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Editorial

Medical Thoracoscopy -
The Window of Opportunity in Pleural Diseases

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Pleural disease remains common, affecting over 3000 persons per million population each year. It therefore contributes significantly to the workload of a Respiratory physician. To find out the cause of pleural effusion, thoracocentesis for biochemical/microbiological analyses of pleural fluid and closed pleural biopsy were usually employed. However, this initial analysis has low sensitivity to detect tuberculosis and malignancies; the two most important causes of pleural effusions in India. The advent of medical thoracoscopy has revolutionized the diagnostic approach of pleural diseases across the globe.

The concept of medical thoracoscopy (MT) is a simplification of video-assisted thoracic surgery (VATS), as it is done under conscious sedation through a single port by the chest physician. The 2010 update of British Thoracic Society (BTS) guidelines for pleural diseases recommended medical thoracoscopy (MT), surgical thoracoscopy (VATS) or radiology guided pleural biopsy in preference to closed pleural biopsy using Abram’s needle in the management of undiagnosed exudative pleural effusion. There are very few studies comparing the diagnostic yield of these procedures. In a prospective study in 40 cases from South Africa in tuberculosis, medical thoracoscopy had a diagnostic yield of 98% in comparison with an 80% diagnostic yield with Abram’s needle biopsy. In an intra-patient comparison study in tuberculosis, a histological diagnosis of tuberculosis was obtained in 94% of the cases by thoracoscopic biopsy compared to 38% with closed pleural biopsy using Trucut needle. Loddenkemper et al
reported a diagnostic yield of 95% for thoracoscopic biopsy compared to 44% with closed pleural biopsy alone and 74% when closed pleural biopsy was combined with fluid cytology in malignant pleural effusions. The sensitivity of MT for malignancy is approximately 93%-95% compared with pleural fluid cytology at 57.6% and closed pleural biopsy at 43%. The diagnostic yield of MT in pleural tuberculosis is 100% specific and sensitive based on histology and bacteriology compared with 79% with Abram's needle biopsy. A randomized controlled study conducted in South India reported a diagnostic yield of 86.2% with a complication rate of 10.3% with medical thoracoscopy when compared to a diagnostic yield of 62.1% and a complication rate of 17.2% with closed pleural biopsy group. The relatively low yield of closed pleural biopsy is due to several factors, including minimal and non-uniform pleural involvement in early disease. These limitations can be overcome by MT. The markedly improved yield of MT over other modalities is likely owing to the size of specimens and ability to reliably perform a biopsy of abnormal area under direct vision. When compared to surgical thoracoscopy (VATS), medical thoracoscopy has the advantage of being performed under local anesthesia and conscious sedation, in an endoscopy suite. Thus, it is considerably less invasive and less expensive. Hence in many centers, a nondiagnostic pleurocentesis is followed by thoracoscopy. In addition to its high diagnostic yield, thoracoscopy can be used for therapeutic procedures too. In this issue of the journal, Rennis D et al present the data of 250 thoracoscopies from his centre in the article “Medical thoracoscopy: Diagnostic utility in a tertiary care setting in South India”. A single center study on 250 subjects undergoing thoracoscopy is one of the few studies from South India. His result also reiterates the high positive yield of MT in exudative pleural effusion.

Rigid thoracoscopy, with or without video assistance has traditionally been the procedure of choice. A semi-rigid thoracoscope (pleuroscope) combining the features of rigid thoracoscope and flexible bronchoscope has been available since its first report in 1998. Two recent systematic reviews have concluded that the semi-rigid thoracoscope is a safe, easy-to-handle, and accurate tool in the diagnosis of pleural effusions of undetermined origin. Another retrospective study found comparable histologic yields of the rigid and the semi-rigid thoracoscopes. The decision to choose semi-rigid or rigid thoracoscopy depends on the extent of the adhesions found on imaging. It is suggested that semi-rigid thoracoscopy is unlikely to help in those with extensive adhesions, and one should directly resort to rigid thoracoscopy or VATS.

MT is mainly indicated for diagnosis of pleural effusions of unknown etiology. MT is also useful for evaluation of spontaneous pneumothorax and empyema. For those familiar with the technique, MT can also be used for diagnostic biopsies from the lungs, diaphragm,
mediastinum and pericardium. The commonest therapeutic procedures for which MT can be used are pleurodesis with talc poudrage for symptomatic recurrent malignant pleural effusion\textsuperscript{13} and recurrent pneumothorax.

Contraindications to MT are uncommon and rarely absolute. The main limitation is the size of the pleural space, which must be at least 10 cm in depth. If extensive adhesions are present MT can be carried out without creating a pneumothorax, but this requires special skills and should not be undertaken without special training\textsuperscript{14}. Several factors that make it necessary to delay MT, but are rarely prohibitive include a persistent cough, hypoxemia, hypocoagulability and cardiac abnormalities. Great care should be taken in presence of hypercarbia. Depending on its severity, respiratory failure proves to be an absolute contra-indication, except in patients with a tension pneumothorax or massive pleural effusion, in whom MT may provide a therapeutic benefit. In such conditions, premedication should be given judiciously. Contraindications to pulmonary biopsy are arteriovenous pulmonary aneurysms, vascular tumors, hydatid cysts and stiff fibrotic lung\textsuperscript{15}. Relative contraindications include previous systemic steroid or immunosuppressive therapy, as the resulting bronchopleural fistulas may heal poorly.

MT is a safe and effective treatment modality in the diagnosis and treatment of several pleuropulmonary diseases if standard criteria are fulfilled. Most of the series have reported a mortality rate of less than 0.1%. The reported complications in various studies were bleeding from a biopsy site, arrhythmias, hypotension, hypoxemia, persistent air leak of over 7 days, subcutaneous emphysema, postoperative fever, empyema, pulmonary infections and malignant invasion of the scar. In case of smaller persistent bleeding, electrocoagulation may be necessary. MT was associated with mortality and complication rates of 0.37% and 5.6%, respectively, whereas the complication rate with Closed-Blind Pleural Biopsy was 8.3% with no mortality\textsuperscript{16}.

In conclusion, MT is the procedure of choice in the evaluation of undiagnosed exudative pleural effusion, due to its higher success rate and an acceptable safety profile. Hence MT has an irrefutable role in the management of exudative pleural effusion and should be the next investigation after an initial inconclusive pleural fluid study.

**References**

1. Maskell NA, Butland RJA, on behalf of the British Thoracic Society Pleural Disease Group. BTS guidelines for the investigation of a


Review Article

High Flow Nasal Cannula for Oxygen Delivery in Pulmonary and Critical Care Practice

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Abstract

Oxygen therapy is the mainstay of treatment in critically ill hypoxic patients with different primary disease states. The therapeutic benefits of oxygen therapy depend heavily on its judicious usage. The delivery device has a key role in the success of oxygen therapy. The choice of oxygen delivery device depends on a multitude of factors including the magnitude of oxygen requirement, efficacy of the device, reliability, ease of therapeutic application, cost of therapy and patient acceptance. Although design plays an important role in selection of these devices, clinical assessment of performance and response is crucial to success. Oxygen delivery devices are categorized into three basic types based on their design: low-flow, reservoir, and high-flow. Regarding the FiO2 range oxygen systems can be divided into three indicated for low oxygen delivery (<35%), moderate delivery (35%-60%) or high delivery (>60%). Some devices can deliver a wide range of oxygen percentages.

The high flow nasal cannulas are high flow oxygen delivery devices that deliver adequately heated and humidified medical gas at up to 60 L/min of flow. High-flow nasal cannula (HFNC) oxygen therapy comprises an air/oxygen blender, an active humidifier, a single heated circuit, and a nasal cannula. It is easy to administer and is well tolerated by patients.

Key words

Respiratory failure, oxygen therapy, respiratory circuits, oxygen delivery devices

Background

Supplemental oxygen therapy is the cornerstone and first-line treatment for hypoxemic respiratory failure due to a multitude of aetiologies. Oxygen supplementation allows immediate correction of hypoxia, rapidly stabilises the hypoxic subject and provides time for definitive therapeutic measures to act. Oxygen may be supplemented via a variety of delivery devices, each having its own unique advantages and disadvantages. The present review briefly touches upon the various currently available delivery devices and attempts to enlist the shortcomings of existing devices. We also provide a detailed description of high flow nasal cannula, a relatively new oxygen delivery device, which circumvents many of the disadvantages.
of conventional ones. Emphasis is placed on available evidences and practical recommendations for bedside usage.

