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Nd-YAG Laser in Management of Endobronchial Lesions, a Five - Year Report

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ABSTRACT

***Background**: Nd-YAG laser is a relatively safe and effective procedure in the management of various types of endobronchial lesions including tracheobronchial tumors. It has been used in treatment of benign tumors and as a palliative therapy in obstructive airway lesions due to non-operable lung cancers.*

***Materials and Methods**: In this study, patients who underwent laser therapy because of their endobronchial lesions that admitted during 1994-99 in our hospital were investigated. A total number of 210 patients including 14 with benign tumors, 77 with malignant tumors, 11 with metastatic lesions, 14 with undefined prognosis tumor, and 94 with other lesions who seek laser therapy were investigated.*

The most common signs and symptoms among these patients were cough, dyspnea, hemoptysis, and obstructive pneumonitis. Improvement in airway obstruction following the application of laser therapy was assessed based on clinical signs and symptoms, arterial blood gas indices and spirometric results.

***Results**: After performing laser therapy, cough in 95.1% of patients, dyspnea in 97.7%, hemoptysis in 89.4% and obstructive pneumonitis in all of these patients showed a significant improvement. Obstruction was relieved in more than 95% of the patients; however, this rate reached to 100% in lesions of trachea and main airways. 98% of 263 obstruction sites were relieved immediately after procedure, and 34.6 % of these cases were completely treated by laser therapy. Complications of laser therapy were observed only in 2 of these patients, that resulted in death in one case.*

Conclusion**: The results of our study were consistent with the previous studies regarding the efficacy and safety of Nd-YAG laser therapy in endobronchial lesions. **(Tanaffos 2004; 3(9): 19-25)

***Key words**: Airway obstruction, Bronchoscopic surgery, Lung neoplasms, Nd-YAG laser*

INTRODUCTION

Having introduced the laser therapy in 1976 (1), a revolution happened in the management of airways obstruction among patients who were at risk for other methods of management like surgery or radiation therapy. This method can be applied in several conditions that were resulted in tracheobronchial obstruction, with less contraindications and side effects compare to other conventional therapeutic approaches.

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Capability of tissue coagulation, vaporization, necrosis, and hemostasis has made it as a very suitable method of palliative treatment for endobronchial malignant lesions as well as obstructive granulation tissue, strictures due to inflammation, amyloidosis, and benign tumors. Pulmonologists usually prefer to use Neodymium: Yttrium–Aluminum–Garnet (Nd- YAG) laser, which provides a desired penetration in tissues and good photocoagulation and homeostasis (2).

MATERIALS AND METHODS

In this study, we evaluated patients with endobronchial obstructive lesions who underwent Nd- YAG laser therapy in our center during a five-year-period from the year 1994 to1999, retrospectively. Because of the wide variation of the laser therapy sessions among these patients, we used median for showing the number of these sessions. All of the patients had the obvious signs and symptoms of airway obstruction. The patients were categorized into five groups according to the cause of airway obstruction, 3 patients had more than one specific cause of airway obstruction that were included in the category with dominant pathology.

The improvement of each patient was evaluated during the first 24-48 hours after laser therapy mainly according to their clinical signs and symptoms before and after treatment and also by bronchoscopic examination. All of the patients received Nd- YAG laser with power of 25-35 watt by a rigid or flexible fiberoptic bronchoscope.

RESULTS

A total of 210 patients with tracheobronchial obstructive lesions were included in our study. The total number of obstructive sites in the respiratory system the patients was 263. Trachea was the most common site of obstruction, reported in 46.2 % of the patients followed by right main bronchus (28.1%) and left main bronchus (15.2%) (Table 1).

