Laser Bronchoscopy : Experience at Siriraj Hospital

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Abstract

Laser bronchoscopy is a major procedure employed in intervention bronchoscopy. From August 1998 to August 2000, 20 patients with endobronchial lesions were treated by this procedure in the Respiratory and Tuberculosis Division of the Department of Internal Medicine, Siriraj Hospital. Of 16 malignant lesion, a good response was obtained in 78 per cent (7 out of 9) of lesions in the proximal right main bronchus with failure to open any of the 3 completely obstructed lesions at the left distal bronchus. The results of treatment of malignant lesions in the trachea and carina were acceptable. Good results were obtained from all 4 benign endobronchial obstructions. No complications arose in this study. This small series demonstrates the benefit of laser bronchoscopy in patients with high risk endobronchial obstructive lesions.

Key word : Laser Bronchoscopy, Siriraj Hospital

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Laser bronchoscopy is a major procedure employed in intervention bronchoscopy. The purpose of this procedure was to use a laser beam in the process of opening the airway lumen obstructed by tumor or abnormal tissue such as granulation tissue during bronchoscopy with either a rigid or flexible bronchoscope. The types of laser in current use are the CO_2-laser and Neodymium yttrium aluminum garnet laser (Nd-YAG laser) of which the latter is more popular because of good tissue penetration, better hemostasis and the capability of being transmitted by a flexible catheter for use with a flexible bronchoscope.

The Respiratory and Tuberculosis Division of the Department of Medicine, Siriraj Hospital have used the Nd-YAG laser bronchoscopy since 1995. In

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the beginning, the procedures were done using only a flexible bronchoscopy. The numbers undergoing the procedure were small because of the limits of selecting patients and the time consumed by the procedure. Since August 1998, the laser procedure has been improved and has expanded the capability of using a rigid bronchoscope under general anesthesia that could shorten the operation time and produce more effective control of bleeding which is the major complication of tumor resection. The first two years experience of this procedure at Siriraj Hospital is reported.

MATERIAL AND METHOD

The patients who were examined in the Laser Unit at the Division of Pulmonary and Tuberculosis Department of Medicine, Siriraj Hospital between August 1998 and August 2000 and had endobronchial lesions suitable for laser resection were enrolled in this study. The laser unit has the capacity of doing Nd -YAG laser procedure both by using either a flexible bronchoscope under local anesthesia or a rigid bronchoscope under general anesthesia. The two laser machines were Sharplan 3000 Nd: YAG surgical laser system which was used in the bronchoscopy suite with the flexible bronchoscope and Dye 600, Multilase 2000 for cases performed in the operating room who needed rigid bronchoscopy under general anesthesia. The choice of each procedure depended on the type, location, extent of the lesions, the suitability of the patients and the estimated operation time.

Pre-operative assessment included clinical examination in all cases and spirometry in patients who could perform the test. Degree of shortness of breath was assessed using visual analogue scale (Borg's scale). Radiological assessment consisted of a plain chest X-ray. Computerized axial tomography was used in selected cases. Flexible bronchoscopy was performed in each case in order to evaluate the possibility of benefit from laser therapy.

Each patient had an endobronchial lesion which was thought to be responsible for his/her respiratory symptoms. The Laser bronchoscopy procedures were aimed at the adequate removal of endobronchial lesions in one session but another procedure was allowed for until the response criteria were met. The response criteria were defined as a good response in patients who had improvement of subjective symptoms such as shortness of breath using a visual analogue scale and also the objective finding of improvement of collapsed lobes on chest radiography taken post-operatively or pulmonary function tests after the Laser procedure. A moderate response was seen in patients who only had subjective improvement in symptoms and a poor response was patients who had stable or worsening of subjective symptoms or objective findings after the procedure.

After bronchoscopic laser resection, the decisions concerning further treatment of the malignant lesions by radiation therapy or chemotherapy were made. It was also decided whether benign endobronchial lesions needed further management.

Statistical Analysis

The forced expiratory volume in 1 second (FEV1) data were analyzed by descriptive analysis for their mean and standard deviation. Means of the FEV1 were compared between before and after laser procedures by *paired -t* test. A statistically significant difference was accepted if the p value < 0.05.

RESULTS

Between August 1998 and August 2000, twenty patients were referred to the laser unit as possible candidates for laser resection. There were sixteen malignant lesions and four benign lesions. Laser bronchoscopic resections were performed in all 20 patients. 18 procedures were done under general anesthesia. A rigid bronchoscope was used in 13 procedures and a flexible bronchoscope was used in 7 procedures. The details of the lesions, the degree of obstruction of the airway, and results of the laser procedure are shown in Table 1 for the malignant lesions and Table 2 for benign lesions.

