Expiratory Central Airway Collapse
A Comprehensive Narrative Review

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KEYWORDS

• Expiratory central airway collapse • Tracheomalacia • Bronchomalacia • Tracheobronchomalacia • Excessive dynamic airway collapse • Dynamic bronchoscopy • Stent trial • Tracheobronchoplasty

KEY POINTS

- Expiratory central airway collapse (ECAC) encompasses the expiratory collapse of the posterior tracheal wall and anterolateral cartilage.
- Diagnosis involves the use of dynamic flexible bronchoscopy and dynamic computed tomography to assess the severity and subtype of ECAC.
- Treatment is aimed at addressing concurrent medical conditions, improving symptoms and airway stabilization.

INTRODUCTION

Definition and Morphology Subtype

Expiratory central airway collapse (ECAC) encompasses 2 major subtypes: excessive dynamic airway collapse (EDAC) and tracheobronchomalacia (TBM). While each has distinct pathophysiological features, they have similar clinical presentations. ECAC is often underdiagnosed and can coexist with conditions like asthma, chronic obstructive pulmonary disease (COPD), and bronchiectasis, complicating its recognition and treatment.

EDAC is characterized by an abnormal inward bulging of the posterior membranous wall of the trachea and bronchi during expiration. This occurs primarily due to weakening and atrophy of the longitudinal elastic fibers. This subtype is solely used to describe abnormality of the posterior membrane dynamics during the respiratory cycle.

TBM involves the weakening of the airway cartilaginous wall, which is subdivided to cartilaginous TBM and circumferential/concentric TBM.[1,2] Cartilaginous TBM is marked by the weakening of the lateral or anterior cartilaginous walls of the trachea. This type of TBM can manifest as crescent type due to the weakening of the anterior wall versus saber-sheath type due to the weakening of the lateral walls, which is most often associated with COPD. Circumferential or concentric TBM involves the simultaneous collapse of both the anterior and lateral walls of the airway. This is often related to inflammatory conditions, such as relapsing polychondritis.

The clinical implications of these subtypes are significant and they should be identified as part of the diagnostic approaches. The understanding of the specific subtype of ECAC will dictate targeted treatments, such as tracheobronchoplasty (TBP), which is only effective in EDAC and cartilaginous TBM of crescent type.

Epidemiology

The true incidence of symptomatic, clinically severe TBM that is amenable to treatment after ruling

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Abbreviations	
3-D	3-dimensional
6MWT	6-minute walk test
APC	argon plasma coagulation
ATS	American Thoracic Society
BID	twice a day
COPD	chronic obstructive pulmonary disease
CPAP	continuous positive airway pressure
CQLQ	Cough Specific Quality-of-Life Questionnaire
CSA	cross-sectional area
CT	computed tomography
ECAC	expiratory central airway collapse
EDAC	excessive dynamic airway collapse
GERD	gastroesophageal reflux disease
KPS	Karnofsky performance scale
mMRC	Modified Medical Research Council
OSA	obstructive sleep apnea
PAP	positive airway pressure
PEEP	positive end expiratory pressure
PEP	positive expiratory pressure
rTBP	robotic-assisted TBP
SGRQ	St. George Respiratory Questionnaire
TBM	tracheobronchomalacia
TBP	tracheobronchoplasty
USEMAS	uncovered self-expanding metallic stents

out other diseases is unknown. The prevalence of TBM historically, which was based on bronchoscopy ranges from 4.1% to 12.7% among patients with respiratory symptoms or lung disease.[3–5] More recently, a study by Krefft and colleagues (2022) found that 37% of military personnel deployed to Iraq and Afghanistan who exhibited persistent dyspnea were diagnosed with ECAC[6] but only 5% had severe ECAC (defined as 85% collapse). The incidence of TBM in post-COVID-19 patients requiring tracheostomies is reported to be around 5%[7] but this can be due to the underlying lung injury and inflammation from the virus rather than primary TBM.