**Supplemental Oxygen therapy**

Oxygen delivery devices may be broadly grouped into low flow and high flow devices. High flow devices deliver oxygen at flow rates sufficient to meet the inspiratory demand of the subject. They therefore, tend to deliver reliable FiO2 levels, although minor fluctuations may be expected based on the degree of tight-fit of the interface. On the other hand, low flow devices deliver O2 at flow rates less that inspiratory requirements and hence deliver imprecise FiO2 levels. The common low flow devices include simple O2 cannula, O2 catheter, simple face mask etc, whereas the venturi mask and non-rebreathing reservoir bag mask are high flow devices. It has to be noted that high flow device is not synonymous with high FiO2 and vice versa. We can deliver low levels of precise FiO2 via a high flow delivery device like venturi mask.

The conventional devices pose a lot of challenges to oxygen delivery.1 During spontaneous breathing, inspired gas has to move through the upper air passages and trachea which effectively warm the air to body temperature and humidify it with water vapour. This is successfully achieved even when the ambient air is cold and dry. Supplemental oxygen is made up of dry gas and is not usually humidified when administered at low flow rates. Dry or poorly humidified medical gas may have adverse medical consequences, such as dry nose, dry throat, and nasal pain, and consequent poor tolerance of oxygen therapy. Unconditioned gas increases airway resistance and contributes to worsening work of breathing.2 Breathing dry air is known to reduce nasal and bronchial mucociliary clearance.3 Using conventional devices, the maximum attainable oxygen flow is limited to 15 L/min. The inspiratory flow demand for critically ill respiratory patients varies widely, ranging from 30 to 120 L/min, which cannot be delivered via the above mentioned devices. This may translate to lower delivered FiO2 than the real patient needs and fluctuating / unreliable FiO2 levels. All these may have adverse effects on clinical outcomes.

**High flow nasal cannula**

High flow nasal cannula is a relatively new oxygen delivery device that is slowly establishing its place in recent years as a safe and efficacious mode of administering supplemental O2.4 It delivers conditioned gas at near body temperatures (37 °C) containing 44 mg H2O/l [100% relative humidity] using a heated humidifier and a heated inspiratory circuit. This is delivered at patient’s nares through a wide bore nasal cannula at very high flow (up to 60 l/min) at a predetermined constant oxygen concentration (21 to 100%). This technique of delivery, as discussed below, has a lot of physiological and clinical benefits in many disease states.

**Pathophysiological mechanisms of clinical benefits**

High flow nasal cannula (HFNC) supportive therapy exerts its beneficial effects through a variety of potential mechanisms.

1. Provision of high and precise FiO2 – HFNC with its high flow rate of upto 60 litres / minute can deliver high FiO2 as well as precise FiO2 (because the inspiratory flow rate can be met even in significantly hyperventilating subjects). With HFNC, especially at high flow, actual delivered FiO2 is almost equal to calculated (predicted) FiO2. In published literature, it was seen that during nose breathing, at inspiratory flow above 30 L/min, the measured FiO2 was close to the delivered FiO2 with HFNC.5

2. Dead space wash out and CO2 clearance - By providing a high fresh air flow during expiration, HFNC is capable of effectively washing out the carbon dioxide contained in the anatomical dead space, thus contributing to CO2 clearance.6 Further, the gaseous admixture achieved by continuous stream of a high flow gas mixture facilitates oxygenation and CO2 clearance.

3. PEEP effect - HFNC therapy contributes to a positive pharyngeal and airway pressure during expiration due to its constant high gas flow. The magnitude of PEEP attained is determined by the flow rate and the expiratory flow exhaled by the patient. Lower pressures are observed when the
patient keeps the mouth open.' Despite this uncertainty about how much positive end-expiratory pressure (PEEP) can really be offered by HFNC, studies have consistently shown increasing end expiratory lung impedance with higher flow rate of HFNC, which is a surrogate marker of an increase in end expiratory lung volume.

4. Effects of humidification - Conditioning of the gas reduced the chance of bronchospasm, improves airway calibre and reduces the work of breathing. Furthermore, conditioned gas improves mucociliary function and thereby promotes clearance of secretions. All these translate to lesser incidence of atelectasis, resulting in a good ventilation/perfusion ratio and better oxygenation. In other words, conditioning gases may be viewed upon as a lung recruitment strategy.

5. Reduction of nasopharyngeal resistance - Another crucial effect noticed with HFNC therapy is the reduction in nasopharyngeal air flow resistance. Research on obstructive sleep apnea subjects by analysing flow volume loops in the nasopharynx has revealed that the nasopharynx is expansible thereby accounting for variations in resistance. The most probable mechanism by which HFNC reduces inspiratory nasopharynx resistance is likely to be by increasing inspiratory flow.

**Indications for O₂ therapy with HFNC**

HFNC as an oxygen delivery device has been tried in a multitude of clinical conditions and a critical appraisal of each and every published trial is beyond the scope of this review. However, the following general comments can be made regarding the published evidences. HFNC has to its credit a higher body of evidence in hypoxemic respiratory failure than hypercapnic failure. The clinical scenarios where HFNC has been employed have been summarised in table 1.

1. Acute hypoxemic respiratory failure due to pneumonia and ARDS
2. Acute hypoxemic respiratory failure due to cardiogenic pulmonary edema
3. Post extubation respiratory compromise
4. During airway and upper gastrointestinal endoscopies
5. During anaesthesia induction and airway instrumentation
6. Immunocompromised subjects with respiratory failure
7. End of life care patients

The first entity has the largest published body of evidence in contemporary medical literature.

<table>
<thead>
<tr>
<th>Indications</th>
<th>Evidences on HFNC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute hypoxemic respiratory failure due to pneumonia and ARDS</td>
<td>Early studies of HFNC in patients with acute respiratory failure focused on the effects on physiological variables and reported improvements in oxygenation with reductions in respiratory rate and no observed alterations in PaCO₂. The first randomized controlled trial (RCT) was conducted on postoperative cardiac surgery patients with mild to moderate acute</td>
</tr>
<tr>
<td>Acute hypoxemic respiratory failure due to cardiogenic pulmonary edema</td>
<td></td>
</tr>
<tr>
<td>During anaesthesia induction and airway instrumentation</td>
<td></td>
</tr>
<tr>
<td>During invasive airway procedures (bronchoscopies)</td>
<td></td>
</tr>
<tr>
<td>Post extubation respiratory compromise</td>
<td></td>
</tr>
<tr>
<td>Respiratory failure in emergency department</td>
<td></td>
</tr>
<tr>
<td>Immunocompromised subjects with respiratory failure</td>
<td></td>
</tr>
<tr>
<td>End of life care</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1 : Usual Indications for Using HFNC**
respiratory failure. This trial observed that HFNC patients were less likely to need escalation to NIV and had fewer desaturations than those who received supplemental O₂ via a standard high flow face mask. In another analysis of a cohort of 37 lung transplant patients readmitted to the ICU because of acute respiratory failure, HFNC therapy was the only variable at ICU admission associated with a decreased risk of mechanical ventilation in the multivariate analysis.

In the authors’ opinion the real landmark trial that attracted the attention of the scientific world to this modality of therapy was published in 2015. This study had the advantage of being a large RCT published in a journal with high impact factor. The study included 310 patients with acute hypoxemic acute respiratory failure having a PaO₂/FiO₂ ratio ≤ 300 mmHg with 10 litre per minute of O₂, a clinical scenario that would probably fit into the Berlin definition of ARDS. The study had stringent exclusion criteria, which would raise concern for its use in many critical care scenarios, but is probably justified considering this as an early path breaking study. Patients with a history of chronic respiratory disease, including COPD, as well as patients with acute cardiogenic pulmonary edema, severe neutropenia and hypercapnia (PaCO₂ > 45 mmHg) were excluded, as were patients with other organ failures, including hemodynamic instability or vasopressors at the time of inclusion. The commonest etiology of acute respiratory failure was pneumonia. Study subjects were randomised to supplemental O₂ via HFNC versus NIV. Although the primary outcome, the intubation rate, did not differ between the treatment arm and controls, the 238 patients with a PaO₂/FiO₂ ratio ≤ 200 mmHg found that HFNC reduced intubation rates (p = 0.009). In the entire cohort, HFNC increased ventilator free days, reduced 90 day mortality and was associated with better comfort and lower dyspnea severity. In contrast, NIV patients had higher 90 day mortality rates than HFNC patients.

