

## **Pediatric Interventional Bronchoscopy**

Pediatric respiratory medicine is a rapidly advancing field with pediatric airway endoscopy or bronchoscopy being a well-established procedure for both diagnostic and therapeutic purposes. Currently, interventional bronchoscopy in children is emerging as a new diagnostic and therapeutic tool in a wide variety of indications which were not possible earlier.

Advantage is that it is minimally invasive, cost-effective and time effective procedure. However, the limitation is that it is available in very few centres in the country due to lack of training and expertise.

It includes complex diagnostic procedures such as:

- ✓ **Endobronchial and brush biopsy**

In the above procedures a biopsy is taken under direct vision from the bronchial wall, or any abnormal or suspicious looking area and sent for microbiological and histopathological examination.

**Indications:**

Pneumonia

Tuberculosis

Fungal pneumonia

Infections in immunocompromised patients and post bone marrow transplant patients

- ✓ **Conventional transbronchial needle aspiration (cTBNA)**

This is a simple and easy method used to sample hilar and mediastinal lymph nodes in cases of suspected tuberculosis (especially when diagnosis is unclear or when resistant tuberculosis is suspected), malignancy or sarcoidosis. The enlarged lymph nodes are first diagnosed on CT (computerized tomography) of chest and then the site of sampling is localized. The advantage is that it is a less invasive method as compared to EBUS TBNA (Endobronchial ultrasound transbronchial needle aspiration)

✓ **Endobronchial ultrasound (EBUS) transbronchial needle aspiration (EBUS – TBNA)**

EBUS TBNA is similar to cTBNA in that it also involves sampling of enlarged lymph nodes in chest cavity in and around the airways or bronchi by penetrating a needle through the airway into the mass which is lying adjacent but outside the bronchus. The difference from cTBNA is that it is a highly precise and safe method as sampling is done by localizing the lymph node by using ultrasound waves. Hence the yield of sample is good and it has a high sensitivity. Also, smaller sized glands can also be sampled.

It is done under general anaesthesia. Usually, the pathologist is also called for the procedure and immediately processes the sample for adequacy and rapid diagnosis. This is called as **ROSE or rapid on - site examination**.

**Indications for cTBNA and EBUS TBNA**

- These procedures are used to sample paratracheal and peribronchial lymph nodes as well as parenchymal lung masses.
- Suspected tuberculosis
- Enlarged lymph nodes due to malignancy or metastasis
- Sarcoidosis or non - caseating lymph nodes
- Sampling of peripheral lesions such as pulmonary nodules
- Leukaemia
- Lymphoma

**Complications:**

- Pneumothorax or air leak into the pleural cavity
- Bleeding from biopsy site and presenting as blood in cough or hemoptysis
- Aspiration

**Transbronchial biopsy (TBB)**

This procedure is done to obtain lung biopsy via bronchoscopy. In the hands of experienced bronchoscopists, adequate tissue sampling is possible and gives a diagnostic yield of approximately 50%, which is equivalent to a diagnostic yield of about 50–80% for open lung biopsy (OLB) or video assisted thoracoscopic surgery (VATS). Generally, it is well tolerated and has a rapid post - procedure recovery as compared to VATS or OLB.

## **Indications**

The following conditions may require TBB:

- Interstitial pneumonitis
- Interstitial lung disease
- Post lung transplant
- Bronchiolitis obliterans
- Lymphoma
- Recurrent pneumonia
- Eosinophilic pneumonia
- Sarcoidosis
- Hypersensitivity pneumonia
- Asthma
- Cystic fibrosis
- Infections and
- Aspiration
- Chronic cough

## **May be preferred over VATS and OLB in risky patients such as:**

- Hyperinflation
- Severe hypoxaemia
- Uncorrectable coagulopathies
- Cystic fibrosis and
- Children on positive pressure ventilation

### ✓ **Cryobiopsy**

Cryoprobe is used to take lung biopsy. Pathologist is usually requested to do a ROSE to ensure that adequate sample has been obtained. Post procedure, child has to be monitored carefully to watch for pneumothorax.

### ✓ **Foreign body removal**

Accidental entry of food substances or any other foreign particle into the airway, is one of the most common indications of emergency bronchoscopies in children. The

most common foreign objects aspirated are peanuts and other nuts, parts of toys, metal pieces, outer shell of nuts etc.

Removal of these objects is possible by using flexible bronchoscopy and it reduces the cost, hospital stay as well as complications of removal like pneumothorax. It is done under local sedation and rarely under general anaesthesia.

### **When should foreign body aspiration (FBA) be suspected?**

When a child comes with a history of:

- Sudden choking
- Breathing difficulty with an acute onset
- Sudden onset wheeze
- Respiratory distress
- The above symptoms in addition to clinical findings of a localized wheeze, decreased air entry or severe retractions, should raise the suspicion of a FBA. Chest x ray may be suggestive if there is differential aeration, and in case of a metallic FBA, it may be seen. However, chest x ray may be normal in many cases.