Etiology

The etiology of ECAC is classified into congenital or acquired causes.[1,8–11] Congenitally, ECAC may arise from developmental anomalies in cartilage maturation, leading to inherent weaknesses in the tracheobronchial walls. This is often seen in genetic disorders, such as glycogen storage diseases or chromosomal anomalies like Down syndrome, and conditions such as bronchopulmonary dysplasia or connective tissue diseases like Ehlers-Danlos syndrome. On the other hand, acquired ECAC generally results from a variety of inflammatory, infectious, or traumatic processes that subsequently lead to cartilage degeneration or smooth muscle atrophy in the tracheal structure. Chronic inflammatory diseases, such as relapsing polychondritis, can lead to progressive cartilage destruction and concentric airway collapse.[12] On the contrary, recurrent respiratory infections and conditions like COPD, asthma, and cystic fibrosis contribute to the weakening of the posterior membranous wall (EDAC). COPD can also cause saber-sheath type TBM. Mechanical stresses, such as those from prolonged intubation, tracheostomy, or external compressive forces from tumors or goiters also play significant roles in the development of acquired TBM.

Pathophysiology

The pathophysiology of ECAC involves a complex interplay of structural weaknesses and dynamic airway responses. These conditions are characterized by the pathologic collapse of the posterior membrane and/or tracheobronchial cartilage of the central airways, mainly during the expiratory phase of respiration. This collapse leads to dynamic outflow obstruction, which can manifest as symptoms of dyspnea, chronic cough, difficulty in clearing secretions, and recurrent respiratory infections.

In normal airways, the anterolateral cartilaginous walls in combination with the smooth muscles of the posterior membranous wall, resist the exaggerated inward bulging during expiration due to the difference in pressure inside (intratracheal pressure) and outside the airways (intrathoracic). In ECAC, when the intrathoracic pressure exceeds the intratracheal pressure, the airway collapses at the weakest points.[13] Specifically, in TBM, the cartilaginous support of the airways is compromised, while in EDAC, it is the excessive floppiness of the posterior membranous wall that leads to airway a reduction in airway cross-sectional area (CSA). This dynamic process worsens with forced expiration and physical exertion, contributing to the clinical symptoms observed.

The chronic cough observed in these patients often likened to a *seal-like barking*, is theorized to result from the excessive vibration of the posterior wall against the anterolateral wall of the trachea.[13] The difficulty in clearance of secretion is caused by the mechanical collapse of the airway, which impedes expectoration and leads to chronic airway inflammation, thereby impairing the mucociliary clearance.[14] Chronic exertional dyspnea leads to deconditioning and muscle atrophy.

An important concept in understanding the pathophysiology of ECAC is the *equal pressure* *point* theory.[13] This theory suggests that there is a point along the airway where the pressure inside the airway equals the pressure outside. Beyond this point, if the external pressure exceeds the internal pressure significantly, the airway collapses leading to expiratory flow limitation. This dynamic interplay results in a cycle of obstruction and air trapping, further exacerbating respiratory symptoms and impairing the ability to clear secretions effectively. Understanding these mechanisms can inform treatments that can mitigate the airway collapse. This is further discussed in the management section of this review article.

DIAGNOSIS

The diagnosis of ECAC primarily involves dynamic flexible bronchoscopy and dynamic computed tomography (CT). They are essential for establishing the diagnosis, determining of the severity and identifying the morphology subtypes that guide the choice of therapy.