Table 1. Sites of airways obstruction at the time of patient's admission:

Sites of obstruction*	Number of lesions at the site	Percent of patients
Trachea	97	46.2%
Right main bronchus	59	28.1%
Left main bronchus	32	15.2%
Larynx	22	10.5%
Right upper lobe	14	6.7%
Right intermedius bronchus	13	6.2%
Left upper lobe	8	3.8%
Right lower lobe	7	3.3%
Left lower lobe	7	3.3%
Right middle lobe	3	1.4%
Lingual lobe	1	0.4%

* Some of the patients had more than one site of obstruction.

The intervention was performed under local anesthesia in 185 patients (88%) and general anesthesia in 25 (12%).

The causes of airway obstructions are presented in table 2.

Table 2. Causes of airways obstruction.

Diagnosis	patients	Percent of patients
Benign tumors	14	6.7%
Malignant tumors	77	36.7%
Metastasis	11	5.2%
Tumors with undefined prognosis	14	6.7%
Non-tumoral lesions	94	44.7%
Total	210*	100%

*Some of the patients had two types of lesion.

Regardless of non-tumoral lesions, malignant tumors were the most common cause (37.7%), reported in 66 males with a mean age of 53.4 years and 11 females with a mean age of 54.3 years. As shown in figure 1, squamous cell carcinoma (SCC) was the most frequent finding (Figure 1).

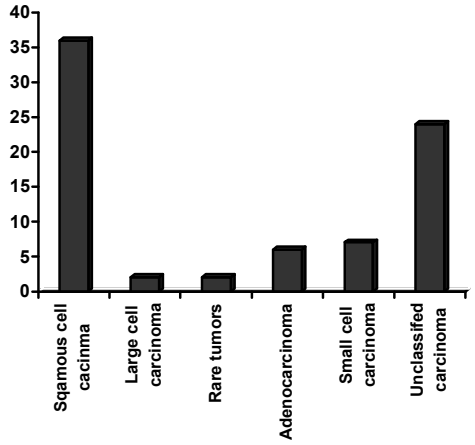

Figure 1. Types of the malignant tumors in 77 patient with airway obstruction.

All of these malignant patients had experienced cough; however, dyspnea (87%), hemoptysis (54.5%), fever (35%), obstructive pneumonitis (3.8%), and atelectasis (2.5%) were also frequent sings and symptoms. The frequency of sings and symptoms of all patients and their related improvement following the intervention are shown in table 3.

Among these patients, 23 prescribed chemotherapy, 11 received radiation therapy, and one underwent surgical resection before Nd-YAG laser treatment. Significant improvement in the obstruction was achieved in 75 (97.4%) patients during the first 24 hours following Nd-YAG laser therapy; however, 2 cases (2.5%), experienced complete relief. Median of laser therapy sessions among these patients was 3. Metastatic lesions accounted for 5.3% of airway obstruction (in 5 males and 6 females). Thyroid (5 cases), breast (2 cases), kidney, colon, endometrium, and larynx (each one case) were the original sites of metastasis. The patients frequently complained of dyspnea (90%), cough (73%), hemoptysis (36%), and fever (27%). For all of these patients, relative improvement of obstruction sites was observed during the first 48 hours after the first attempt of laser therapy, and in one case complete relief was seen. The median of laser therapy sessions was 3 among the patients with obstructive metastatic lesions. Among these patients, 8 were given chemotherapy, 3 received radiation therapy and 4 were candidated for surgical resection earlier (Figure 2).

Table 3. Frequency of symptoms and signs among the patients with airways obstruction and their related improvement following the Nd- YAG laser therapy

Sign and Symptom	Number of the patients with the sign /symptom	Improvement after treatment with Nd- YAG laser (% of patients)
Cough	185	95.1%
Dyspnea	176	97.7%
Hemoptysis	76	89.4%
Fever	52	69.2%
Obstructive Pneumonitis	15	100%
Atelectasis	3	33.3%

Nine patients with carcinoid tumor and 5 adenoid cystic tumor were categorized as patients with undefined prognosis for whom slow growing tumor and low metastasis rate were supposed. They received Nd-YAG laser irradiation therapy with a median of 3 sessions. None of these were subjected for chemotherapy; however, one received radiation therapy and 6 cases underwent surgical resection. Like other subgroups, cough (93%), dyspnea (71.5%),hemoptysis(64.5%),obstructive pneumonitis, (21.5%) and fever (14.2%) were the most complaints. Although all of these patients showed improvements in their obstruction during the first 48 hours after Nd-YAG laser application, none of them experienced complete relief of the obstruction.

