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Endobronchial management of malignant central airway obstruction: the first 6-year single center experience

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ABSTRACT

Objectives: Central airway obstruction (CAO) develops in 20-30% of lung malignancies during the disease. The symptoms related to obstruction often result in poor quality of life and poor prognosis. Interventional bronchoscopic treatments are now recommended in guidelines to improve quality of life and symptom palliation in this patient group. In our study, we aimed to determine the efficacy and safety of our methods in the malignant CAO caused by endobronchial exophytic tumors.

Methods: Between May 2012 and August 2018, 432 endobronchial debulking procedures were performed in 388 patients with symptomatic malignant CAO due to endobronchial exophytic or mixed lesions.

Results: Primary lung tumors were the most common cause of airway stenosis (84.0%). The most common debulking technique was argon plasma coagulation assisted mechanical debridement (APC+MD) (79.9%). Airway patency was achieved with additional stents (10.2%) in the operations. The success rate of airway patency was 85.5% in APC+MD method, 75.6% in cryorecanalisation method, 91.7% in electrocautery assisted MD method, 100% in MD method and overall success rate was 85.4%. Stent use rate was significantly higher in the stenosis around main carina (42.9%) than in other localizations ($p < 0.001$). The overall serious complication rate was 2.1%. Procedure-related dead rate was 0.2%.

Conclusions: Endobronchial treatment of malignant CAO with interventional bronchoscopic procedures is effective and safe. The first 6 years of experience in our interventional pulmonary clinic show that it has similar characteristics with the world experience in the endobronchial treatment of malignant CAO.

Keywords: Interventional bronchoscopy, debulking, malignant central airway obstruction

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Central airway obstruction (CAO) develops in 20-30% of lung malignancies during the disease and constitutes 40% of disease-related deaths [1, 2]. The symptoms related to obstruction, such as dyspnoea, haemoptysis, and atelectasis with post-obstructive pneumonia, often result in poor quality of life and poor prognosis. The average life expectancy in these patients does not exceed 1-2 months [3-5]. For such complications, surgery is contraindicated in proximal lesions, chemotherapy has uncertain and delayed benefits, radiotherapy solves atelectasis in half of cases (54%), but results are delayed also [6]. Interventional

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bronchoscopic treatments are now recommended in guidelines to improve quality of life and symptom palliation in this patient group [7]. Many useful interventional bronchoscopic techniques have been developed to rapidly treat the endoluminal exophytic part of a malignant tumor that causes CAO such as mechanical debridement (MD), laser (L), electrocautery (EC), argon plasma coagulation (APC), cryorecanalization (CR) [8-17]. Combined methods are currently preferred in combination with each other (eg, APC+MD) and in combination with stents [8, 12, 18]. In our study, we aimed to determine the efficacy and safety of our methods in the malignant CAO caused by endobronchial exophytic tumors.

METHODS

Patients

This retrospective cross-sectional study was approved by the local ethics committee and was performed in accordance with the Declaration of Helsinki. Informed consent was obtained from all patients. Between May 2012 and August 2018, 432 endobronchial debulking procedures were performed in 388 patients with symptomatic malignant CAO due to endobronchial exophytic or mixed lesions. Interventional procedures other than debulking during this period (such as interventions to external compression stenosis, hemoptysis, fistulae and, benign airway strictures) were not eveluated.Patients with large vessel tumor invasion, clotting disorders, or low platelet count, as well as pregnant subjects, those under the age of 18, and those who did not sign the informed consent were excluded.

Operative Technique

General anesthesia was administered by an total intravenous anesthesia technique. Patients were intubated with a rigid bronchoscope (Efer-Dumon, 11 mm diameter, 43 cm length, Efer Endoscopy, Marseille, France) and respiration were achieved by conventional balloon method. Debulking procedures were performed by MD using the tip of the rigid bronchoscope, rigid pliers or APCor EC assisted MD (APC+MD, EC+MD) (ERBE ICC 200/APC 300 electrosurgical unit, rigid APC probe, 50 cm length, 2.3 mm diameter or rigid EC probe 50 cm length, 2.3 mm diameter; ERBE, Medizintechnik, GmbH, Tübingen, Germany) or CR (ERBOKRYO® CA unit, rigid cryoprobe 3 mm diameter, 53 cm length; ERBE, Medizintechnik, GmbH, Tübingen, Germany) (Figure 1, 2). When using APC or EC for coagulation, FiO2 was kept below 40%. After extubation, the patients