Dynamic flexible bronchoscopy is considered the gold standard for diagnosing TBM and EDAC due to its ability to provide real-time visualization of the airways during both inhalation and exhalation. At Beth Israel Deaconess Medical Center, this procedure begins with anesthetizing the patient's upper airway with 1% lidocaine delivered with an atomizer to the posterior oropharynx to blunt the gag reflex, followed by irrigation of the larynx, vocal cords, and aryepiglottic folds.[15] The procedure is performed while the patient is supine with continuous monitoring of the patient's vital signs. Patients undergo minimal sedation[16] with intravenous midazolam and fentanyl. Ketamine is avoided due to its relaxing effect on smooth muscle and enhancing airway collapse.[17] A bronchoscope with an outer diameter of 4.9 mm and a 2.0 mm working channel is used to minimize any stenting effect. The entire tracheobronchial tree is anesthetized with aliquots of 1% lidocaine. The patient is then asked to perform forced respiratory maneuvers (deep breath in, hold, and then blow out) while the bronchoscope captures still images of the airway at end inhalation and end exhalation. This maneuver is performed at 6 specific airway levels: (1) cricoid; (2) mid tracheal (5 cm proximal to carina); (3) distal trachea (2 cm proximal to carina); (4) right main stem bronchus (at right tracheobronchial angle); (5) bronchus intermedius; and (6) left main stem (at left tracheobronchial angle).[18]

The degree of collapse is quantified by comparing the anteroposterior diameter of the airway lumen during inspiration and expiration. This technique not only confirms the presence of dynamic collapse but also allows for the evaluation of coexisting pathologies, such as vocal cord abnormalities, laryngopharyngeal reflux, or bronchitis. This forms the comprehensive management approach for ECAC. Studies have shown high interobserver and intraobserver agreement among pulmonologists in evaluating the extent of airway collapse using this technique.[15]

On the other hand, dynamic CT provides detailed images of the airway structure during different phases of respiration and concurrently evaluates other potential causes of the patient's symptoms, such as COPD, bronchiectasis, and extrinsic compression. The dynamic CT measurement has been shown to correlate well with bronchoscopic findings[19] and is particularly useful for patients who may not tolerate bronchoscopy well. The images obtained at end inspiration and forced expiration are used to calculate the collapsibility index: [1 – (CSA at forced expiration/CSA at end inspiration)] x 100%.[20] This is performed at the same 6 specific airway levels as described earlier for dynamic bronchoscopy. Traditionally, this assessment was performed with a multidetector CT,[19] but a study has shown single axial plane used in traditional CT is sufficient.[20] Recent developments have also introduced automatic segmentation techniques in dynamic CT, which improve the accuracy and reproducibility of airway collapse measurements.[21]

Airway collapsibility of more than 70% of the airway is required for establishing the diagnosis of ECAC.[8] This is because studies have shown that expiratory collapse of up to 70% can be present in normal healthy subjects with no symptoms or lung abnormalities.[22,23] The severity of collapse is graded as mild (70% – 80%), moderate (81% – 90%), and severe (91% – 100%).[18] Invasive interventions for ECAC are usually reserved for patients with severe collapse.[24] This is further described in the management section of this article. The severity of ECAC can also be quantified using specific scoring systems. Abia-Trujillo and colleagues (2023) introduced an EDAC severity score, where each of the 6 specific airway levels mentioned earlier is given a score from 0 to 3 points based on the severity of the collapse. A total score of less than 9 indicates mild to moderate disease, and a score greater than 9 signifies severe disease.[25] This scoring system aids in stratifying patients based on the severity of their airway collapse, which helps predict the need for further intervention.

MANAGEMENT

Evaluation of Intervention/Treatment Outcome

Evaluating the treatment outcomes for ECAC involves both subjective and objective measures to determine the efficacy of interventions, such as airway stenting and TBP. Studies evaluating ECAC treatment (stent trial or TBP) outcomes typically consist of self-reported respiratory symptoms, self-report measures, and functional assessment at baseline and following intervention.[26–30] Self-reported respiratory symptoms consist of whether there is improvement in dyspnea, cough, and ability to clear secretions. Self-report measures frequently used in these evaluations include the modified St. George Respiratory Questionnaire (SGRQ), Modified Medical Research Council (mMRC), American Thoracic Society (ATS) dyspnea score, Karnofsky performance scale (KPS), and Cough Specific Quality-of-Life Questionnaire (CQLQ).[26,27,30] Functional assessment of patients is performed using spirometry FEV1 and 6-minute walk test (6MWT) measurements.