HFNC has been used in the peri-intubation setting and has the advantage, as opposed to bag and mask ventilation, that it continues to deliver high FiO₂ levels even when the process of endotracheal tube insertion is ongoing. Although not routine, HFNC is an acceptable way to provide oxygen to patients undergoing intubation, both before (preoxygenation) and during the procedure (to prevent desaturation). Data are conflicting regarding the value of HFNC for preoxygenation prior to intubation. One randomized single centre study compared four minutes of preoxygenation with HFNC (100 percent FiO₂ at 60 L/minute) together with concomitant NIV (10 cm H₂O pressure support ventilation and 5 cm H₂O PEEP) with NIV alone prior to intubation. HFNC/NIV resulted in higher peripheral oxygen saturations (100 versus 96 percent) and fewer patients with episodes of desaturation below 80 percent (0 versus 21 percent). In contrast, in a multicentre study of 124 patients undergoing intubation who had severe hypoxemia (PaO₂/FiO₂ ratio <300 mmHg, respiratory rate >30 breaths/minute, and a FiO₂>50 percent to achieve a saturation of >90 percent), HFNC did not reduce the lowest saturation during intubation when compared with preoxygenation using a conventional high-flow oxygen face mask.

HFNC has also been used to successfully oxygenate hypoxemic patients undergoing fiberoptic bronchoscopy. Such patients are at high risk of respiratory decompensation requiring ventilator support as a consequence of the procedure. In a randomized trial of 40 patients with hypoxemic respiratory failure who underwent bronchoscopy, there was no difference in peripheral oxygen saturation between patients who were supported with NIV and patients supported with HFNC. One HFNC patient deteriorated and required NIV; however, three NIV patients required endotracheal intubation within 24 hours of bronchoscopy versus one in the HFNC group. The role for HFNC during high-risk bronchoscopy remains to be defined with larger studies.

Studies have looked at the success of HFNC in post extubation respiratory failure subjects. The first RCT comparing HFNC with conventional oxygen devices after extubation included patients with acute respiratory failure due to pneumonia and trauma who were mechanically ventilated for a mean of almost five days before extubation. In these patients, the use of HFNC was associated with better comfort, better oxygenation, fewer desaturations and interface displacements, and a lower reintubation rate. Hernandez et al. compared HFNC with NIV in patients at high risk for reintubation in a non inferiority trial. This study confirmed that the reintubation rate was non inferior in the HFNC group compared to the NIV group within 72 h (22.8% vs 19.1%). For postextubation respiratory failure, the authors reported a lower rate in
the HFNC group compared to the NIV group (26.9% vs 39.8%), suggesting that the postextubation respiratory failure rate could be even higher in the NIV group.

Tables 2 and 3 given below summarise some of the major trials conducted with HFNC in respiratory and critical care arenas.

### Table 2: Major trials of HFNC in acute hypoxemic respiratory failure and cardiac surgery

<table>
<thead>
<tr>
<th>ETIOLOGY</th>
<th>YEAR (NUMBER)</th>
<th>STUDY GROUP</th>
<th>NATURE OF STUDY</th>
<th>OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Hypoxemic Respiratory Failure</td>
<td>2015 (37)</td>
<td>Roca et al</td>
<td>Retrospective cohort</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>2015 (313)</td>
<td>Frat et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>2015 (100)</td>
<td>Lemiale et al</td>
<td>RCT</td>
<td>No change</td>
</tr>
<tr>
<td></td>
<td>2015 (175)</td>
<td>Kang et al</td>
<td>Retrospective observational study</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>2015 (178)</td>
<td>Mokart et al</td>
<td>Retrospective propensity matched</td>
<td>Positive</td>
</tr>
<tr>
<td>Cardiac Surgery</td>
<td>2013 (340)</td>
<td>Parke et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>2015 (155)</td>
<td>Corley et al</td>
<td>RCT</td>
<td>No change</td>
</tr>
<tr>
<td></td>
<td>2015 (830)</td>
<td>Stephan et al</td>
<td>Randomised non inferiority</td>
<td>No change</td>
</tr>
</tbody>
</table>

### Table 3: Major trials of HFNC in Post extubation subjects, ED and during invasive procedures

<table>
<thead>
<tr>
<th>ETIOLOGY</th>
<th>YEAR (NUMBER)</th>
<th>STUDY GROUP</th>
<th>NATURE OF STUDY</th>
<th>OUTCOME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoxygenation</td>
<td>2015 (124)</td>
<td>Vourch et al</td>
<td>RCT</td>
<td>No change</td>
</tr>
<tr>
<td>Post extubation</td>
<td>2014 (105)</td>
<td>Maggiore et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>2014 (17)</td>
<td>Rittayamai et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>2010 (50)</td>
<td>Tiruvoipati et al</td>
<td>RCT</td>
<td>No change</td>
</tr>
<tr>
<td></td>
<td>2016 (527)</td>
<td>Hernandez et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
<tr>
<td>During bronchoscopy</td>
<td>2012 (45)</td>
<td>Lucangelo et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>2014 (40)</td>
<td>Simon et al</td>
<td>RCT</td>
<td>Negative</td>
</tr>
<tr>
<td>Emergency Department</td>
<td>2015 (40)</td>
<td>Rittayamai et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>2015 (303)</td>
<td>Jones et al</td>
<td>RCT</td>
<td>Positive</td>
</tr>
</tbody>
</table>

Table 2: Major trials of HFNC in acute hypoxemic respiratory failure and cardiac surgery

Table 3: Major trials of HFNC in Post extubation subjects, ED and during invasive procedures
Instrumentation

HFNC is being commercially marketed by Fisher and Paykel health care under the trade name AIRVO 2. The AIRVO 2 has a humidifier with integrated flow generator that delivers high flow warmed and humidified respiratory gases to spontaneously breathing patients through a variety of patient interfaces.

It has an inbuilt heated humidifier with ports for oxygen inlet, heated breathing tube and a slot to mount the auto fill water chamber. Reusable accessories include the water chamber, the heated breathing tube and the patient interface. The interface is available in paediatric and adult sizes. The device has no battery back-up and mandatorily needs a power source to work. Control panel exhibits the temperature of delivered gas, flow rates and FiO₂. Flow rates and temperature can be directly set whereas the FiO₂ can be adjusted by controlling the O₂ inflow rate into the blender.

Bedside Institution

There are no set recommendations for its practical application; thus, the suggestions below is an opinion of the authors based on sound rationale and our own practice. Although HFNC can be administered on an unmonitored floor, in our opinion, it is best applied in a monitored setting such as the intensive care unit, high dependency unit, or emergency department. Our recommendation is based upon the rationale that patients in need of HFNC are at high risk of severe respiratory failure or mechanical ventilation, in which case a closely monitored setting is often needed. However, once the patient improves and needs serially reduced oxygen requirements (e.g., 50 L/minute at 60 percent fraction of inspired oxygen [FiO₂]), HFNC may be delivered in a less monitored setting.

Oxygen flows from the source, is heated and humidified, and is then delivered to the patient through wide bore nasal cannulae, which are generally made of softer, more pliable plastic than cannulae for low-flow systems. The cannulae fit snugly into the nares and are held in place with a head strap. Two parameters need to be set for optimal care are the flow rate through the cannula and the FiO₂. The temperature also needs to be set, but is more of a concern for patient comfort. We prefer to set the flow rate first, typically at 20 to 35 L/minute (range 5 to 60 L/minute). The FiO₂ (range 21 to 100 percent) is next set to target a desired peripheral oxygen saturation. The flow rate can subsequently be increased in 5 to 10 L/minute increments if the respiratory rate fails to improve, oxygenation fails to adequately improve, or breathing remains laboured. Increasing the flow rate and FiO₂ will both result in improved peripheral oxygen saturation; we prefer to maximize the flow rate first in an attempt to keep the
FiO₂ ≤ 60 percent; however, an increase in FiO₂ may be necessary to achieve adequate oxygenation. Patients may be switched to conventional low-flow nasal cannula system once the flow rate reaches ≤ 20 L/minute and FiO₂ ≤ 50 percent.