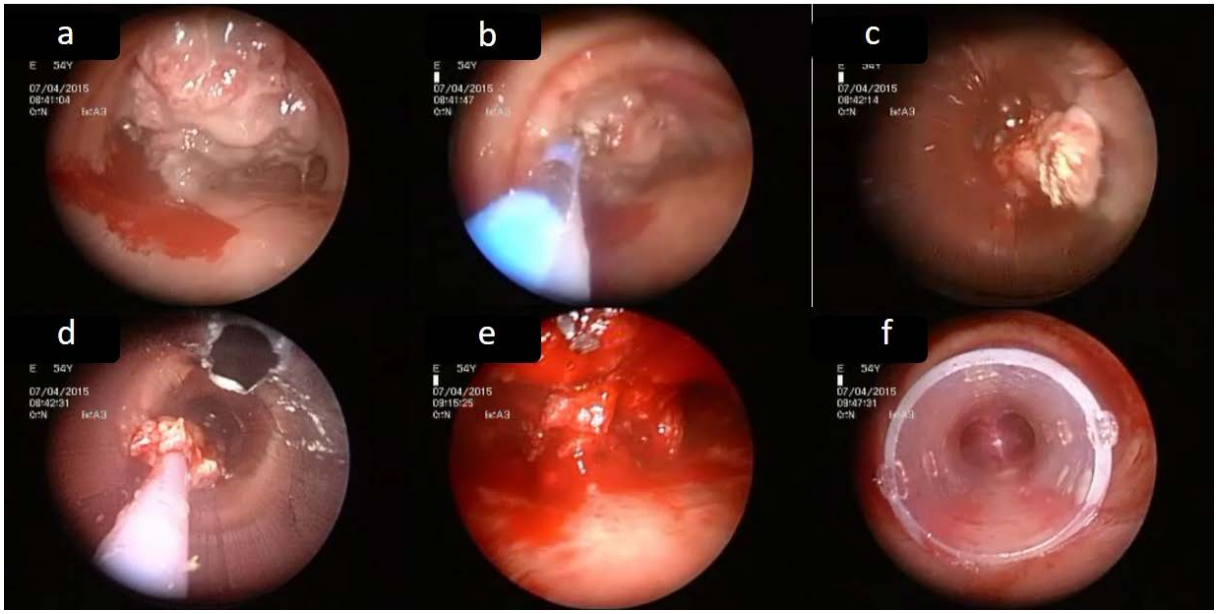

Figure 1. Argon plasma coagulation assisted mechanical debridement plus silicone Y stent. (a) malignant tumor on the main carina, (b) argon plasma coagulation, (c) mechanical debridement with tip of rigid bronchoscope, (d) tumor extracting by aspiratory probe, (e)residual tumor occluding both main bronchus, and (f) silicone Y stent appearance.

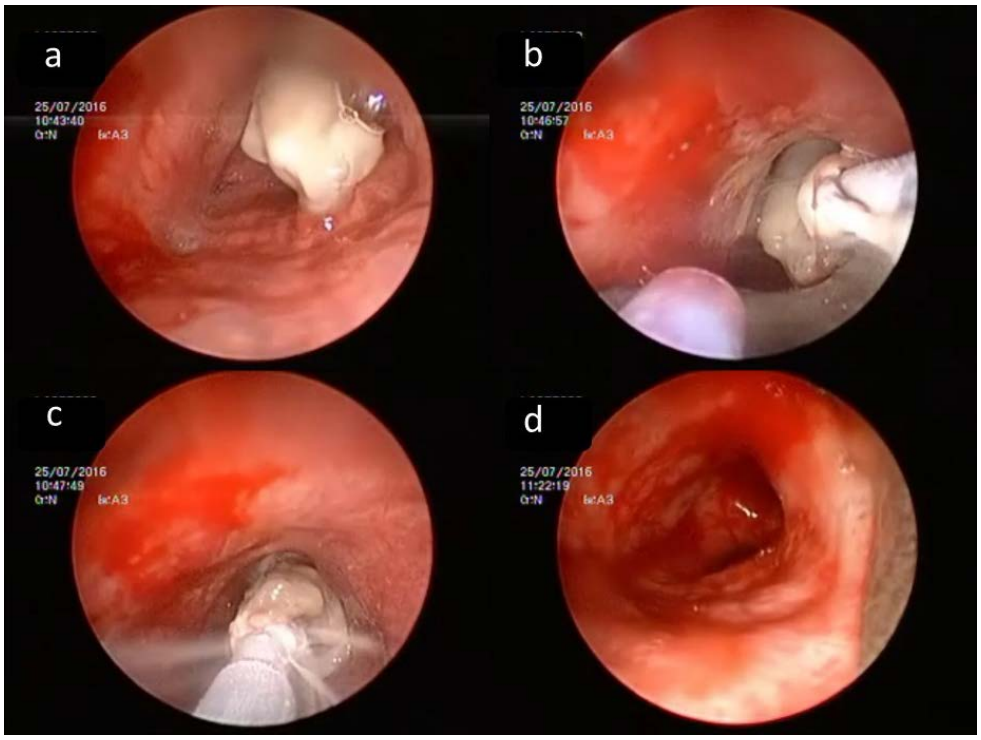

Figure 2. Cryorecanalization. (a) malignant tumor that narrows the right main bronchus, (b) cryorecanalization with rigid cryo probe, (c) repeated cryorecanalization with rigid cryo probe, and (d) airway patency provided in the right main bronchus.

were followed up in intensive care unit. Anteroposterior chest radiography and an arterial blood gas test were performed routinely. All patients were consulted to the oncology unit for chemotheraphy and/or radiotherapy treatment according to the stage of their tumor.