The following are the minimal clinically significant differences to indicate improvement: SGRQ score decrease of 4 points,[31] mMRC score decrease of 1 point,[32] CQLQ score decrease of 10 points,[33] FEV1 increase of 12% or 100 mL,[34] and 6MWT distance increase of 30 m.[35] In our institution, we combine the self-reported respiratory symptoms, self-report measures, and functional assessment to form the criteria for positive treatment response to the stent trial (Table 1).

Medical

There are 2 main treatment goals, which are alleviating the patient's respiratory symptoms and optimizing concurrent medical condition that contributes to ECAC. Aggressive pulmonary toileting is employed to help patient enhance their clearance of airway secretion. An example of a regimen used in our institution consists of mucolytic therapy with nebulized 10% N-acetylcysteine for 15 min twice a day (BID), expectorant therapy with Guaifenesin 1200 mg BID, and flutter valve BID or a vest 30 min every day. Exertional dyspnea and dynamic hyperinflation are managed with breathing techniques that increase positive end expiratory pressure (PEEP), such as purse lip breathing or intermittent use of positive airway pressure (PAP). Pulmonary rehabilitation, in combination with a weight lost program, can be employed to improve exercise induced dyspnea and deconditioning. Physiotherapy can potentially play a role in improving airway clearance, reducing dyspnea and increasing exercise capacity though further studies are needed to confirm its efficacy.[36]

Continuous positive airway pressure (CPAP) can provide pneumatic stenting of the airway, which can normalize airflow, potentially alleviate symptoms, and improve the quality-of-life for these patients.[13] The oral positive expiratory pressure (PEP) device offers a portable and hands-free alternative that has been trialed for exertional dyspnea in COPD.[37,38] So far portable CPAP and oral PEP devices in ECAC have been limited to small case series.[39–43] Our institution is trialing the use of oral PEP devices for ECAC patients but well-designed controlled studies are needed to evaluate the impact of this intervention.

Patients should be thoroughly evaluated for concurrent medical diseases, such as asthma, COPD, vocal cord dysfunction, obstructive sleep apnea (OSA), and gastroesophageal reflux disease (GERD). Lifestyle modifications and antiacid medications are a cornerstone in managing GERD for patients with ECAC. These include dietary changes, weight loss, and elevating the head of the bed to reduce nighttime reflux. Pharmacologic treatment primarily involves the use of proton pump inhibitors. In more severe cases, surgical interventions, such as fundoplication, may be considered for patients who do not respond adequately to medical therapy. A study by Majid and colleagues 2019 has shown that GERD is present in 45% of patients with ECAC based on formal evaluation.[44] Aggressive antireflux therapy (medical treatment and anti-reflux surgery) can lead to significant improvement in respiratory symptoms without further treatment of ECAC in 46% of patients with GERD.[44] The outcome of surgical TBP can be negatively affected by the presence of GERD.[45] Aggressive management of GERD is recommended to mitigate its impact on respiratory symptoms and prevent further airway damage. Patients with OSA are

Table 1
Criteria for positive stent trial based on improvement in 2 out of the 3 domains

Domain	Criteria
Subjective Improvement in SOB Improvement in cough Improve ability to clear secretions	1 out of 3
Subjective/objective SGRQ reduced by 4 points CQLQ reduced by 10 points mMRC reduced by 1 point	1 out of 3
Objective FEV1 increased by 0.1 L 6MWT increase by 30M	1 out of 2
Positive stent trial	2 out of 3 domains

at risk for nocturnal GERD during obstructive events induced by negative intrathoracic pressure distal to the pharynx,[44] which can potentially be mitigated by CPAP therapy.

