Central airway obstruction (CAO): laser, APC, stents and other techniques

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AIMS

- How to evaluate central airway obstruction (CAO).
- Which classification for CAO is useful in daily clinical practice.
- To discuss hot and/or cold central airway desobstruction techniques.
- To discuss the outcome (symptom palliation, quality of life, survival) of bronchoscopic desobstruction of CAO.

SUMMARY

Significant central airway obstruction (CAO) with imminent respiratory failure, stridor and/or severe dyspnea requires immediate action to restore airway passage [1]. An interventional treatment plan must be carefully considered and executed to obtain an optimal outcome, i.e. improvement in survival and quality of life [2-5]. CAO can be caused by intraluminal tumor growth, extraluminal tumor compression, or a combination of both. A standardized classification scheme has been proposed in 2007 with descriptive images and diagrams for rapid and uniform classification of central airway stenosis [6]. There has been a consensus that a symptomatic CAO presenting with an extraluminal airway stenosis with ≥50% airway narrowing or (partially) intrinsic airway stenosis with ≥50% airway narrowing after debulking require stent implantation. Airway stenting with a covered stent can protect the airway lumen from tumor ingrowth (barrier effect) and/or counterbalance extrinsic/intrinsic pressures (splinting effect). The role of a silicone prosthesis to prevent airway obstruction recurrence in asymptomatic residual CAO <50% of the normal has been evaluated in a French multicenter randomized controlled trial (SPOC) and could confirm a trend towards improved (HR 0.71; P=0.17) recurrence free survival and benefit on dyspnea (P=0.08) during the first year after stenting [7]. Though there is a clear immediate benefit with any type of airway stenting, their use should be limited to experienced providers since stent selection (silicone or metallic) for a particular indication is more important than choosing the stent based on the provider’s skills and equipment.

Rigid bronchoscopy with its large working channel is the core procedure of interventional pulmonology. It can guaranty excellent airway control with preserved ventilation, safe manipulation to perform thermocoagulation and rapid mechanical debulking, dilation and airway stent insertion. Several hot techniques are available (laser, electrocautery, argon plasma coagulation) [1,8]. Laser resection is the application of laser energy in order to manage endobronchial lesions. Different types of laser are available (Nd-YAG, YAP-Nd, diode, CO2) and mainly noncontact mode probes are used with power settings of 10-40 Watts and pulse duration of 0.5-1 seconds representing a safe setting to obtain coagulation and devascularisation. Protective eyewear is mandatory when the laser beam is activated and the inspired oxygen concentration should be limited to FiO2 ≤40%. Electrocautery is the use of electric current for tissue heating through a contact mode probe. Due to the voltage difference between probe and tissue, electrons will flow and generate heat for tissue coagulation. Argon plasma coagulation (APC) uses ionized argon gas jet flow to conduct electrons allowing a noncontact mode of treatment. The ultimate tissue effect depends on voltage difference between probe and tissue, the surface area of contact, and the duration of energy application. Electrocautery requires no protective eyewear but a grounding pad is mandatory when the electric current is activated and the inspired
oxygen concentration should be limited to FiO2 ≤40%. The clinical utility of cryodebulking of CAO by a small tumor lesion or cryoextraction of an obstructive foreign body within the central airways can be considered as an alternative to the hot techniques in selected lesions consisting of cryosensitive tissue. Typically cryoresistant tissues are fat, cartilage and connective tissue. In addition, the operator should realize that vascular thrombosis only occurs in frozen tissue which will be mechanically extracted by cryodebulking, and not in the warm tumor tissue that remains inside and thus can be at risk for bleeding.

Rigid bronchoscopy under general anesthesia provides more treatment options and procedure safety as complications under flexible bronchoscopy and moderate sedation can be serious. Alternatively, flexible bronchoscopy through an endotracheal tube (ETT) utilizing electrocautery, argon plasma coagulation, balloon dilation, or the insertion of a self-expandable metallic stent can also be used to relief obstructing airway disorders in centers without rigid bronchoscopy facilities, although more procedures are often required to complete the treatment and safety might be an issue compared to a rigid intervention [9]. Despite the availability of devices suited for the flexible videobronchoscope, its blocking effect within an ETT may limit ventilation and jeopardize safety. Nevertheless, the ultimate execution of any technique depends on the available facility and expertise of the team, and not the technique per se.