As shown in Table 1, there were 16 patients who had 16 malignant obstruction of the airway. They were all male. The mean being was 61.92 ± 11.98 years with the youngest being 34 years and the oldest an 82 year-old. Patients with malignant obstruction of the airway who were referred for laser procedures had significant airway obstruction with 9 out of 16 having collapsed lungs on one side (100% obstruction). Squamous cell carcinoma was the main pathological finding in 11 lesions, adenocarcinoma in 4 lesions and metastatic renal cell carcinoma in 1 lesion. Most of the patients had a lesion at the right main bronchus (9 out of 16). A lesion at the distal left main bronchus was found in 3, a lesion at the right intermediate bronchus causing obstruction of

Table 1. Details of each malignant lesion concerning the location, histology, degree of airway obstruction, the procedure used for laser resection, and the response to the laser procedure are shown.

No	Location	Histologic cell type	Degree of Obstruction (%)	Under flexible/rigid bronchoscopy	Response
1	Right main bronchus	SqCCA	100	Rigid bronchoscopy	Good
2	Right main bronchus	SqCCA	100	Rigid bronchoscopy	Good
3	Right main bronchus	Adeno	80	Rigid bronchoscopy	Good
4	Right main bronchus	Adeno	80	Rigid bronchoscopy	Moderate
5	Right main bronchus	SqCCA	100	Rigid bronchoscopy	Good
6	Right main bronchus	Adeno	90	Rigid bronchoscopy	Poor
7	Right main bronchus	SqCCA	100	Rigid bronchoscopy	Good
8	Right main bronchus	SqCCA	100	Rigid bronchoscopy	Good
9	Right main bronchus	Adeno	100	Rigid bronchoscopy	Good
10	Left distal bronchus	SqCCA	100	Flexible bronchoscopy	Moderate
11	Left distal bronchus	SqCCA	100	Flexible bronchoscopy	Moderate
12	Left distal bronchus	SqCCA	100	Flexible bronchoscopy	Poor
13	Right intermediate bronchus	Renal cell carcinoma	90	Flexible bronchoscopy	Good
14	Trachea	SqCCA	80	Rigid bronchoscopy	Moderate
15	Carina	SqCCA	90	Rigid bronchoscopy	Moderate
16	Carina	SqCCA	90	Rigid bronchoscopy	Good

SqCCA = Squamous cell carcinoma, Adeno = Adenocarcinoma

Table 2. Clinical and histopathological details of benign lesions causing obstruction to the airway. This includes treatment details and response to treatment.

No	Location	Histologic cell type	Degree of obstruction (%)	Under flexible/rigid bronchoscopy	Response
1	Left distal bronchus	Papilloma	100	Flexible bronchoscopy	Good
2	Left upper lobe bronchus	Hamartoma	90	Flexible bronchoscopy	Good
3	Trachea	Stenosis	80	Rigid bronchoscopy	Good
4	Trachea	Web	80	Flexible bronchoscopy	Good

the right middle lobe and right lower lobe in 1, lesion at the proximal trachea in 1, and lesions at the carina causing significant obstruction of both main bronchi in 2 patients.

As shown in Table 2, there were 4 patients with benign obstruction of the airway. Their mean age was 42.5 $\pm$ 22.12 years (range 17 to 71). One case of diffuse papillomatosis of the tracheobronchial tree in a 17 year-old patient who required permanent tracheostomy was referred for possible laser resection of one of the papilloma causing obstruction of his left lung. At operation it was found that the papilloma protruded from the opening of the left lower lobe and occluded the opening of his left upper lobe bronchus. Flexible laser bronchoscopy helped to re-expand the left upper lobe as demonstrated by chest radiography and produced an improvement in his symptoms. There was one case of endobronchial hamartoma in a 42 year-old man who presented with hemoptysis and collapse of the left upper lobe. The two cases of benign tracheal obstruction (post-intubation tracheal stenosis and tracheal web) were treated by laser bronchoscopy. The only female in this study was a patient who had a tracheal web.