Patients with intractable cough unresponsive to GERD therapy, breathing techniques, and PAP therapy may require anti-tussive medications, such as benzonatate 100 to 200 mg three times a day (TID) or codeine 30 mg every 6 to 8 hr on as needed basis.

Endoscopic

Stent trial

Short-term stent placement in ECAC is pivotal for assessing candidacy for TBP.[28] Stent trials involve the temporary (1 – 2 weeks) placement of airway stents to evaluate if airway stabilization leads to improvements in respiratory symptoms and quality-of-life for patients with severe ECAC.[46] Only patients who are still symptomatic despite the medical therapy aforementioned are selected for stent trials. Dynamic flexible bronchoscopy and CT scans are employed to identify the sites of severe collapse.

The proceduralist can choose between silicone stents and uncovered self-expanding metallic stents (USEMAS), each with distinct advantages and disadvantages. Silicone stents, often in a Y-shaped configuration, were historically the only choice of stent.[26,47] They are preferred for their ability to accommodate in large airway diameters without migration. Nonetheless, silicone stents are associated with relatively high rates of mucus plugging (36% – 66%) and a granulation tissue formation rate (33%).[47,48] USEMAS, on the other hand, preserves the airway's innate mucociliary clearance and has a superior inner diameter-to-wall thickness ratio.[46] This improved functionality allows the stent trial to better predictor of response to TBP and avoid the benefits of airway stabilization from being confounded. Currently, our institution adopted the use of patient-specific 3-dimensional (3-D) printed airway stent[49] for highly selected cases where the patient's central airway poorly conforms to the silicone Y-stent and long-term stenting is needed.

Before stent placement, patients undergo subjective and object assessments (as described earlier) to establish a baseline for evaluating treatment outcomes. The stent trial involves the placement of stents under general anesthesia using rigid bronchoscopy. After placement, patients are monitored for approximately 1 to 2 weeks, during which time they undergo the same assessments to determine improvements in respiratory function, exercise capacity, and symptom relief. The criteria for positive stent trial used in our institution are shown in **Table 1**. Earlier studies using silicone Y-stents have shown that up to 77% of patients achieved improvement in quality-of-life score (SGRQ), dyspnea scores (ATS), functional status (KPS), and exercise capacity (6MWT) during the stent trial.[47] The placement of USEMAS was associated with up to 88% improvement in respiratory symptoms and significant improvement mMRC, CQLQ scores, and 6MWT distance.[27] In direct comparison, USEMAS demonstrated greater improvement in health-related quality-of-life and exercise capacity and was more predictive of TBP response compared to silicone Y-stents.[50] Patients who had a positive stent trial do maintain the improvements in CQLQ, mMRC, and 6MWT distance post-TBP.[28]

The short duration of stent placement minimizes the complications associated with USEMAS in benign airway disease, especially with stent removal as neoepithelialization only begins as early as 3 to 6 weeks after stent placement.[51] In a study comprising 90% benign airway disease, metallic stents removed within 30 d were associated with a lower rate of complications and health care utilization as compared to removal after 30 d.[51] Despite the Food and Drug Administration issuing a warning in 2005 against the use of metallic stents in benign airway diseases due to reported complications and removal difficulties,[52] studies have demonstrated that short-term use of USEMAS for stent evaluations is safe and has a lower complication rate compared to silicone Y-stents.[27,50]

In our institution, we place silicone Y-stents when the largest airway diameter exceeds 20 mm, which is the upper limit diameter for the USEMAS. Otherwise, USEMAS are placed only in the airway portions (trachea/left mainstem/right mainstem) that fulfill the criteria for severe ECAC. Post-stent care consists of a mucociliary clearance regimen to prevent mucus plugging and infection. This comprises of mucolytic with nebulizer treatments using 10% N-acetylcysteine for 15 min BID, expectorant therapy with Guaifenesin 1200 mg BID, and a flutter valve BID.