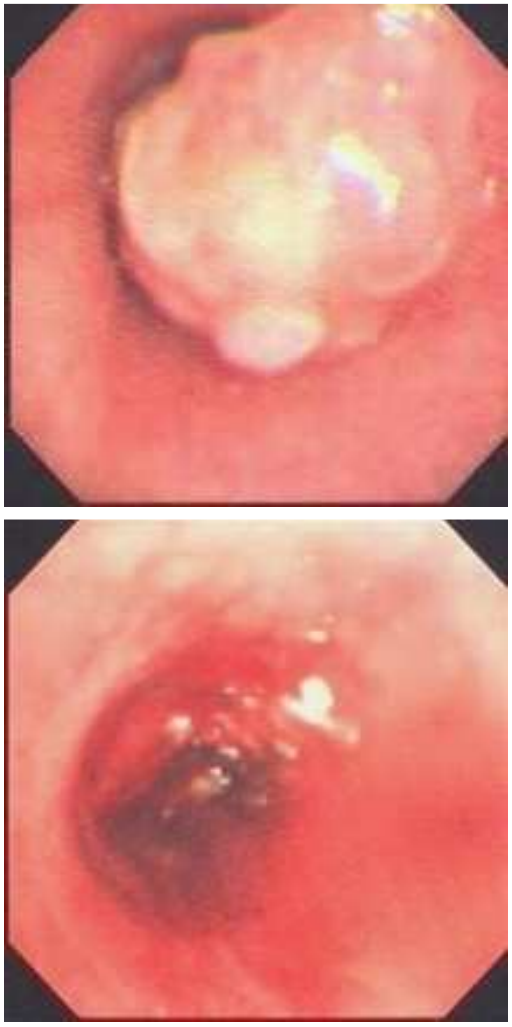

Figure 2. A tumoral mass (bronchial adenoma) in the left main bronchus of a 74-year-old man was removed by the laser therapy

Benign tumors as the cause of airway obstruction were seen in 14 patients (6.8%) of whom 9 were male with mean age of 43.3 years and 5 were female with mean age of 31.25 years old. These tumors include papilloma (7 cases), myoblastoma (4 cases), adenoma (one case), hamartoma (one case) and angioma (one case).

They received nothing except laser therapy (median; 3 sessions). The common signs and symptoms among this group were cough (92.8%), dyspnea (85.7%), fever (38.5%), hemoptysis (28.5%), and obstructive pneumonitis (7%). All of them showed immediate improvement following the first laser therapy; however, in 11 patients (78%), airway obstruction completely relieved.

Ninety-four patients underwent Nd-YAG laser therapy because of non-tumoral lesions. Of these, 55 had granulation tissues in their trachea, 13 had vocal cord nodules, 16 had fibrosis in their tracheobronchial tree, 2 treated by Nd-YAG laser because of the hemorrhage, and 7 had stenosis due to tuberculosis (3 cases), dysplasia (2 cases), and Wegeners' granulomatosis (2 cases).

From 55 patients with tracheal granulation tissue 39 were male with mean age of 30 years old and 16 were female with mean age of 11.1 years old. Most of the obstructions among these patients were caused by intubations due to accident and few of them had undergone tracheostomy. The minimum of intubation period was 1 hour and the maximum of this period in these patients was 14 hours. In most of these patients, the length of lumen was 2 centimeters and the diameter of trachea was more than 5 millimeters. The median of laser therapy sessions in this group was 3.