More than 50% ordinary diameter expansion of the bronchus diameter with malignant airway obstruction and the presence of distal healthy bronchus were accepted as a successful procedure. Silicone stents (Novatech® GSS ™ / Dumon®, Novatech SA, La Ciotat, Cedex, France) were placed in patients with expansion below 50% due to external compression despite after debulking of endobronchial exophytic part of tumor and reaching the healty bronchi.

Statistical Analysis

The statistical analyses were conducted with PASW Statistics for Windows (SPSS Inc. Version 18.0, Released 2009, Chicago, USA). Descriptive statistics were presented with frequency, percentage, mean, standard deviation (SD) and median values. Pearson chi-square test was used to analyze the relationships between categorical variables. The significance level was taken as $p < 0.05$

RESULTS

Three hundred eighty eight patients with malignant exophytic or mixed endobronchial lesions underwent a debulking procedure 432 times. The mean age of the study population (87.4% males) was 59.6 ± 11.2 (range 20-83) years. Primary lung tumors were the most common cause of airway stenosis (84.0%). 43.0% of the patients underwent interventional bronchoscopic procedures under emergent or urgent conditions. The first anatomic region, which caused more than 50% stenosis under the cord vocal, was accepted as the main stenosis. The majority of the procedures (47.7%) were applied for right-sided stenosis (right main bronchus, intermediate bronchus, right upper, middle, lower lobe bronchi). The most common debulking technique was APC+MD (79.9%). Airway patency was achieved with additional stents (10.2%) in the operations, that had robust bronchi in the distal area after debulking but residue airway stenosis was more than 50% due to external compression (Table 1).

The success rate of airway patency was 85.5% in APC+MD method, 75.6% in CR method, 91.7% in EC+MD method, 100% in MD method and overall

Table 1. Patient demographics and clinical data

Variables	n	%
Age (years) (mean±standard deviation)	59.6 ± 11.2	
Sex		
Male	339	87.4
Female	49	12.6
Origin of malignancy		
Primary lung tumors	326	84.0
Low grade tumors	31	8.0
Metastatic tumors	31	8.0
Operative indication		
Urgent	167	43.0
Elective	221	57.0
Site of main stenosis		
Trachea	107	24.8
Main carina	21	4.9
Right side	206	47.7
Left side	98	22.7
Techniques used		
APC+MD	345	79.9
CR	41	9.5
EC+MD	36	8.3
MD only	10	2.3
Additional silicone stent used		
Trachea	27	25.2
Main carina	9	42.9
Right side	7	3.4
Left side	1	1.0
Total	44	10.2
Complications		
Carbon dioxide retention	5	1.2
Pneumothorax	3	0.7
Severe bleeding	1	0.2
Total	9	2.1

APC+MD = Argon Plasma Coagulation assisted Mechanical Debridement, CR = Cryorecanalization, EC+MD = Electrocautery assisted Mechanical Debridement, MD = Mechanical Debridement

success rate was 85.4% (Table 2). The success rate of airway patency in left-sided lesions (65.3%) was significantly lower than other localizations ($p < 0.001$) (Table 3).

Stent use rate was significantly higher in the stenosis around main carina (42.9%) than in other localizations ($p < 0.001$). The need for stenting in tracheal lesions (25.2%) was higher than right (3.4%) and left (1.0%) sided stenosis ($p < 0.001$, $p < 0.001$ respectively) (Table 4).

Table 2. The success rates of debulking techniques in our study and literature

Technique	n	Succesfull	%	In literature %	References
APC+MD	345	295	85.5	67-96%	[8, 9]
CR	41	31	75.6	73-91%	[10-12]
EC+MD	36	33	91.7	88-89%	[13-15]
MD only	10	10	100.0	76-90%	[8, 16, 17]
Total	432	369	85.4	85-93%	[18, 20, 21]

APC+MD = Argon Plasma Coagulation assisted Mechanical Debridement, CR = Cryorecanalization, EC+MD = Electrocautery assisted Mechanical Debridement, MD = Mechanical Debridement

Table 3. Success rates according to localization

Localization of obstruction	Number of interventions	Succesfull	%	Unsuccesfull	%	*p* value
Trachea	107	106	99.1	1	0.9	
Main carina	21	21	100.0	0	0.0	
Right side	206	178	86.4	28	13.6	< 0.001
Left side	98	64	65.3	34	34.7	
Total	432	369	85.4	63	14.6	

The overall serious complication rate was 2.1%. In 5 (1.2%) patients had carbon dioxide retention treated with invasive mechanical ventilation support for an average of 2 hours and after extubation did not recur. Three (0.7%) patients had pneumothorax treated with tube thoracostomy. One patient (0.2%) with severe bleeding intubated with the double-lumen endotracheal tube and 2 units of erythrocyte suspensions were given. The patient died in the fifth day of the procedure in intensive care unit due to respiratory failure and this was considered as only 1 (0.2%) perioperative mortality related to the procedure (Table 1).