Long-term airway prosthesis

Depending on the severity and location of the ECAC, the malacic airway can be permanently stented by way of tracheostomy, Montgomery T-tube, silicone Y-stent, or 3-D printed airway stent.[53–55] This should be reserved as the last resort since long-term airway prosthesis is associated with recurrent complications, such as granulation tissue formation, mucus plugging, infection, migration, stent fracture, and potentially worsening ECAC.[56–61]

Thermoablative

Thermoablation techniques, including laser TBP and argon plasma coagulation (APC), have emerged as promising endoscopic treatments for ECAC. Laser TBP involves the use of a laser to create controlled scarring and fibrosis in the tracheal and bronchial walls, thereby stiffening the airway and preventing collapse during expiration.[62] This technique has shown significant improvement in symptoms, with patients reporting substantial reductions in their dyspnea scores post-procedure.[63] APC, another thermoablative method, uses ionized argon gas to achieve similar outcomes by coagulating the airway tissues and reducing collapsibility.[64] Other lesser-known thermoablative modalities include radiofrequency ablation and electrocautery. These procedures are performed endoscopically and offer a less invasive alternative to surgical options TBP, making them suitable for patients who are not candidates for surgery. Despite promising results in initial ex-vivo animal studies and case reports, further research and larger clinical trials are necessary to establish the long-term efficacy and safety of these thermoablative techniques in the management of ECAC and should only be offered to patients who are not surgical candidates under a protocol in a clinical trial.

Surgery

TBP is a surgical procedure designed to stabilize and reinforce the central airways in patients with severe crescent type TBM or EDAC who are still symptomatic despite medical optimization (Fig. 1). The surgery typically involves a right open thoracotomy or robotic approach, where the posterior membranous wall of the trachea and often the main bronchi are reinforced with a knitted polypropylene mesh or acellular dermis.[24,65–67] This reinforcement helps to restore the normal D-shape of the trachea and prevent collapse during expiration. The mesh is secured to the posterior airway wall using 4 rows of 4-0 polypropylene or vicryl sutures at the trachea and 3 rows of 4-0 polypropylene or vicryl sutures at each left and right main bronchus, with each row consisting of 4 stitches (see Fig. 1).[24,45,66]

In a study conducted by Gangadharan and colleagues, TBP was performed on 63 patients with severe TBM, resulting in a significant reduction in dyspnea, as evidenced by the decrease in the ATS Dyspnea Score from 3.06 to 1.65 and an increase in the KPS score from 62 to 76.[45] Additionally, the SGRQ score improved significantly from 74 to 46. The 6MWT distance also showed a significant increase from 987 ft preoperatively to 1187 ft postoperatively. Buitrago and colleagues

