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EDITORIAL

Oxygenation during Endobronchial Ultrasound
Where do we stand?

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Supplemental oxygen is almost always needed during bronchoscopy. A fall in arterial oxygen tension (PaO_2) of about 2.5 kPa during the procedure is common.[1] A fibreoptic bronchoscope occupies about 10% of the cross-sectional area of the trachea and 15% of the cricoid ring leading to a partial obstruction.[2,3] During suction, air and oxygen are drawn back leading to a lower end-expiratory lung volume with attendant consequences. Fluid instilled during bronchoalveolar lavage can act as a barrier and can further worsen the hypoxia. Oxygen desaturation is the most common adverse event during procedural sedation as it can induce respiratory depression and upper airway obstruction.[4] Bronchoscopy is often done on patients with a poor cardiopulmonary reserve or on patients with an impaired gas exchange like pneumonia, interstitial lung disease or advanced lung malignancy.

Conventionally, low flows of oxygen delivered through nasal prongs or masks are used for routine bronchoscopy procedures under mild-to-moderate sedation. High flow nasal cannula, noninvasive ventilation, endotracheal tube/laryngeal mask airway and controlled ventilation, intermittent apnoeic oxygenation and jet ventilation are the other techniques used depending on the patient's reserve or critical status. High flow nasal oxygenation (HFNO) is a relatively new noninvasive respiratory support delivering humidified and heated mixture of oxygen and air at flows up to 60–70 L/min with an FiO_2 varying between 0.21 and 1.0. Higher flow rates matching the patients inspiratory demand and allowing a more stable FiO_2, generation of a small positive end expiratory airway pressure, reduction of dead space leading to an increase in alveolar ventilation and the inspiratory pressure support leading to reduced work of breathing are the major physiological benefits of using HFNO. In addition, ease of operation, patient comfort, bronchoscopist's convenience and an available free airway makes HFNO highly acceptable. In cases where the upper airways are shared fully or partially like during bronchoscopy, laryngeal surgeries or dental procedures, the use of HFNO has yielded effective oxygenation.[5–9] A systematic review showed that HFNO is effective in reducing the incidence of hypoxaemia, requirement of minor airway manoeuvres and procedure interruptions during sedation.[4]

Currently, endobronchial ultrasound (EBUS) and transbronchial sampling have moved from the interventional pulmonology domain to the regular respirology practice. Transbronchial needle aspiration (TBNA), needle biopsy or cryobiopsies are the techniques used to sample lesions around major airways with a linear EBUS scope. Radial EBUS is used for peripheral lesions and the techniques and sedation strategies differ with the location and indications. The duration of linear EBUS procedures and sampling after introduction of the scope vary from a few minutes to an hour or more depending on the indication of a diagnostic pass to the sequential sampling of the intrathoracic lymph nodes in the staging of lung cancer. EBUS scopes have larger diameter and with additional use of a balloon can exert greater negative effects on respiratory mechanics. So, the larger size, necessary intense mucosal contact to obtain images and a longer procedure time cause more discomfort to the patients.[10] Moreover, cough and airway spasm during the procedure have to be prevented to obtain a clear view of the target lesion and to reduce the chances of a difficult or risky insertion of the needle.[10] Adequate anaesthetic depth is thus required to have less procedure interruption, desaturation, cough and agitation during a shared airway procedure.[11] Therefore, EBUS requires a deeper level of sedation compared to a simple bronchoscopy.

The drop in oxygen saturation was noted to be less with HFNO when compared to oxygen administration through a nasal cannula in patients undergoing more advanced, prolonged endoscopic procedures.[12,13] However, Douglas *et al.* found that HFNO do not reduce the proportion of patients experiencing desaturation during EBUS and that it may not protect patients against hypoventilation-induced hypoxaemia or hypercapnia.[14] Oxygen delivery via nasal continuous positive airway pressure (nCPAP) have been shown to shorten the mean desaturation time during EBUS-TBNA when compared with oxygen delivery through a simple mask at the same dose of anaesthetic

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drugs.[15] Longer procedure duration, need for oxygen supplementation and older age are known to be associated with immediate respiratory complications. However, a few authors found no such correlation for any complication, including desaturation with the length of the procedures.[16] Though, may studies have reported that the safety of EBUS-TBNA is unaffected by anaesthesia type, Levin *et al*. reported that general anaesthesia is safer with a higher diagnostic yield in patients with respiratory compromise.[17]

In this issue, Ravi *et al*. report a comparable outcome but having the HFNO outperforming the supraglottic airway (SGA) in the overall performance.[18] They did not notice any difference in the diagnostic yield between patients undergoing EBUS-TBNA under sedation with HFNO or SGA. By monitoring the venous carbon dioxide tension, the authors found effective ventilation was better with HFNO. Though the HFNO group desaturated for a longer period, the grade of hypoxia was less. However, the study has limitations of a small number, inadequate randomisation, possible outlier interference and the absence of a note regarding physician and patient satisfaction.

Nevertheless, HFNO is not without any challenges. One of the primary concerns is the expense for care compared to low flow nasal cannula. The oxygen requirement for a bronchoscopic procedure using HFNO is more than 6 times compared to the nasal cannula. Concerns have been raised regarding a potential delay in necessary interventions to prevent worse outcomes in patients with respiratory failure while using HFNO.[19] While on HFNO, SpO_2 may not fall until the cause is prolonged and hence during bronchoscopy one has to be vigilant for other signs of worsening. The positive expiratory airway pressure advantage of HFNO can be reduced while the patient breaths through the open mouth during the trans oral route of scope introduction, theoretically losing its benefit on alveolar distending pressure. Transnasal humidified rapid-insufflation ventilatory exchange (THRIVE) is a new development in HFNO technique employed in both spontaneously breathing and apnoeic patients. This method ensures a safe and extended apnoea time, reduce the incidence of airway related events and enhance post procedure recovery.[20]

Conclusion

The approach to oxygenation during EBUS should be based on the patient's cardiopulmonary reserve and pre-oxygenation status along with the anticipated oxygen requirement for the procedure and the risks for a post-procedure respiratory morbidity. Oxygen administration with HFNO may be considered as a first choice because it may increase patient comfort, operator convenience and reduce the risk of hypoxia. HFNO with moderate sedation have the advantage of a reasonable cost and will not need an artificial airway, anaesthetic assistance, additional personnel, drugs, or equipment. In resource limited settings or with financial constraints, conventional oxygen and moderate sedation will be more practical. However, in patients with significant hypoxaemia, critical illness or poor clinical status the use of nasal continuous positive airway pressure or a supraglottic airway with deeper sedation or anaesthesia is advisable.

AUTHORS' CONTRIBUTION

BJ conceptualized and drafted of the initial manuscript. BJ and HG contributed to the literature review. HG performed a critical review and both the authors approved the final version of the manuscript.

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