The most common signs and symptoms in the group with non-tumoral lesions of airway obstruction were dyspnea (88%), cough (86%), hemoptysis (18%), fever (17%), obstructive pneumonitis (8.5%), and atelectasis (1%). Most of them (98.9%) showed significant relief of obstruction immediately after

laser therapy and in 75 patients (79.9%) the sites of obstruction completely removed.

In general, the most common site of obstruction was trachea (47.5%). For all of these cases the improvement of airway obstruction was observed immediately after the first attempt of laser therapy; however, complete relief occurred only in 48 out of 97 patients with tracheal stenosis (47.5%).

96% of patients with obstruction in right and left main bronchus showed the immediate improvement after laser therapy.

Totally, 675 sessions of Nd-YAG laser therapy were achieved, 26 of these sessions complicated by bleeding; however, it was controlled by photocoagulation and supportive care except in one patient, who was a 56-year-old man with advanced large cell carcinoma that occluded the trachea and invaded the carina. An intractable tracheal bleeding happened during the laser therapy that led to death.

Severe dyspnea and respiratory failure occurred in one case that was successfully managed by intubation and medical treatment.

In general, the signs and symptoms due to the airway obstruction improved significantly in nearly all the patients after laser therapy. (Table 3)

In addition restructuring the obstructive sites was observed among these patients by using the bronchoscope after laser therapy.

DISCUSSION

Treatment of obstructions in the endobronchial system by means of the Nd-YAG laser is one of the most promising methods in relieving the obstruction and its related signs and symptoms. Being repeatable in a short period compare to the other methods of treatment such as radiation therapy or surgery as well as being applicable under local anesthesia has made it as one of the most desirable palliative therapies for patients with lung tumors. Meanwhile, it is a quite non-expensive approach as compared to surgical intervention. Exophytic lesions of the trachea and mainstem bronchi are the most amenable to therapy by laser, and improvement in symptoms correlates best with improved patency of large airways (3). Nd-YAG Laser not only cuts but also seals blood vessels and bronchi and can prevent bleeding as well as air leaks (4).

According to the experiences in this regard, Nd-YAG laser has been considered as the best approach for the management of malignant central airway obstruction (5). Laser therapy is also important in resection of early stage lung cancer as well as removing excessive granulation tissue following lung transplantation (6, 7).

Effectiveness of Nd-YAG laser in relieving the signs and symptoms of airway obstruction has been evaluated by several studies. Dyspnea is one of the most important symptom that is considered as an indication for applying bronchoscopic laser therapy. We achieved a significant improvement in dyspnea as well as other disabling symptoms among the patients with airway obstruction after Nd-YAG laser therapy, that is consistent with the results of previous studies in this regard (8, 9, 10, 11). Decreasing the need for surgery among the patients as well as relieving the obstruction in non-operable patients are the other achievements of applying the Nd-YAG laser therapy among our cases. Before induction chemotherapy or surgery, preliminary endoscopic palliation helps to improve evaluation and staging and contributes to reducing morbidity during chemotherapy without increasing surgical complications (12).

In addition, in the situations that foreign bodies are indistinguishable because of the granulation tissue, eliminating the granulation tissue by laser is helpful both in detecting and removing the foreign body.

The most important side effects of Nd-YAG laser therapy are perforation and bleeding as well as

burning during the process of laser therapy (13, 14,15). Another reported complication of Nd-YAG laser therapy is coronary spasm and cardiac arrest because of the carcinoid crisis during the laser therapy of patients with carcinoid tumors but it is relatively uncommon (16). Indeed, our complication rate was in consistence with prior studies (9, 17).

Totally, it seems that Endobronchial usage of the Nd-YAG laser has provided a relatively new technique to treat otherwise untreatable obstructive malignant tumors as well as the means to avoid the need for more extensive surgical procedures for benign lesions.

The results of our study support the previous studies regarding the effectiveness and safety of Nd-YAG laser.

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