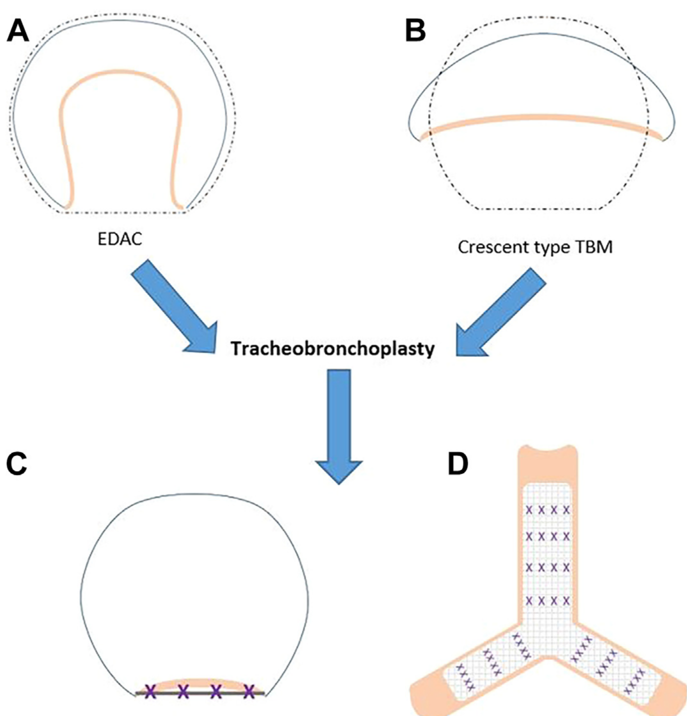

Fig. 1. Tracheobronchoplasty performed in patients with (*A*) excessive dynamic airway collapse or (*B*) severe crescent type tracheobronchomalacia. (*C, D*) Polypropylene mesh is secured to the posterior airway wall by rows of sutures.

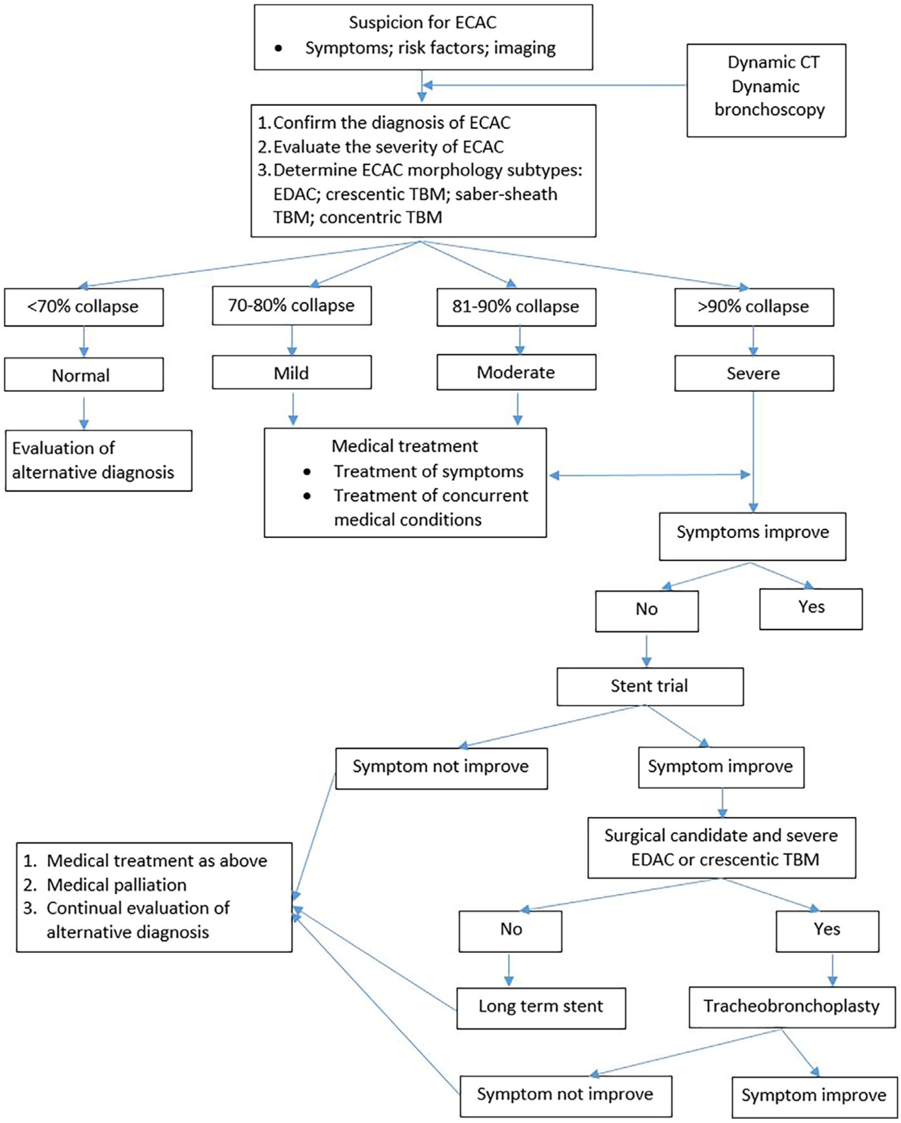

Fig. 2. Diagnostic and treatment algorithm for expiratory central airway collapse.