An interventional bronchoscopy practice should only be developed when there is a locoregional unmet medical need and when a dedicated interventional pulmonology unit can be guaranteed. The practical and financial advantages and disadvantages of its implementation should be positively evaluated in advance. Although the financial investment in equipment depends on the scope of the practice. The start-up and maintenance cost is in general high and returns on investment are not always positive. Furthermore, performing these interventional procedures requires a team which must include at least 2 well-trained bronchoscopists, at least 1-2 specialized nurses and anesthesiologists, and time as procedures often can be time-consuming [10-12]. In addition, these departments should be available 7 days a week and should give a fast and appropriate response to referrals in emergency.

Data from diagnostic bronchoscopy (e.g. linear endosonography) and from other specialties (cardiology, surgery) illustrate that procedural volume or a high-volume hospital is associated with better outcome [13-15]. Therefore centralization of services should be proposed for certain procedures such as airway debulking with or without stenting. I acknowledge that setting up criteria regarding the procedural volume would punish smaller institutions performing smaller volumes. Therefore, as competence is not solely defined by the number of procedures performed, the participation in outcome databases should be mandatory. An open outcome database evaluating quality presents a more attractive model than just procedural volume, and will automatically lead to centralization of more advanced procedures to centers where qualitative development and performance of particular interventional procedures is guaranteed. This is crucial, as interventional bronchoscopy is associated with significant risks and as a specialty probable more complex than frequently assumed. Prospective risk-adjusted and disease-specific outcome analysis after interventional bronchoscopic procedures in experienced centers demonstrated that complications are common (morbidity of 20%) and 30-day mortality can be high (mortality of 8%) [16-17].

Not only the field of interventional bronchoscopy itself but also the prospects for certain diseases of the chest are evolving. Interventional pulmonologists should be aware of this and should always reconsider their ability to anticipate, avoid, and manage complications associated to their interventions. There are numerous examples of situations where the interventional pulmonologist co-impacts on long-term outcome of an individual patient [2-5]. Right decision making and/or appropriate complication prevention/management are crucial in this regard. A first example is airway stenting in malignancies. The use of airway stents should be limited to experienced providers who are able to select the best stent for any particular indication of symptomatic central airway obstruction. Indeed, either a temporary stenting might be required in patients receiving modern combined modality treatments resulting in a durable disease control and requiring stent removal during follow-up, or a definitive stenting and thus long-term stent care might be required in stage IV NSCLC as modern
systemic therapy results in 2-year survival rates up to 30%. A second example are benign central airway disorders. There has been an increase in the number of non-malignant or iatrogenic related causes of tracheal obstruction including post-intubation stenosis, post-tracheotomy stenosis, idiopathic laryngeotracheal stenosis, or tracheomalacia. Although the role of the interventionist might be rather limited as an early definitive surgical treatment if often warranted, the interventionists’ role in the multidisciplinary assessment is key (accurate evaluation of the extent of the disorder), as well as his/her intervention to relief acute stridor or dyspnea upon presentation and bridge the patient to an elective surgical intervention.

In conclusion, significant CAO with imminent respiratory failure, stridor and/or severe dyspnea requires immediate and appropriate action. Initial evaluation and emergent care to CAO, electrocautery or argon plasma coagulation for hemoptysis, cryobiopsy for the removal of certain foreign bodies, ... should be part of the training of every general pulmonologist. More advanced interventions such as rigid bronchoscopy for mechanical debulking with/without stenting of malignant lesions or the assessment of benign tracheal disorders should be reserved for centers that qualify in terms of multidisciplinarity, technicities and reported outcome data.

REFERENCES