In malignant airway obstruction, a good response can be obtained in lesions of the proximal right main bronchus (78%, 7 out of 9). Fig. 1 demonstrates re-expansion of the right lung after laser treatment in one of the patients in the good response category. One patient who had a right main bronchus lesion had increased obstruction of the right lung after the laser procedure resulting in deterioration of his dyspneoic symptoms. This

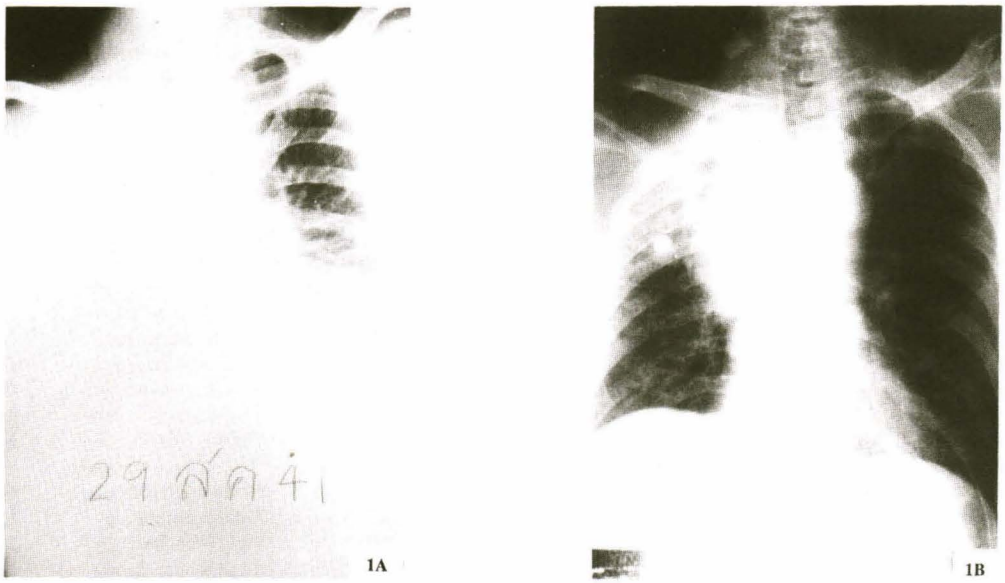

Fig. 1. Chest X-ray of patient in good response category showed (A) collapsed of the right lung and (B) re-expansion of the right lung after laser treatment. The residual hilar tumor and collapse of the right upper lobe still presented.

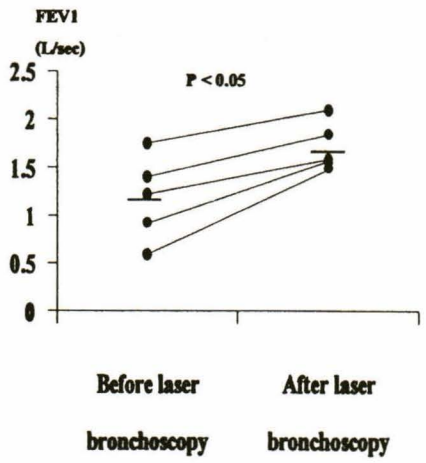

Fig. 2. The FEV1 before and after laser bronchoscopy in 5 individual patients who were in the good response category.

obstruction was assumed to be due to the extraluminal part of the tumor. The collapsed lung and dyspnoeic symptoms improved after a full course of radiation therapy. Laser bronchoscopy to the carinal lesions produced a good response in one patient and moderate response in the other. Both reported marked improvement in their dyspnoea but only one patient could perform spirometry to demonstrate objectively their improvement. Their chest X-rays were normal. However, the results of laser resection at the distal left main bronchus were disappointing because only slight symptomatic improvement without demonstrable reopening of the left lung were observed. The results of laser bronchoscopic resection in benign lesions were all in the good response category.

Among the patients who benefited from the laser procedure (in the category of "good response"), most showed improvement in the chest X-rays-especially in patients who had total lung collapse. Re-expansion of a collapsed lobe(s) was demonstrated in 8 patients including 6 patients with malignant obstruction of the right main bronchus, 1 case of re-expansion of the right middle and right lower lobes which were obstructed by metastatic renal cell carcinoma at the right intermediate bronchus and 1 case of endobronchial papilloma obstructing the left upper lobe. The forced expiratory volume in 1 second (FEV1) was done before and after the laser procedure in only 5 of these patients (Fig. 2). The

mean FEV1 before and after the laser procedures were 1.182 ± 0.443 Liter/second and 1.710 ± 0.254 Liter/second (mean ± SD) respectively. This difference was statistically significant with a p value of 0.007.

The average operating time was 1 hour 51 minutes ± 36 minutes. There were no complications in this study.