followed up on the same cohort of patients after 5 y and found that the benefits of TBP persisted long-term.[29] They reported sustained improvements in respiratory symptoms and quality-of-life, with the majority of patients maintaining or further improving their functional status. This long-term study underscores the durability of TBP as an effective treatment for severe TBM, providing lasting relief from symptoms and enhancing the overall quality-of-life for patients.

Robotic-assisted TBP (rTBP) offers a minimally invasive alternative to the open approach. This offers several benefits including lower postoperative pain, shorter of hospital stays, fewer complications, and expands the pool of candidates eligible for TBP who may not qualify for the open approach.[67] The largest study on rTBP is a retrospective study by Lazzaro and colleagues in 2019 involving 42 patients. It showed significant improvement in quality-of-life and physiologic measurements with low morbidity and mortality.[68] A follow-up to this study (median 40 mo) showed that durable operative improvements in quality-of-life and pulmonary function.[69]

TBP is associated with significant perioperative complications as nearly half of the patients experience some form of complications. The largest study, conducted at Beth Israel Deaconess Medical Center (BIDMC) involving 161 patients, reported 47% overall complication rate, with 23% classified as minor and 24% major.[70] Major complications included bleeding, mesh erosion, chest wall hernia, rhabdomyolysis, and so forth. The 30-d mortality rate in this series was 1.2%. A study from Lenox Hill Hospital, which utilized a robotic-assisted approach showed a similar 45% overall complication rate among a cohort of 42 patients with major complications occurring in 19% of the patients.[68] TBP is a valuable surgical option for patients with severe TBM, has its associated complications. The TBP complication rates cited earlier were performed in centers of expertize. Hence, careful patient selection and performance in center of excellence are crucial to optimizing outcomes and minimizing these risks.

The practice of stent trial to determine TBP candidacy (practice in our institution) is not universal. Due to stent complications affecting the reliability of stents to predict response to TBP, some centers forgo stent trials and proceed with TBP if the patient's severe symptoms are in line with radiographic imaging and bronchoscopic findings of ECAC.[30,66] The potential risk of not performing a stent trial prior to surgery is that 12% to 23% of patients undergoing surgery will not benefit from the operation.[27,47] In our institution, we limit this practice to patients with chronic cough and severe ECAC who remain symptomatic after maximal medical treatment since stents have shown to have significant limitations in predicting surgical success in this subset of patients.

SUMMARY

Suspicion for ECAC should be considered in patients presenting with dyspnea, chronic cough, and recurrent respiratory infections. Accurate diagnosis involves the use of dynamic flexible bronchoscopy and dynamic CT to assess the severity and subtype of ECAC. Optimizing medical management includes addressing concurrent conditions like COPD, asthma, paroxysmal vocal fold motion (PVFM), and GERD, along with techniques to improve airway clearance and increase PEEP. Selected patients may benefit from stent placement trials and, if positive, TBP to stabilize the airway and alleviate symptoms. Fig. 2 algorithm summarizes the diagnostic and treatment described in this article.

CLINICS CARE POINTS

- ECAC should be considered in patients presenting with dyspnea, chronic cough, and recurrent respiratory infections.
- Diagnosis involves the use of dynamic flexible bronchoscopy and dynamic CT to assess the severity and subtype of ECAC.
- Medical management includes addressing concurrent conditions, such as COPD, asthma, GERD, and paroxysmal vocal fold motion, along with techniques to improve airway clearance and increase positive end expiratory pressure.
- Selected patients may benefit from stent placement trials and, if positive, TBP to stabilize the airway and alleviate symptoms.

DISCLOSURE

The authors have nothing to disclose.

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