**Predictors of success**

Reliance on early predictors of HFNC success is important given the fact that delayed intubation may worsen the prognosis of patients treated with HFNC. Therefore, the ability to describe accurate predictors of HFNC success that can allow timely endotracheal intubation in patients who are likely to fail is of paramount importance. Sztrymfet al. reported that respiratory rate as well as the percentage of patients exhibiting thoracoabdominal asynchrony as early as 30 and 15 min after the beginning of HFNC were significantly higher in patients who required endotracheal intubation. Moreover, the PaO₂/FiO₂ ratio 1 h after the start of HFNC was significantly lower in patients requiring invasive mechanical ventilation. Interestingly, a recent prospective study showed that patients with severe pneumonia who had a ROX index (defined as the ratio of SpO₂/FiO₂ to respiratory rate) ≥ 4.88 after 12 h of HFNC therapy were less likely to be intubated, even after adjusting for potential covariates. From the previous evidences, it is clear that physiological and clinical response in the first few hours of institution helps predict success of HFNC and anyone who does not improve fast potentially needs early intubation and mechanical ventilation.

**Shortcomings of HFNC**

From a clinical stand point, O₂ supplementation with HFNC needs to be head to head compared with other O₂ delivery systems as well as non-invasive ventilation (NIV) with regard to superiority and shortcomings. Clearly, HFNC is a superior O₂ delivery device than O₂ cannula, face mask, venturimask etc in its ability of being a reliable and comfortable device. The challenges dealt with relate to the economic implications, HFNC being a costly device. There needs to be personnel who are familiar with the setting up and disinfection of the HFNC apparatus and setting up takes more time delay than conventional O₂ devices.

With regard to NIV, HFNC therapy and NIV have fundamental differences, each device having some advantages and limitations. The significantly better comfort and better tolerance of HFNC therapy compared with NIV, permitting nearly 24 h of daily use, are significant advantages and justify using HFNC therapy as the first alternative if O₂ supplementation is the sole aim. The role of HFNC therapy during the weaning period is questionable with regard to physiological rationale and evidences. Even if HFNC therapy provides a continuous flow, pressure is low and not continuous. The ability of HFNC therapy to reduce work of breathing in patients with COPD and high level of auto - PEEP is questionable. Most importantly, institution of HFNC should not delay intubation and mechanical ventilation, because unduly delayed mechanical ventilation has been shown to be deleterious in multiple studies. The readers should keep in mind the universal problem with these kinds of studies with regard to near impossibility of blinding, introducing a major bias.

**Conclusion**

Delivery of heated and humidified air-oxygen gas mixture at high flow rates through HFNC is increasingly being employed in adult patients with critical respiratory illness. Its mechanisms of action are physiologically sound and potential clinical benefits consistently demonstrated in trials. It has the potential to improve the management of patients with acute respiratory failure or during the weaning phase. With the currently available evidence, there are prevailing uncertainties in many aspects of HFNC usage; there is strong evidence for usage in some clinical indications, whereas the body of evidence is bleak in some others. Institution of HFNC treatment should be individualized in each particular situation and due consideration needs to be given to local experience, expertise and resources. Notwithstanding all these shortcomings, HFNC therapy is still an innovative and powerful technique that is currently changing the management of patients with respiratory failure.

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Medical Thoracoscopy: Diagnostic Utility in a Tertiary Care Setting in South India

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Abstract

Introduction

Medical thoracoscopy is a minimally invasive procedure for inspecting the pleura, diagnosing and treating pleural diseases, especially undiagnosed exudative pleural effusions.

Objective

To analyse the results of medical thoracoscopy in our hospital over a specific time period.

Materials and Methods

A hospital record based descriptive study with respect to patients who underwent medical thoracoscopy between 2011 and 2018 in Amala Medical College, Thrissur.

Results

Among the 250 patients who underwent medical thoracoscopy, malignant effusions were seen in 88 (35.2%); Tuberculosis was seen in 68(27.2%); Chronic inflammation in 35 (14%); Empyema in 10 (4%); benign cells in 8 (3.2%); inconclusive result in 35 (14%); normal study in (2%) and Silicosis in 1 patient.

Conclusion

Medical thoracoscopy is a useful procedure for the diagnosis of pleural diseases due to its safety, shorter hospital stay and high diagnostic yield.

Key words

Medical Thoracoscopy, Diagnostic Utility, Tuberculosis, Malignancy, South India
Introduction

Thoracoscopy is a procedure that involves access to the pleural space with an endoscope and allows direct visualization of the pleural space and intrathoracic structures and aids in obtaining tissue or performing interventions under direct visual guidance. Pleural effusions are a frequently encountered condition in pulmonary medicine outpatient clinics. Thoracentesis is often able to establish a diagnosis and is an appropriate first step, but how to approach undiagnosed exudative pleural effusions remains a source of debate.

The recent rapid growth in the field of interventional pulmonology along with the evolution of sedation techniques and development of flexirigid thoracosopes has brought Medical thoracoscopy (MT) to the forefront.

Over the past two decades, medical thoracoscopy has developed very rapidly in India, and has gradually become the first-choice for pleural biopsy instead of video-assisted thoracoscopic surgery (VATS). With thoracoscopy, one can visualise the entire visceral and parietal pleura and take pleural biopsy from suspicious sites under vision. Larger pleural biopsy specimen taken under direct vision allows greater diagnostic yield up to 90 percent. Diagnosis of pleural tuberculosis can be achieved in 99% of patients with thoracoscopy, which is higher than the 51% yield for closed pleural biopsy.

Similarly, yield of thoracoscopic pleural biopsy is higher in patients with suspected pleural malignancy. A diagnosis could be achieved in 95% of patients as against 44% patients using closed pleural biopsy. Medical thoracoscopy can also be used for therapeutic procedures, such as adhesiolysis and evacuation of pleural fluid in patients with empyema, pleurodesis in patients with malignant pleural effusion and spontaneous pneumothorax. This study aims to explore the diagnostic profile of this procedure, with respect to patients who underwent the same in a tertiary care hospital setting.

Objective

To analyse the results of medical thoracoscopy for a variety of pleural diseases in a tertiary care hospital setting and to explore the diagnostic profile, safety and complications of this procedure.

Materials and Methods

Conceived as a hospital record based descriptive study of the medical thoracoscopies done during the period 2011-2018, all patients with pleural diseases who underwent medical thoracoscopy during this study period in Amala Medical College were included in the study. Descriptive statistical methods were used in the data analysis (mean, Standard Deviation etc.). Being a record based study, permission of the gatekeeper of information was obtained and patient identifiers were not extracted. The diagnosis of pleural disease was established by the presence of the positive findings of respective diseases in pleural biopsy. All patients underwent detailed clinical evaluation with history and clinical examination. Computed tomography (CT) of the chest was performed when necessary to assess feasibility of thoracoscopy. All patients undergoing thoracoscopy were investigated with complete blood count including prothrombin time (PT), activated partial thromboplastin time (aPTT) and platelet count to rule out bleeding diathesis. Patients with platelet count less than 50,000/mm3 and those with PT or aPTT prolonged by more than four seconds above control were not subjected to thoracoscopy. Patients were kept fasting for 4 hours prior to the procedure. Vascular access was achieved with intravenous cannula inserted in the upper limb opposite to the side of thoracoscopy. Patients were positioned in lateral decubitus with diseased side up and with the arm on the side of thoracoscopy positioned above the patient's head. This allowed better access and widens the intercostal spaces. Thoracoscopy was conducted under conscious sedation with intravenous midazolam, small doses of pentazocine (for pain relief) and promethazine. The skin, subcutaneous tissue, intercostal muscle and parietal pleura were anesthetised with 2% lignocaine. A single port was used for visualising and taking pleural biopsy or for sampling of pleural fluid. A 1.5cm to 2cm long skin incision along the line of intercostal space was given in 4th or 5th intercostal space in mid-axillary line (Triangle of safety) using sterile surgical blade. After blunt dissection of subcutaneous tissue and the intercostal muscles with curved artery forceps, a cannula of 10mm diameter with blunt trocar is inserted into the pleural cavity. The trocar was then
replaced with semi flexible scope. Pleural fluid was suctioned to enable clear visualization of entire pleural surface. Thoracoscope was manoeuvered to see visceral, costal, diaphragmatic pleura as well as the costophrenic recess. Adhesions were gently lysed using thoracoscope or biopsy forceps to allow better visualizations of pleura. After selecting suitable site on parietal pleura for biopsy, biopsy forceps was introduced through working channel of the thoracoscope. The pleura was grasped under vision and biopsy was taken with a lateral movement of the thoracoscope. After the procedure was completed, thoracoscope and the cannula were removed and a 28 to 32 Fr chest tube was inserted. Chest drain was connected to an underwater-seal. Once the lung had expanded and drain output had decreased to less than 150mL over 48hours, chest drain was removed. For malignant pleural effusions (as per histopathological report) pleurodesis is achieved by instilling 2-4 gm of talc through the intercostal drain and clamped for 12 hours before removal.

