Review Article on Interventional Pulmonology in the Intensive Care Unit

Therapeutic bronchoscopy facilitates liberation from mechanical ventilation and improves quality of life for critically ill patients with central airway obstruction

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Abstract: Central airway obstruction (CAO) remains a challenging disease for both patients who are suffering from it and for physicians who are managing it. Patients will frequently present with acute symptoms of respiratory failure that require management in an intensive care unit (ICU). While the true prevalence and incidence of CAO in the ICU setting is unknown, recent estimates suggest that approximately 20–30% of patients with a cancer diagnosis may present with CAO or develop it after diagnosis. Therapeutic bronchoscopy focuses on performing minimally invasive procedures using multiple ablative modalities to recanalize the central airway and alleviate the obstruction. While procedures are usually technically successful, they appear to be underutilized. An individually tailored approach is often used based on patient characteristics, operator preference, and available equipment. After therapeutic bronchoscopy procedures are completed, many patients are successfully liberated from mechanical ventilation (MV) or immediately transferred out of the ICU. Data reviewing the effects of therapeutic bronchoscopy have also shown success in palliation of symptoms, with significant improvement in subjective measures such as patient quality of life and dyspnea and objective values like pulmonary function studies. Given the potential benefits with a low risk profile and high likelihood of technical success, treatment of CAOs with therapeutic bronchoscopy represents a reasonable consideration for patients with acute respiratory failure in the ICU.

Keywords: Therapeutic bronchoscopy; central airway obstruction (CAO); mechanical ventilation (MV); quality of life; dyspnea; spirometry

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Introduction

Central airway obstruction (CAO) occurs when a blockage of airflow develops in the trachea and/or mainstem bronchi due to a primary lung cancer, metastatic malignancy, or benign disease. Because CAO is a challenging disease both for patients to live with and for clinicians to manage, many patients may present acutely in respiratory failure and require intensive care unit (ICU) admission. This review focuses on the positive impact of therapeutic bronchoscopy on liberation from mechanical ventilation (MV) and on quality of life for patients with critically ill CAO complicated by respiratory failure and ICU admission. CAO incidence, prevalence, and management is discussed.

Incidence and prevalence

The exact incidence and prevalence of CAO in the general population and in the ICU setting is unclear. An attempt to record the prevalence of CAO at the time of lung cancer diagnosis was terminated early, suggesting that challenges behind accurately capturing this information exist (1). One of the initial reports from a large case series of 291 patients undergoing thoracotomy found that 24% had CAO (2). A more recent estimate suggested that 20–30% of lung cancer

patients may develop complications associated with, or secondary to, CAO (3).

A recent single center cohort analysis of 342 newly diagnosed lung cancer patients identified CAO in 45 (13%) patients at the time of diagnosis with an additional 15 patients (5%) developing CAO over a median follow up of approximately one year (4). Of the 45 CAO patients, 23 received a diagnosis during or after a hospital admission for cough or breathlessness (4). A careful review of these 45 CAO patients also found that 14 (31%) did not have CAO reported on index CT imaging (4). Further efforts to prospectively assess the true incidence and prevalence of CAO are an area of interest requiring further investigation.

Therapeutic bronchoscopy

Therapeutic bronchoscopy utilizes flexible and/or rigid bronchoscopy to treat CAO due to endoluminal tumor, extrinsic compression, or both. While many bronchoscopic ablative therapies and management algorithms exist for CAO (3), there is no standardized treatment approach. Management decisions are based upon multiple factors, including patient's clinical status, CAO cause, available equipment, and operator experience and preference (3). Existing therapies have both positive and negative qualities, with detailed descriptions previously published (3,5-7).

The AQuIRE (ACCP Quality Improvement Registry, Evaluation, and Education) registry established a threshold for restoring the airway to at least 50% patency for a therapeutic bronchoscopy to be considered technically successful (8). In this registry, overall technical success was 93%, ranging from 90–98% at the different participating centers (8). The complication rate was 3.9% (45/1,115 total procedures) and was increased with urgent and emergent procedures and for patients with an American Society of Anesthesiologists (ASA) score >3 (9). Another single center study looking at 2008 patients treated with multiple therapeutic modalities over 13 years showed a similarly high success rate, with 93% of patients having immediate restoration of airway patency post bronchoscopic procedure (10).

While therapeutic bronchoscopy is usually technically successful and well tolerated, many eligible patients do not undergo treatment for poorly understood reasons. A single center cohort study reported that only 26% of eligible patients underwent therapeutic bronchoscopy (4). Studies designed to identify the obstacles to therapeutic bronchoscopic intervention focusing on provider, patient, family, and institutional aspects are needed.

Liberation from MV and change in level of care

Therapeutic bronchoscopy facilitates patient liberation from MV and transfer out of the ICU for patients with malignant CAO. A study examined the role of laser bronchoscopy in 17 patients with inoperable lung cancer requiring MV for acute respiratory failure (11). Laser bronchoscopy treatment of endoluminal CAO in 9 patients allowed for earlier removal from MV and facilitated further medical treatment compared to 8 patients with CAO due to extrinsic disease (11). A similar study of 12 inoperable lung cancer patients with CAO found that 9 were successfully extubated from MV post therapeutic bronchoscopy (12).

Patients with benign CAO also benefit from therapeutic bronchoscopy. In a series of 32 ICU CAO patients, 14 with malignant and 18 with benign disease, rigid bronchoscopic intervention allowed immediate discontinuation of MV in 10 and immediate transfer to a lower level of care in 20, with a similar number of benign and malignant patients benefiting from intervention (13). Another study showed that 14 of 15 ICU patients with benign CAO who failed multiple weaning attempts from MV or decannulation were extubated and decannulated immediately post therapeutic rigid bronchoscopy with dilation and stent insertion (14). With appropriate therapeutic treatment of CAO, there is an improved chance of extubation for critically ill patients.

Improvements in quality of life, dyspnea, and spirometry

Quality of life and symptomatic dyspnea due to CAO have also been shown to improve for many patients after therapeutic bronchoscopy. In a prospective study of 20 patients with malignant CAO undergoing therapeutic bronchoscopy without concomitant chemotherapy or radiation therapy, dyspnea scores improved in 85% as assessed by the Borg scale, and 65% reported an improvement in quality of life 1 month post procedure (15). Another prospective study of 102 patients with malignant CAO followed up monthly post procedure until death showed initial and sustained improvement in dyspnea as measured by the Borg scale and health-related quality of life (16).

Spirometric evaluations of patients also improve post

intervention. Twenty patients with CAO (8 malignant and 12 benign) showed significant increase in both median American Thoracic Society dyspnea grade and forced expiratory volume in one second (17). Forced vital capacity and forced expiratory volume in one second improved significantly in 53 patients (24 malignant and 29 benign) after completion of their therapeutic procedures (18). Quality of life measured by the SF-36 and dyspnea measured by the San Diego Shortness of Breath questionnaire were also positively impacted (18).

Conclusions

CAO management is complex, requiring treatment that should be tailored to each individual patient's specific situation. Evidence supports that after therapeutic bronchoscopy patients are more likely to be liberated from MV and leave the ICU. There is also significant improvement in dyspnea, quality of life, and objective spirometric values. Given these benefits in the setting of overall low risk and high chance of technical success, treatment of CAO should be considered for patients with respiratory failure and MV in the ICU. Future studies identifying the incidence and prevalence of CAO and barriers to therapeutic treatment have the potential to positively impact patient care.

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Footnote

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