Table 4. Use of stents according to localization

Localization of obstruction	Number of interventions	Stent usage	%	*p* value
Trachea	107	27	25.2	
Main carina	21	9	42.9	
Right side	206	7	3.4	< 0.001
Left side	98	1	1.0	
Total	432	44	10.2	

Recurrent CAO was observed in 36 of 388 patients (9.3%). Due to recurrence, debulking was performed 44 times (range 1-4 times) in 36 patients. The median time to relapse was 74 days (range 7-1646 days). Of the 44 procedures, 7 (15.9%) resulted in unsuccessful. Treatment success was achieved with additional silicone stents in 12/36 (33.3%) in these patient group.

DISCUSSION

Malignant CAO is synonymous with poor prognosis [3-5]. Conventional treatments do not alter the poor outcome in this patient group. However, patients with airway patency provided by interventional bronchoscopic techniques have the same survival with patients without CAO [19].This evidence suggests that interventional bronchoscopy should be part of conventional therapies in this group of patients.

There are many useful studies on rapidly debulking of endobronchial exophytic part of tumor in malignant

CAO [8-21]. The success rates of patency of the techniques (used in our study) in the literature are APC+MD 67-96%, CR 73-91%, EC+MD 88-89%, MD 76-90% [8-17]. Although the number of interventions except APC+MD were small, our success rates were consistent with the literature (Table 2). The overall success rates found in three major studies were between 85-93% [18, 20, 21]. The overall success rate we found in our study (85.4%) is consistent with the literature in this respect. These data show that the techniques we use for endobronchial management of malignant CAO are effective.

We detected low success rate of patency among patients with left side tumors in accordance with the literature [21]. We think that the cause of the failure is related to the anatomical structure and lymphatic flow of the left bronchial system. Anatomically, the left upper lobe and left lower lobe are separated by the same angle in the same plane. There are left interlobar lymph nodes (11L) between them. In our experience, when the tumor in any part of the left lung invades to occlude the left main bronchus, it usually enlarges the 11 L ganglia with lymphatic spread. Growing 11L ganglia are narrowed by external compression in both lobe bronchus. Even if you remove the endobronchial exophytic tumors obstructing the left main bronchus, the left upper and lower lobe bronchi remain narrow due to external compression caused by the enlarged of 11L lymph nodes. This situation causes a failure of the operation.

The best palliative treatment of malignant tumors stenosis around the main carina is silicone Y stent placement [7, 22]. Therefore, it is expected that we will use silicone stents at a significantly higher rate (42.9%) in the main carina lesions after debulking.

It is reported that the overall complication rate is 1.6-11.0% and mortality rate is 0.8-3.0% due to techniques for endobronchial management of CAO [9, 18, 23-26]. Complication rate (2.1%), types of complications and mortality rate (0.2%) in the current study are consistent with the research in this field [9, 18, 23-26]. Our findings provide an evidence that our techniques are safe for the treatment of malignant CAO.

Recurrence rate after successful interventional bronchoscopic procedures in malignant CAO is 12.5% [27]. The rate of failure in repetitive processes increases. One of the indications for stent is recurrent endobronchial malignant tumors [28]. In our study, we found the recurrence rate is 9.3%, failure rate is 15.9% and, additional stent use rate is 33.3% in these group. Our data consistent that these results.

Limitations

Our study has a few limitations, this was a retrospective study and single-institution design. The retrospective nature of our study is a source of recall bias and does not allow us to evaluate improvements in quality of life. Prospective, multicenter trials are ideal and recommended in the future.

CONCLUSION

Endobronchial treatment of malignant CAO with interventional bronchoscopic procedures is effective and safe. The first 6 years of experience in our interventional pulmonary clinic established in 2012 show that it has similar characteristics with the world experience in the endobronchial treatment of malignant CAO. We think that there should be a team and equipment for treat malignant CAO by endobronchial methods in oncology centers.

Clinical Trial Registration

This study was approved by Ethical Committee of University of Health Sciences, Atatürk Chest Disease and Thoracic Surgery Training and Research Hospital with the number of 107.12.2018/583.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript .

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