DISCUSSION

Since 1981, reports of laser use with either a rigid or a flexible bronchoscope have increased (1-6). The results of an early series of case reports were satisfactory and demonstrated the benefit of this procedure in patients who have endobronchial lesion responsible for symptoms of shortness of breath, cough, hemoptysis and obstructive pneumonia. With improvement in techniques of anesthesia, patient selection and the type of laser used, the results of this procedure have been confirmed to be useful in benign or malignant major airway obstruction especially in patients presenting with critical airways obstruction. Most of the reports have come from both Europe and America. An early report from an Australian unit also gave a similar good risk benefit ratio of this procedure(7). This report is of the first two years' experience using an Nd -YAG laser with a bronchoscope in managing benign and malignant airway obstruction in the Respiratory Unit, Siriraj Hospital, in Thailand.

There were 20 patients and 20 lesions in this study. All patients had a lesion in their major airway which was thought to be responsible for their respiratory symptoms. Rigid bronchoscopy under general anesthesia was used when the lesion was malignant and there was critical obstruction in the trachea or right main bronchus because it is possible to maintain good control of bleeding and ventilation (8). Lesions in the distal left main bronchus were treated by using a flexible bronchoscope passed through a large bore endotracheal tube. This operation was also performed under general anesthesia. Flexible bronchoscopy under local anesthesia was chosen in benign lesions with limited extension. Dumon's suggestions for laser and bronchoscopic technique(9) were followed that the power of the laser was not more than 45 watts with an intermittent pulse duration of 0.5 second and perpendicular firing on the bronchial wall was avoided in order to minimize complications.

Although all patients had critical obstruction (80-100% degree of obstruction), the results of the operation were mostly satisfactory. The finding by Dumon et al(2) that good results were obtained in benign lesions was confirmed in this study. In malignant lesions, the location of the lesion is the main factor affecting success; lesions in the trachea or right main bronchus which are easily accessed by rigid bronchoscopy gave better results than lesions in the more distal airways eg. the distal left main bronchus in which a flexible bronchoscopy had to be used. Because there were no proximal left main bronchus lesions in this series the other explanation for poor results of the distal left main bronchus lesions may be the complex anatomy of the airways in this area besides a limited operative field when flexible bronchoscopy is used.

Laser bronchoscopy is accepted for palliation in malignant airways obstruction with no advantage in prolonging survival except in the case of emergency critical obstruction when compared with external radiation therapy(10). The patients in this series had critical airway obstruction but none of them needed an emergency operation in the sense of severe shortness of breath or uncorrectable blood gases, so improvement of survival was neither anticipated nor recorded. All patients with benign lesions were alive at the time of writing this report.

In conclusion, a series of benign and malignant airways obstruction treated by Nd-YAG laser bronchoscopy at the Respiratory and Tuberculosis Division, Department of Internal Medicine, Siriraj Hospital, Thailand is reported. The excellent results obtained with no procedural complications suggest a promising future for this alternative approach.

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เลเซอร์ บรองโคสโคปี : ประสบการณ์ในโรงพยาบาลศิริราช

*แจ่มศักดิ์ ไชยคุนา, พ.บ.**

Laser bronchoscopy เป็นหัตถการที่ใช้แสงเลเซอร์ในการทำลายก้อนเนื้อเยื่อที่อุดหลอดลมระหว่างการส่องกล้องหลอดลม ได้รายงานการรักษาผู้ป่วยโดยวิธีการนี้ในช่วงระหว่างเดือนสิงหาคม พ.ศ. 2541 ถึงเดือนสิงหาคม พ.ศ. 2543 ที่สาขาวิชาโรคระบบการหายใจและวัณโรค ภาควิชาอายุรศาสตร์ คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล โดยมีจำนวนผู้ป่วยทั้งหมด 20 รายที่มีการอุดกั้นหลอดลมใหญ่ แบ่งตามสาเหตุออกเป็นการอุดกั้นด้วยก้อนมะเร็ง 16 รายมีผลการรักษาได้ผลดีในรอยโรคที่ตำแหน่ง trachea และหลอดลมใหญ่ขวาส่วนต้น ส่วนผลการรักษาก้อนมะเร็งที่ตำแหน่งส่วนปลายของหลอดลมใหญ่ซ้ายไม่ได้ผลดีนัก ผลการรักษาในผู้ป่วย 4 รายที่มีการอุดกั้นหลอดลมชนิด benign นั้นได้ผลดีทุกราย การศึกษานี้สนับสนุนการใช้ laser bronchoscopy เป็นทางเลือกในการรักษาผู้ป่วยที่มีการอุดกั้นหลอดลมใหญ่จากโรคที่เกิดภายในหลอดลม

คำสำคัญ : เลเซอร์ บรองโคสโคปี, โรงพยาบาลศิริราช

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