**Results**

A total of 250 patients (62% males; 38% females) underwent medical thoracoscopy. The mean age of the study sample was 57.6yrs. These patients had a variety of pleural diseases varying from undiagnosed pleural effusions (240), empyemas (10) to persistent air leaks (3). Out of the 250 patients who underwent the procedure, 88 (35.2%) had malignant pleural effusion (see Table 1). Out of these 42 (47.78%) were found to have Adenocarcinoma; 17 (19.31%) Metastasis; 10 (11.36%) Mesothelioma; 6 (6.81%) poorly differentiated carcinoma; 5 (5.6%) Small cell carcinoma and 4(4.54%) were reported as Non Small Cell Carcinoma after pathological diagnosis. Only 2 patients were diagnosed with Squamous Cell Carcinoma and there were just one case each of lymphoma and sarcoma. Relevant cases underwent further Immuno histochemistry typing for planning of treatment purposes.

A diagnosis of Tuberculosis as evidenced by granulomas on biopsy was seen in 68 (27.2%) patients. Out of those who were diagnosed with Tuberculosis by biopsy, 44 patients had high clinical suspicion.

The number of mesotheliomas diagnosed by thoracoscopy was 10. The diagnosis of Silicosis was obtained in 1 patient.

10 (4%) patients had Empyema, chronic inflammation was seen in 35 (14%), an inconclusive result was seen in 35 (14%) possibly due to transudative nature of pleural effusion screened to look for any additional pathology. 5 (2%) patients had a normal histopathological report. 8 (3.2%) patients had a pathology report of benign reactive cells and 1 patient had silicotic nodule confirming silicosis.

Chronic inflammation, a normal pleura and benign reactive cells were seen in patients with persistent air leak, in patients with recurrent pneumothorax and in some patients with exudative pleural fluid picture where no cause could be determined. It should be noted that some of these patients had an underlying chronic kidney disease or coronary heart disease, but evaluation of its significance is beyond the scope of this study.
Table - 1: Diagnosis after histopathology among the 250 patients who underwent thoracoscopy

<table>
<thead>
<tr>
<th>Confirmed Diagnosis</th>
<th>Number</th>
<th>(n - 250)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculosis</td>
<td>68</td>
<td>27%</td>
</tr>
<tr>
<td>Malignancy</td>
<td>88</td>
<td>35%</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>42</td>
<td>48%(37.5-58.4)</td>
</tr>
<tr>
<td>Squamous cell Carcinoma</td>
<td>2</td>
<td>2%(0-4.9)</td>
</tr>
<tr>
<td>Small Cell Carcinoma</td>
<td>5</td>
<td>6%(1.03-10.9)</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>1</td>
<td>1%(0-3.07)</td>
</tr>
<tr>
<td>Sarcoma</td>
<td>1</td>
<td>1%(0-3.07)</td>
</tr>
<tr>
<td>Mesothelioma</td>
<td>10</td>
<td>11%(4.46-17.5)</td>
</tr>
<tr>
<td>Poorly Diff Carcinoma</td>
<td>6</td>
<td>7%(1.66-12.3)</td>
</tr>
<tr>
<td>NSCLC</td>
<td>4</td>
<td>5%(0.44-9.55)</td>
</tr>
<tr>
<td>Metastasis from other organs</td>
<td>17</td>
<td>19%(10.8-27.1)</td>
</tr>
<tr>
<td>Silicosis</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Empyema</td>
<td>10</td>
<td>4%</td>
</tr>
<tr>
<td>Inconclusive</td>
<td>35</td>
<td>14%</td>
</tr>
<tr>
<td>Normal</td>
<td>5</td>
<td>2%</td>
</tr>
<tr>
<td>Benign reactive cells</td>
<td>8</td>
<td>3%</td>
</tr>
<tr>
<td>Chronic Inflammation</td>
<td>35</td>
<td>14%</td>
</tr>
</tbody>
</table>

A haemorrhagic appearance was seen in 42 patients (17.5%) straw coloured in 190 patients (79.16%) while pus was obtained in 8 patients. Among the patients with haemorrhagic effusion 41 (97.6%) were diagnosed with malignancy.

Pleural fluid cytology was able to diagnose TB successfully in 37 patients with thoracoscopy confirmed results (see Table 2). In thoracoscopy confirmed malignancy only 12 patients got a successful positive result. This is possibly due to presence of paramalignant effusions. Atypical cell clusters were seen in patients with malignancy and in those with inconclusive biopsy results. Eosinophilic effusion was seen in a patient with Non small Cell Lung Cancer.

Discussion

Medical thoracoscopy is a procedure
Increasingly being used in India. Since the prognosis for patients with malignant pleural effusion is poor, an efficacious procedure that can establish a definite diagnosis as early as possible with a minimum risk and discomfort would be highly desirable. If a patient with undiagnosed pleural effusion is suspected as malignant, cytologic examination of pleural fluid is the first choice of investigation. Although repeated thoracentesis can enhance the sensitivity of cytology, it is usually only up to 50 to 70%. CT or ultrasound-guided pleural biopsies are quite sensitive and safe, with the only reported complications being local hematoma and minor hemoptysis. The limitation of the image-guided pleural biopsy is the blindness of the procedure and chances of iatrogenic pneumothorax.

Closed percutaneous needle biopsy was traditionally performed blindly by an Abrams or cope's needle, but its diagnostic yield is only 50%. The medical thorascopies are useful in this context, and help in a positive diagnosis in 86% of cases (215/250). There was a yield of 35.2% with respect to malignancy. These results are corresponding to the results obtained by Wu et al (41%) which is a larger scale similar study conducted in China.

With respect to the morphology, a wide pattern was seen including large nodules, small sago grain like granular nodules, septations, adhesions, plaques, pleural hyperemia and thickening. Large nodular lesions appear to be more in favour of a malignant etiology (68/88), while sago grain/granular nodules seemed to favour a diagnosis of tuberculosis (23/68). India is a region prevalent in tuberculosis, which also explains its high yield 27.2%. The patients with tuberculosis also were found to have septations, adhesions, loculations and some amount of hyperemia. It has been reported that carcinoma from any organ can metastasize to the pleura, but lung and breast carcinomas and lymphomas are the most common causes, digestive and ovary carcinomas are less frequent. Our study confirms that the most common sites of metastasis is from the lung. Other sources include breast, lymphoma, sarcoma and colorectal cancers. Primary pleural malignancy was seen in only 10 patients. It was noted that no etiological causes of pleural effusions could be identified in 14%. This was similar to the results reported by Wu et al (7.4%). The patients with inconclusive results after this procedure further underwent bronchoscopy (n=22) or CT guided biopsy (n=2) for diagnosis. There was a suspicion of intraluminal extension of mass or peripheral nodules by CT scan in these cases.

With respect to complications post procedure, 1 patient developed bronchopleural fistula, 1 patient developed hypoxia which responded to oxygen therapy. No serious adverse events were observed, and transient chest pain induced by the indwelling chest tube was the most frequent minor complication. Complications like bleeding, subcutaneous emphysema or post procedure infection were not seen though described in various other studies.VATS had to be done in 4 patients post thoracoscopy for bullae excision or bronchopleural fistula.

Medical thoracoscopy has an excellent safety profile when performed by a trained physician. Mortality rate associated with medical thoracoscopy is about 0.8%. The strength of this study is that, it is a large scale study in South India which examines the efficacy of a relatively new procedure. At the same time, no long term follow up of patients was done, which can be taken as a limitation of this study. Though we had data of patients with both biopsy proven tuberculosis and malignant etiologies as causes for effusion, their pleural fluid analysis were not always done at our centre in ~20% of patients prior to procedure. Before undergoing thoracoscopy, blind needle biopsies or image assisted biopsies were performed only in a few patients, due to financial constraints. Moreover this study included data from only a single pulmonologist of the same centre due to feasibility issues.