### **Procedure:**

In aspiration of sharp objects or large foreign bodies, localization of the foreign body is done via the flexible scope and then removal is done via rigid scope.

In difficult cases and in case the child has a severe respiratory distress, removal is done by securing the airway first by using laryngeal mask airway (LMA) of appropriate size or endotracheal tube.

In older children, cryoprobe is used to remove vegetable foreign body.

After removal, check scopy is always done to ensure that there are no further foreign bodies as well as to check for any complications like bleeding.

### ✓ **Endoscopic balloon dilatation (EBD)**

This procedure is done to relieve airway obstruction due to a variety of conditions, by using endoscopic balloon via flexible bronchoscope. Usually, general anaesthesia and muscle relaxation with topical anaesthesia with lidocaine is used to reduce airway irritability. The airway is always secured first preferably via a laryngeal mask airway (LMA). Sometimes it is used along with cryotherapy to remove the pseudomembrane.

**Indications:**

- Tracheal stenosis
- Bronchial stenosis
- Laryngotracheal stenosis
- Post ventilation pseudomembrane
- Airway ballooning can be performed to achieve endobronchial occlusion in cases of bronchopleural fistula or massive haemoptysis

**Complications:**

- Dislodgement of the balloon
- Pneumothorax
- Airway rupture

✓ **Cryotherapy**

Cryotherapy is a procedure in which a freezing instrument is used during bronchoscopy. The cryogen or freezing agent is liquid carbon dioxide. The freezing probe is applied to the lesion and an ice ball is generated which is subsequently removed from the airway. The procedure may have to be repeated many times to remove the lesion.

**Indications:**

- Cryobiopsy of lung
- Foreign body removal
- Removal of a mass

✓ **Whole lung lavage (WLL)**

WLL is performed under general anaesthesia and muscle relaxation, with meticulous monitoring including heart rate, ECG, blood pressure and pulse oximetry

It is done by using a double-lumen endotracheal tube (ETT). Only one lung is washed at a given time, by using prewarmed normal saline. It can be performed either by use of passive gravity or by performing lavage or wash by using prewarmed normal saline in aliquots of 20–120 mL. The lavage is continued till the returning fluid is clear.

### **Indication for WLL**

- WLLs are performed in conditions in which there is alveolar filling by abnormal material as in pulmonary alveolar proteinosis.
- Metabolic disorders such as lysinuric protein intolerance
- Niemann–Pick disease
- Lipoid pneumonia

### ✓ **Endoscopic intubation**

Flexible bronchoscopic intubation is the most common primary indication for interventional bronchoscopy in paediatric intensive care patients especially in critically ill children and in difficult airways.

#### **Procedure:**

The endotracheal tube (ETT) is mounted on the flexible bronchoscope. The external diameter of the ETT should be more than 1 mm than the external diameter of the bronchoscope. It is secured near the proximal end. The lubricated bronchoscope is introduced via the nostril or the mouth and inserted into the larynx under local sedation. Once the bronchoscope enters the trachea, the ETT is advanced over it and positioned under direct vision. The bronchoscope is slowly withdrawn and the ETT is secured with a tape and its placement checked by auscultating.

### ✓ **Broncho pleural fistula (BPF) repair**

Bronchopleural fistula (BPF) usually is a complication of empyema, necrotising pneumonia, foreign body aspiration and iatrogenic as after surgery. Flexible bronchoscopy is used to confirm and/or treat persistent BPF. Selective instillation of methylene blue into segmental bronchi and its subsequent appearance in the chest drainage can confirm and localise the BPF. Further, endobronchial occlusion using a balloon can be done and the fistula confirmed by observing disappearance of the bubbling in the intercostal tube. The fistula can be closed with medical glue - like N-butyl cyanoacrylate glue.

Great care has to be taken for this procedure to avoid spillage into adjacent area and to prevent contact of the medical glue to the tip of the bronchoscope, hence experience and expertise is required.

✓ **Instillation of medical glue**

Tracheo-oesophageal fistula (TOF) repair is performed via flexible bronchoscopy as an alternative to open surgery. Different techniques are used as follows:

- Injection of a sealant
- De-epithelialisation of the fistula, or
- Combination of both

✓ **Atelectasis treatment**

Atelectasis means collapse of a part or segment of the lung which results in its non - aeration. If prolonged it become irreversible and lead to volume loss and may result in decreased oxygenation. Various endoscopic techniques can be used to open these collapsed areas like:

Local application of acetylcysteine, saline, and recombinant human DNase. In case mucoid plugs are present they may be removed. They are helpful in patients of chronic lung diseases like cystic fibrosis.

✓ **Control of hemoptysis**

Hemoptysis means presence of blood in cough. Various techniques may be used like:

- Therapeutic lavages with epinephrine (1:10 000 or 1:20 000 solution) or cold saline at 4°C
- Occlusion of the site of bleed by application of direct pressure by using Fogarty balloon

So, in conclusion, we have seen that in present times with the help of interventional bronchoscopy, a variety of diagnostic and therapeutic procedures can be performed in the hands of an experienced and expert pediatric bronchoscopist.