for CAP and VAP sampling guidelines.
- The following tests for potential pathogens are currently NOT routinely tested as part of these order sets (not exhaustive):
    - *Pneumocystis jivorecii* (PCP)
    - TB
    - Galactomannan for *Aspergillus* spp.
    - CMV
    - These tests must be requested separately and may generate extra labels, and therefore you may need to split the sample futher.
- Print the test request labels yourself; do not hand off to another member of staff.
- Once you know how many separate samples you need and before you leave the bedside
    - In a sterile fashion, split the BAL into equal volumes in the relevant number (determined by the number of stickers your test request has generated) of sterile containers.
    - If required, top up each sample to 10 mLs with sterile saline.
    - Affix the labels to the containers
    - Inform Biomedical Scientist
        - RIE: x26021 (or bleep 2900 between 2000-0800).
        - SJH: x53075
        - WGH: x31482
    - Send samples to laboratory via hospital porter. Do not use pneumatic pod system

Bronchoscope cleaning

Disposable bronchoscopes should be disposed of in clinical waste at the end of the procedure. Scopes should not be left at the bedside for any period.

Reusable bronchoscopes should be cleaned using the cleaning solution. Use the sponge to clean the exterior of the scope and aspirate the remaining solution through the working channel of the bronchoscope until it is exhausted. Place the scope in the tray and cover with red transparent plastic sheet. Return to floor CSW or ODP (depending on site) who will arrange for formal decontamination in the endoscopy department and subsequent return to HEPA cabinet.

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