**Conclusion**

In India, a large number of pleural diseases exist of which malignancy and tuberculosis still appear to be the most common. Since medical thoracoscopy is a safe, easy to perform procedure with a very high yield, this procedure should be performed more actively in all cases where non invasive techniques fail to reach a diagnosis.
Acknowledgements

The Authors would like to acknowledge the guidance and help received from Dr. Sanjeev Nair, Associate Professor, Department of Pulmonary Medicine, Government Medical College, Thiruvananthapuram & Dr. Hisham Moosan, Technical Expert - Epidemiology, Regional Technical Resource Centre for HTA, Achutha Menon Centre for Health Science Studies, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, in analysis & drafting of the manuscript of this article.

References


A 79 year old female, presented with persistent non pleuritic, non cardiac central chest pain, chronic dry cough and MMRC grade 2 dyspnea on exertion for the last 6 months.

Respiratory examination was normal.

Relevant images of her digital Xray of chest and contrast enhanced CT scan of thorax given below was diagnostic.

What is the diagnosis?
The chest X-ray shows a retrocardiac shadow suggestive of an esophageal abnormality. The CT Scan shows widening of esophageal hiatus with gastric rugal folds extending above the level of gastro esophageal junction. This finding is diagnostic of hiatus hernia. The diagnosis was confirmed by endoscopy.

**Discussion**

Hiatus hernia is a condition in which contents of the abdominal cavity, most commonly the stomach herniates through a widening of the right crus of the diaphragm into the mediastinum. Among the three openings in the diaphragm - caval, aortic and esophageal, the esophageal is the weakest, and therefore, the most susceptible to visceral herniation. Prevalence of hiatus hernia has been reported to be between 10 to 50% of the population, the exact prevalence is difficult to determine. Incidence increases with advance in age and this may be explained by the decrease in collagen fibers with increasing age. Other risk factors include central obesity, previous gastroesophageal surgery (antireflux procedures, esophagomyotomy, partial gastrectomy), thoraco abdominal trauma, skeletal deformities and congenital conditions such as scoliosis, kyphosis, and pectus excavatum. Hiatus hernias can occur congenitally also in children, and may be associated with other malformations, such as intestinal malrotation.

There are four types of esophageal hiatal hernias: sliding (type I), paraesophageal (type II), combined (type III), which include elements of types I and II, and giant paraesophageal (type IV). Sliding hernias are the commonest, accounting for more than 85%. The common symptoms of a sliding hernia are of gastroesophageal reflux, esophagitis and esophageal ulceration.

Paraesophageal hiatal hernias (type II) are predominantly seen in adults older than 40 years. Unlike in sliding hernia, here the gastroesophageal junction remains in its normal position. So the dilated stomach which lies between the pericardium and the spine, compresses the esophagus and prevents gastric reflux. Because of this mechanism, gastroesophageal reflux symptoms are rare in paraesophageal hernia patients. The main complaints being postprandial fullness, palpitation, shortness of breath, pain, and dysphagia. Paraesophageal herniation may cause serious complications like gastric volvulus and infarction.

Mixed hiatal hernias (type III) are a combination of sliding and paraesophageal hiatal hernias and so may have symptoms of both.

Giant paraesophageal hiatal hernias (type IV) are those which include more than one-third to one-half of the stomach. They commonly include herniation of upper abdominal organs into the thorax, including colon, omentum, small intestine, liver and even spleen. Their characteristic symptoms include GERD and iron deficiency anemia due to chronic gastric bleeding.

Most of the hiatus hernias are asymptomatic. Many patients with hiatus hernia first present to a pulmonologist, because of symptoms like chest pain, persistent cough or unexplained dyspnea. As the stomach moves into the chest, respiratory symptoms may predominate as a result of lung compression and decreased forced vital capacity (FVC). Large hiatal hernias are often visible in routine chest radiograph as a retrocardiac opacity. Presence of retrocardiac air corresponding to the gastric bubble suggest the diagnosis.
Computed tomography helps to demonstrate the widened esophageal hiatus, hiatal size and content, the orientation of the stomach, and the location of hernia. The characteristic CT features of a sliding hiatus hernia include dehiscence of the diaphragmatic crura, evident as widening of esophageal hiatus on cross section (normal value being less than 15 mm) and projection of a part of stomach into the mediastinum. These findings are visualized in the CT of the cited patient (Fig 2 & 3).

Diagnosis is established with the use of barium swallow contrast chest radiographs, in which, hiatal hernias appear as a shadow in the posterior mediastinum. Upper gastro intestinal endoscopy also helps in diagnosis. High resolution manometry and reflux monitoring is done to decide the mode of treatment. Radiological differential diagnoses of hiatus hernia include Bochdalek diaphragmatic hernia and bronchogenic cysts.

**Treatment**

Treatment is not indicated for asymptomatic sliding hernias. Paraesophageal hernias might need interference due to fear of potential complications like obstruction. Medical management of GERD is the cornerstone for treatment of hiatus hernia. This includes proton pump inhibitors (PPIs), histamine 2 receptor antagonists and antacids. Surgical treatment consists of restoring the stomach into the abdominal cavity by laparoscopic fundoplication.

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Self Assessment Quiz

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Fig 1 : CT scan thorax

Question 1:

This 72 year old man was admitted with chronic cough. What is the most likely diagnosis from the above image?

1. Bronchogenic carcinoma
2. Thymic cyst
3. Bronchogenic cyst
4. Aneurysm involving arch of aorta and descending thoracic aorta
5. Posterior mediastinal tumor

Answer : 4

Contrast enhanced CT scan thorax shows aneurysm involving arch of aorta and descending thoracic aorta

Question 2

Which is a WRONG statement about aortic aneurysm?

1. More common in elderly males
2. Smokers have higher risk to develop aneurysm
3. Uncontrolled hypertension is a risk factor
4. May be associated with abdominal aortic aneurysm
5. All aortic aneurysms once diagnosed should be treated by surgery

Answer : 5

Small asymptomatic aortic aneurysms less than 5.5cm in diameter without any risk factors can be managed conservatively¹. Medical management includes proper control of blood pressure and treatment of hyperlipidemia. Smoking cessation in smokers, proper treatment of infection in cases where aneurysm is due to infection (mycotic aneurysm) is essential. Size of the aneurysm should be regularly monitored by CT scan or MRI scans every six months in these patients.

Question 3:

Which of the following is LEAST LIKELY cause for descending thoracic aortic aneurysm?

1. Ehlers-Danlos syndrome type IV
2. Marfan’s syndrome
3. Genetic (Family history of thoracic aortic aneurysm)  
4. Aortitis  
5. Tertiary syphilis  

**Answer : 5**  
Except syphilis all of the above conditions can lead to descending thoracic aortic aneurysm. In some families, there appears to be an autosomal dominant trait causing thoracic aortic aneurysm. Syphilitic aortic aneurysm almost always involves the ascending aorta or aortic root. Syphilis does not cause descending thoracic aortic aneurysm. The prevalence of tertiary syphilis is now very low.

**Question 4 :**  
Which is a rare symptom in thoracic aortic aneurysm?  
1. Chronic cough  
2. Hemoptysis  
3. Chest pain  
4. Hoarseness of voice  
5. Back pain  

**Answer : 2**  
If the aneurysm erodes into a bronchus leading to aorto-bronchial fistula hemoptysis can occur. This is very rare and can be fatal. Compression over a bronchus can lead to chronic cough. Acute severe chest pain is a symptom in acute aortic dissection. Compression of recurrent laryngeal nerve can lead to hoarseness of voice. Constant pressure and compression of vertebral body can lead to erosion of vertebral body causing back pain.

**Question 5 :**  
Which of the following is NOT a pressure symptom in descending thoracic aortic aneurysm?  
1) Hoarseness of voice  
2) Dysphagia  
3) Raised left dome  
4) Dyspnea  
5) Superior vena cava obstruction  

**Answer : 5**  
Superior vena cava is on right side where as descending thoracic aorta is on left side. Hence descending thoracic aortic aneurysm can't compress superior vena cava. Compression of phrenic nerve can lead to raised left dome due to phrenic nerve palsy on left side. Dyspnea can occur due to compression of left main bronchus and or phrenic nerve palsy due to compression of left phrenic nerve. Dysphagia can occur due to compression over the esophagus.

