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ORIGINAL ARTICLE

Fiberoptic bronchoscopic cryo-ablation of central bronchial lung cancer

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KEYWORDS

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Abstract *Background:* Radiotherapy and chemotherapy are the standard palliative treatments in patients with inoperable carcinoma of the lung present with obstruction of the central airway but have limited effectiveness in reopening obstructed airways. Cryosurgery is one of the several techniques that can be used to reopen an obstructed tracheobronchial lumen.

Objective: The aim of this study was to evaluate safety and clinical efficacy of flexible cryoprobe as an important option to treat the patients with inoperable obstructive central bronchial lung tumors.

Patients and methods: This study was conducted on 38 patients with central endobronchial malignant tumor. A flexible cryoprobe was used during flexible bronchoscopy. The endobronchial tumors and symptoms were assessed 2 and 6 weeks after cryotherapy.

Results: After 6 weeks, the endobronchial lesions were completely removed in 32/38 patients (~85%), partly removed in 4/38 patients (~10%), and could not be removed in 2/38 patients (~5%), with a symptomatic improvement in dyspnea, cough and hemoptysis 78%, 63.0%, 85% after 2 weeks and up to 89%, 84.0%, 100% after 6 weeks respectively.

Conclusion: Cryotherapy using fiberoptic bronchoscopy is a safe with a high efficacy technique in treating endobronchial malignant obstructive lesions.

Introduction

Lung cancer, the most frequent cause of cancer related death, is responsible for more than 1 million deaths annually [1,2].

Lung cancer represents >17% of all new cases of cancer and 28% of all cancer deaths worldwide. At the time of diagnosis, >80% of patients are inoperable, resulting in a 5-year survival rate of 15% [3,4].

Approximately 30% of inoperable patients with carcinoma of the lung present with obstruction of the central airway, which can cause distressing symptoms of cough, breathlessness, hemoptysis and recurrent infections, and may lead to gradual asphyxiation [5,6].

Palliative reopening of the affected airways often alleviates symptoms. Where the possibility of surgery has been eliminated, radiotherapy and chemotherapy are the standard palliative treatments but have limited effectiveness in reopening

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obstructed airways, so, other palliative measures must be considered [7].

Interventional bronchoscopy, particularly therapeutic bronchoscopy, includes many diverse modalities, such as the Nd:YAG laser, electrocautery, argon plasma coagulation, photodynamic therapy, airway stenting, brachytherapy, and cryotherapy, which have advantages and disadvantages [7,8].

The advantage of endobronchial cryotherapy is that it has been proven effective with minimal complications. It is also relatively easy to use and economical compared with other therapeutic modalities. Cryotherapy is safe, with no danger of bronchial wall perforation, no radiation danger, no risk of electrical accidents or fires, and does not require much special training. Disadvantages include delayed results and the requirement for multiple bronchoscopies to remove debris or to retreat, which is a serious issue for cryotherapy in a patient with impending respiratory failure due to an obstructive airway lesion [8,9].

The currently available rigid cryoprobe requires rigid bronchoscopy and general anesthesia, rendering the distal upper lobe bronchial lesions inaccessible [10].

The development of a thin and flexible cryoprobe has revolutionized cryotherapy for endobronchial lesions. This new generation cryoprobe can be passed through a flexible fiberoptic bronchoscope and cryodestruct nearly all visible airway lesions [10,11].

The success of freeze injury, which is the main mechanism of cryotherapy for malignancy, depends on the cooling rate, the thawing rate, the lowest temperature achieved, and repeated freeze–thaw cycles [8,12,13].

Aim of the study

The Current short-term follow-up study aimed to evaluate safety and clinical efficacy of flexible cryoprobe as an important option to treat the patients with inoperable obstructive central bronchial lung tumors.

Patients and methods

In this study, a total of 38 patients with an endobronchial malignant lesion were recruited from Chest and Clinical Oncology departments, Tanta University.

Inclusion criteria: (1) histologically proven carcinoma of the trachea and bronchi, (2) inoperable carcinoma based on the position of the tumor, performance status or poor respiratory function. Exclusion criteria: (1) severe respiratory distress and (2) uncorrectable bleeding profile.

Patients were assessed before cryotherapy and 2–6 weeks after cryotherapy, as regards the: (1) symptomatic; dyspnea, hemoptysis and cough, (2) chest radiography, (3) respiratory function tests: forced expiratory volume in one second (FEV1), and forced vital capacity (FVC) (4) performance status, using the Karnofsky scale [14].

The New York Health Association (NYHA) classification was used for assessment of dyspnea [15]. Hemoptysis was classified as none, blood tinged, and frank hemoptysis. Cough was assessed as regards the severity and persistence (does not disturb sleep or disturbs sleep).

All procedures were carried out during flexible bronchoscopy that was done in a standard fashion with topical anesthesia (5% lidocaine) of the oral-nasopharyngeal area and conscious sedation (IV midazolam).

The distal tip of the bronchoscope was placed about 5 mm above the lesion and the appropriate cryoprobe was inserted through the biopsy channel (bronchoscope) into the tumor. A flexible cryoprobe measuring 90 cm in length and 2.4 mm in diameter was used (ERBE, Germany). The probe was cooled with CO_2 that decreases the temperature in the probe's tip to −70 °C within several seconds.

Statistical analysis

A Wilcoxon matched pairs signed rank sum test was carried out for each outcome variable to determine whether there was a difference between pre- and post cryotherapy values. Results were expressed as numeric values (%). A p value of less than 0.05 was considered significant.

Results

This study was conducted on 38 patients, M/F ratio (23/15), mean age (61.80) with a central endobronchial malignant tumor (65% located in Rt. main, Rt. LL, and Lt. UL bronchi), 60% of the tumors at the time of presentation for cryosurgery at stage IIIb or IV (23 patients), and 40% (15 patients) at stage II or IIIa Table 1.

The endobronchial lesions, after 2 weeks, were completely removed in 29/38 patients (76.31%), partly removed in 5/38 patients (13.16%), and could not be removed in 4/38 patients (10.53%). After 6 Weeks, they were completely removed in 32/38 patients (~85%), partly removed in 4/38 patients (~10%), and could not removed in 2/38 patients (~5%). So, there was an objective significant response ($p < 0.05$) of malignant endobronchial tumors to cryotherapy (using flexible cryoprobe) Table 2 and Fig. 1.

As regards the symptomatic improvement, dyspnea was improved at least one class after 2 weeks in 30/38 patients (78.94%), with more improvement after 6 weeks in 34/38 patients (89.47%). Cough was improved after 2 weeks in 24/38 patients (63.15%), with more improvement after 6 weeks in 32/38 patients (84.21%).

Hemoptysis was improved after 2 weeks in 12/14 patients (85.71%) after 6 weeks in 14/14 patients (100%), completely controlled Table 3.

Table 1 Basic characteristics of study population.

Characteristics	*N*	%
M/F	23/15	
Age	61.80 ± 8.72	
CT tumor size		
⩾3 cm	29	76.32
<3 cm	9	23.68
Lesion localization		
Rt. main bronchus	7	18.42
Rt. LL	9	23.68
Rt. UL	2	5.26
Lt. main bronchus	5	13.15
Lt. LL	6	15.78
Lt. UL	9	23.68