**Question 6 :**  
Which of the following is NOT considered as an indication for surgery in aortic aneurysm?  
1. Acute symptoms due to aortic aneurysm  
2. Age less than 60 years  
3. Pressure symptoms due to aortic aneurysm  
4. Aneurysm growth rate 0.5 centimeters over a period of six months to one year  
5. Presence of genetic disorders or familial history of thoracic aneurysms  

**Answer : 2**  
Age is not considered as an indication for surgery. Except this, all of the above require surgery because there is a higher risk for aortic rupture or dissection.

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2. Aortic Aneurysm, Familial Thoracic 2, AAT2 ; Online Mendelian Inheritance in Man (OMIM)  
Case Report

Thoracic Ewings Sarcoma with Right Atrial Invasion - A Case Report

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Abstract
A 28 year old male manual labourer, presented with progressive breathlessness for 1 month, cough and abdominal pain for 2 weeks. Clinical picture suggestive of right sided pleural effusion with collapse. Chest X-ray showed right mediastinal mass with pleural effusion. Echocardiography suggestive of right atrial mass protruding to right ventricle with pericardial effusion. Computed tomography (CT) thorax showed large lobulated heterogeneously enhancing lesion in anterior mediastinum extending upto the upper mediastinum and left pulmonic recess with mild pleural effusion. Lesion was encasing and compressing the right pulmonary artery. There was also invasion into right atrium and ventricle with pericardial effusion. Ultrasonography guided fine needle aspiration cytology was suggestive of small round cell tumor, possibly of lymphoma. On immunohistochemistry of the biopsy specimen, tumor cells expressed CD99 and vimentin positivity consistent with the diagnosis of primitive neuroectodermal tumor (PNET).

Key words
Pleural effusion, mediastinal mass, immunohistochemistry, primitive neuroectodermal tumour

Introduction
Primitive neuroectodermal tumor (PNET) represents a family of tumors with varying degrees of neuronal differentiation, presenting as a bone or soft tissue mass in the trunk or axial skeleton in adolescents and young adults. Peripheral Primitive neuroectodermal tumor (pPNET) are the rarest class of PNET belonging to the Ewing's or Askin's family of tumors. They are highly aggressive and have an average life
expectancy of 8 months. Intrapulmonary PNET is a very rare entity. PNET is a highly malignant neoplasm and it is composed of small, round, uniform cells. Diagnosis of the tumor is confirmed using various immunohistochemical studies and detecting the presence of a translocation, t(11;22) through fluorescent in situ hybridization (FISH). PNET can be treated with various combinations of radical surgical resection, neoadjuvant and adjuvant chemotherapy, and radiation.

A 28-year-old male manual laborer presented with progressive breathlessness of one month duration and scanty mucoid expectoration with tinge of blood streaks on few occasions for the last 2 weeks. He also complained of generalized abdominal pain for 2 weeks. He had loss of appetite and unintentional weight loss which was not quantified. He was a smoker with smoking index of 65 and a alcoholic. No significant family histories were obtained. On general examination he was noted to have elevated non pulsatile JVP with facial puffiness and bipedal edema. On chest examination, trachea was shifted to the right side. Apex beat was not palpable. Chest movements were decreased in right hemithorax. Percussion note was impaired anteriorly from second intercostal space and stony dull on right infra axillary and infra scapular area. On auscultation, tubular breath sounds was heard in the right infra clavicular area. Vocal resonance was diminished in all areas except right infra clavicular area on the right side. Heart sounds were muffled. Examination of other systems including lymphoreticular system and testicular examination were all within normal limits. The clinical picture was suggestive of right sided upper lobe mass with effusion. Chest X-ray postero anterior view revealed a homogenous opacity with broad base towards the mediastinum at the upper, mid and lower zones of right lung field with distinct superior, lateral and inferior borders. Lesion was forming an obtuse angle with the lung margin. There was moderate ipsilateral pleural effusion.

Pleural fluid aspiration under USG guidance yielded 250 ml of hemorrhagic fluid which was neutrophilic exudate. (Total cell count – 500/cu.mm, polymorph – 88%, lymphocyte - 12%, protein 4.5g/dL, sugar – 166mg/dL ADA – 20IU/L, LDH – 890 IU/L). Cytology was negative for malignant cells. A concomitant screening echo done at that time showed a right atrial mass protruding into right ventricle. Cardiology opinion with proper echocardiogram was done which reported large right atrial mass protruding to right ventricle (78 x 48 mm), moderate to large pericardial effusion, fair left ventricular systolic function and bilateral pleural effusion.

Fig. 1: X-RAY CHEST

An emergency contrast enhanced CT (CECT) was done which showed large lobulated heterogeneously enhancing coalescent lesion seen in the right hilum extending up to the upper mediastinum and left pulmonic recess. Lesion was encasing and compressing the right pulmonary artery. There was also invasion into right atrium & ventricle. Lesion was abutting and compressing the carina, bilateral main bronchus and bilateral superior pulmonary veins.

Fig. 2:
Heterogeneously enhancing pleural based nodular lesions morphologically like the mediastinal lesion were noted. Mild pleural effusion was present. Few tiny calcific foci were noted within.

No acid fast bacillus was found in sputum smear microscopy. Hematological evaluation showed markedly elevated LDH with normal beta HCG and AFP. USG abdomen revealed no significant abnormalities. USG guided FNAC of the mass was suggestive of small round cell tumor, possibly lymphoma. CT guided true cut biopsy of the lesion was performed which showed fragments of cellular neoplasm with small round cells arranged in sheets and in perivascular pattern and scattered singly, moderate to scanty cytoplasm with mild to moderate nuclear pleomorphism.

On immunohistochemistry the tumor cells expressed CD 99 strong diffuse positivity and vimentin positive and immuno-negative for leukocyte common antigen and EMA/CK. The findings were consistent with primitive neuroectodermal tumor.(Fig.4). CT brain was then done which was within normal limits. Patient was referred to the oncology department. Relatives refused further treatment and patient died after one month of presentation.

**Discussion**

PNET is a highly malignant tumor arising from the germinal matrix cells of primitive neural tube. It has a very poor prognosis. PNET most commonly arises from soft tissue and bone with case reports of it arising from intra thoracic region being rare. The most common site of origin from intrathoracic region is chestwall. Peripheral PNET are small round cell malignant neoplasm of neuroectodermal origin and are members of ES/PNET family of tumors. Primary pulmonary PNET are very rare with few case reported till date. Review of literature have shown that it occurs more commonly in males with a ratio of 1.8:1, with mean age of 28.2 (8-56 years). Fever, cough, dyspnea, hemoptysis and chest pain were noted to be the most common presenting complaints. The differential diagnosis of PNET of lung include small cell carcinoma and other small round cell tumors such as malignant lymphoma, Langerhans cell histiocytosis, granulocytic sarcoma, rhabdomyosarcoma, neuroblastoma and synovial sarcoma.

The diagnosis of PNET is facilitated by histological and IHC markers and antibodies like O13, HBA-T1 and 12E7 that recognize the cell surface antigens defined by CD99. In imaging studies, primary PNET presents as circumscribed solitary mass with heterogenous appearance on both contrast and non-contrast CT. Intra lesion calcification or ipsilateral pleural effusion have been demonstrated. Very infrequently the mass is shown to have invaded the adjacent structures.

Chromosomal arrangements such as demonstration of the t(11;22) (q24;q12) chromosomal translocation (EWS-FLI1 gene rearrangement) is highly specific for ES/PNET as it is encountered in more than 90% of the neoplasms.

The treatment of choice for these tumors are various combinations of radical surgical resection, neo adjuvant and adjuvant chemotherapy and radiation.
This case shows the importance of considering a differential diagnosis of primary PNET in persons presenting with mediastinal mass. Once diagnosed the treatment options are different from others as PNETs are more chemo sensitive. A retrospective study of 24 patients with extra skeletal (ES) PNET showed an overall five-year survival rate of 61%. Wide excision with tumor free margins in conjunction with multi-agent chemotherapy are necessary for good clinical outcomes.13

Extra skeletal ES/PNET should be considered in the differential diagnosis of primary mediastinal neoplasms especially in children or young adults. Primary mediastinal PNETs are rare and usually located in the posterior mediastinum. However they can also be found in the anterior mediastinum. Histopathological confirmation is mandatory especially in cases of unusual location.

We could not find in literature such a presentation of Ewing’s sarcoma with cardiac invasion13,14.

References


Case Report

An Unusual Bronchiectasis of Azygos Lobe

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Abstract

We are reporting a rare case of Bronchiectasis affecting the Azygos lobe. Though the patient had bronchiectasis affecting the Right Middle lobe and Left lower lobe, this rare entity which can create confusion regarding the diagnosis if CT thorax is not done with the problems it can produce is discussed. The typical appearance of bronchiectasis of the azygos lobe is clear from the CT Thorax.

Key words

Azygos lobe, bronchiectasis, Paratracheal opacity, CT Thorax

Case Report

A 35 year old, housewife, presented with fever and cough of 1 week duration. Fever was mild with no chills and rigors. The cough was associated with copious amounts of mucopurulent sputum. Cough and sputum increased in supine position. No h/o haemoptysis. Cough was associated with wheezing. Dyspnoea on exertion was present. No h/o orthopnoea /PND or chest pain.

She had recurrent episodes of cough with mucopurulent sputum and wheezing, for 10 years which used to subside with medications and inhalers. No h/o Pulmonary TB / sinusitis / discharge from ears. No previous h/o of hospitalisations.

Examination showed a tall, thin female who was pale with no icterus /cyanosis / clubbing /pedal oedema or lymphadenopathy. She had tachypnoea, no tachycardia and no tracheo mediastinal shift. Coarse crepitations were present in Lt infra axillary, mammary areas and Rt mammary and Rt infraclavicular areas. Wheezes were heard bilaterally.

Her chest Xray showed a right paratracheal opacity and the CT Thorax showed bronchiectasis affecting left lower lobe, right middle lobe and surprisingly of an azygos lobe.
The presence of bronchiectasis in azygos lobe is extremely rare and hence this case report.

Azygos lobe is a normal anatomical variant of right upper lobe of lung, and is very rare with a CXR prevalence 0.4% and 1.2% on HRCT.

**Embryology**

Azygos lobe occurs when right posterior cardinal vein, one of the precursors of azygos vein, fails to migrate over the apex of the lung and penetrates the lung, carrying along pleural layers that entrap a portion of the right upper lobe.

**Clinical importance of azygos lobe**

It can be a cause of recurrent haemoptysis, it can lead to bleeding during thoracic surgery.

It can produce an ‘empty azygos fissure’ or ‘vanishing azygos’ due to atelectasis.

It can mimic mass, scar, pneumothorax, and oesophageal dilatation as in achalasia cardia.

Detection of this anomaly and clarification of its precise anatomical features are important not only to differentiate this anomaly from other pathological conditions, but also to alert the surgeon to potential problems during surgery. With the progress in minimally invasive thoracoscopic surgery, azygos lobe identification has become important for anaesthetists also.

Some of the complications associated with azygos lobe are:

- Infarction of azygos lobe due to pulmonary embolism,
- Lung cancer in azygos lobe,
- Azygos lobe bullae causing spontaneous pneumothorax,
- Aneurysm of the azygos vein.
- Tuberculosis of azygos lobe
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References


Fig. 4: CT thorax showing bronchiectatic cysts in azygos lobe
Case Report

Cannonball Lesions in a Young Patient: An Unusual Cause

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Abstract

Cannonball metastases refer to well-defined spherical nodules scattered over both lungs, being a classical presentation of hematogenous tumor spread. Striking progression of lung metastases without established primary malignancy can raise a diagnostic challenge. We herein report a case of a 25 year old female patient with alveolar soft part sarcoma (ASPS), a rare soft tissue sarcoma of children & young adults which manifested with respiratory symptoms & cannonball metastases at initial presentation.

Key words
Alveolar soft part sarcoma, cannonball lesions, metastasis lung

Introduction

Alveolar soft part sarcoma (ASPS) is a rare distinctive soft tissue sarcoma affecting mainly adolescents & young adults with a female preponderance & a predilection for the soft tissues of the thigh. Early metastasis is a characteristic feature & in a good number of cases, metastasis to the lung or brain is the first manifestation, hence, in spite of relatively slow growth of the tumour ultimate prognosis is poor.

Case Report

A 25 year old female presented to the outpatient department with complaints of dry cough of 6 months duration with one episode of hemoptysis a few months back. She also complained of dyspnoea on exertion of 1 week duration. She gave a history of loss of appetite & loss of weight of 9 kg over the past 10 months. Examination of the respiratory system revealed bilateral reduction in air entry. Her routine blood examination showed normal blood counts. Chest X-ray showed multiple nodular opacities with a cannon ball appearance. A contrast enhanced CT chest was done which showed multiple hypervascular soft tissue density lesions of sizes varying from few mms to 6 cms diffusely involving both lungs with multiple enlarged mediastinal lymph nodes. A CT abdomen was done which showed no significant abnormality.
Meanwhile, a CT guided biopsy was obtained from the largest lung nodule which showed a neoplasm composed of epithelioid cells arranged in solid & organoid patterns with reticulin stain highlighting the organoid pattern. Individual neoplastic cells showed abundant eosinophilic cytoplasm & vesicular nuclei some with prominent nucleoli. Immunohistochemistry (IHC) for synaptophysin was negative ruling out pulmonary paraganglioma. PAS positive, diastase resistant granules were noted in most of the cells with presence of very occasional crystalline inclusions. On further probing & on detailed clinical examination, an ill-defined swelling was palpated in the left thigh which was deep to the muscles.

MRI of the left thigh showed a large heterogeneous soft tissue lesion in the anterior compartment of the thigh involving the vastus lateralis, intermedius & medialis - suggestive of a soft tissue sarcoma. An ultrasound guided biopsy of the thigh mass showed a lesion with similar histology as that of the lung mass with more prominent alveolar & organoid patterns. The morphology & histochemistry along with the typical clinical presentation enabled us to confirm the diagnosis of ASPS of thigh with lung metastasis. The patient was then referred to the oncologist for further management.
Discussion

ASPS is a rare tumour of unknown histogenesis with a distinctive & generally invariable histological appearance & having specific molecular characteristics. It can occur at any age but mainly affects adolescents & young adults with occurrence being rare before 5 & after 50 yrs of age. There is a female predilection before 30 yrs of age & a male predilection thereafter. In adults the most common site of involvement is the extremities especially the deep soft tissue of the thigh while the head & neck esp. the orbit & tongue are the most common sites of origin in children & infants. Other unusual locations include the female genital tract, mediastinum, lung, stomach, bone.

Because it is a tumour that typically grows slowly & causes few to no local symptoms, the first clinical manifestation of disease in ASPS is frequently metastasis to the lung or brain. Other common metastatic sites are bone & liver. These tumours are extremely vascular & occasionally present as a pulsatile mass with associated bruit.

The histology of ASPS is unique in that it varies little in appearance from case to case & is in some respects remarkable among soft tissue neoplasms for the absence of described variants. As originally described by Christopherson et al ASPS is characterised by uniform organoid nests of polygonal tumour cells separated by fibrovascular septae & delicate capillary sized vascular channels. Within the nests there is prominent cellular dyscohesion leading to the distinctive pseudoalveolar pattern for which it is named. In some cases the organoid pattern may be lost & the tumour may be composed of sheets of epithelioid cells. Intravascular tumour extension is seen in most cases & is responsible for early metastasis. The histopathological differential diagnosis of ASPS includes any tumour with eosinophilic/clear cytoplasm in an organoid/pseudoalveolar pattern including adrenal cortical carcinoma, hepatocellular carcinoma (HCC), malignant melanoma, renal cell carcinoma (RCC) & paraganglioma among others. Coarse PAS positive diastase resistant granules with occasional rod shaped or crystalline structures are the histological hallmarks of the tumour. The characteristic ultrastructural feature is the presence of membrane bound or free rhomboid crystals with a periodicity of 10 nm.

Cytogenetic studies of ASPS have identified a specific unbalanced translocation der(17) t(X;17) (p11;q25) which results in the formation of ASPL-TFE3 fusion gene. This gene can be detected by molecular genetics or IHC analysis.

Treatment of ASPS primarily is surgical with only minor roles for chemotherapy & radiotherapy. Achievement of complete microscopic resection is critical in localized alveolar soft part sarcoma, but incomplete excision due to lack of appreciation of the correct diagnosis is all too often encountered. Despite the occurrence of metastases in up to 79% of patients, 5-year overall survival rates range from 45 to 88%.
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