RAPID IMPROVEMENT OF OPAQUE HEMITHORAX-ENDOBRONCHIAL TUMOR DEBULKING USING ELECTROCAUTERY, LASER AND ARGON PLASMA COAGULATION

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ABSTRACT

A 35-year-old nonsmoker male having history of seasonal asthma presented with one year history of respiratory symptoms and collapse right upper lobe which was not responding to anti tuberculous drugs. His chest CT scan showed tumor in right lung with extensive mediastinal adenopathy and distant bony and liver metastasis (stage IV lung cancer) and bronchoscopy revealed a lung cancer in right main bronchus that was adenocarcinoma on histology. This patient was reluctant for chemotherapy and over passage of time developed complete lung collapse on right side with worsening in respiratory symptomatology. He required sessions of endobronchial tumor debulking every few months utilizing electrocautery first time, endobronchial laser second time and argon plasma coagulation in the third procedure. Tumor debulking lead to remarkable improvement in his symptoms and chest radiographs. After the last endobronchial tumor debulking session he required medical thoracoscopy for pleurodesis after decompressing the pleural space filled with a large pleural effusion, providing him greater symptomatic relief. This case report highlights the palliative interventional bronchology procedures which can provide improvement in symptoms, quality of life and probably survival in patients with endobronchial cancer causing symptomatic airway obstruction.

Key words: Advanced stage lung cancer; argon plasma coagulation; electrocautery; laser; tumor debulking; medical thoracoscopy.

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INTRODUCTION

Patients with lung cancer can have large obstructive lesions in the major airways which can cause complete collapse of a lobe or lung causing intractable dyspnea and ipsilateral opacification on chest radiograph.[1] Interventional pulmonology procedures may lead to marked symptomatic and radiological improvement by debulking the tumor utilizing several ways which may include but are not limited to endobronchial electrocautery, argon plasma coagulation (APC) or laser through flexible or rigid bronchoscope.[1,2]

CASE REPORT

A 35-year-old nonsmoker male, milk seller by profession and resident of Okara was on empirical anti-tuberculous treatment (ATT) by his family physician. He had history of seasonal asthma for which he received symptomatic treatment. At presentation, he had a right upper lobe collapse on chest radiograph (figure 1a) in the presence of cough, exertional dyspnea, and recurrent hemoptysis, wheeze and weight loss of one year duration. He had abdominal surgical history due to fire arm injury five years ago. His wife and seven children were healthy and his mother died due to ovarian malignancy a few years ago. On physical examination, he was of normal built, alert and was cooperative with a pulse of 100 /m, BP 110/70 mmHg, afebrile & respiratory rate 30 /m with SpO_2 91% on room air. Expansion and movements were decreased on right side of chest with ipsilateral tracheal shift. Percussion was dull as was decreased vocal fremitus, vocal resonance and reduced breath sounds on right upper side of chest. Remaining systemic examination was unremarkable. Alternative diagnosis was sought when ATT showed poor response and he developed worsening in respiratory

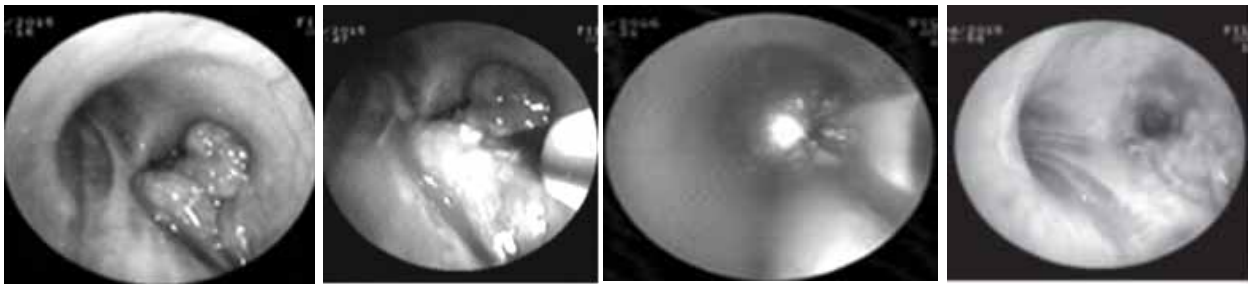
symptoms. His hemogram revealed Hb 14.3 g/dL, TLC 9.11/cmm (N 70%, L 18%, M 7.8%, E 4% & B 4%) & platelets 423/cmm. Serum IgE levels were 624 iu/ml; sputum analysis was negative for Gram stain, ZN staining, fungal smear & cytology. Blood gas analysis, serum biochemistry (RFTs, LFTs) and urine routine examinations were also normal. His contrast enhanced chest computerized tomography (CECT) (figure 1b and c) and flexible bronchoscopy confirmed the presence of a huge tumor occupying right main bronchus (RMB) with carinal infiltration. CT also showed extensive mediastinal lymphadenomegaly and metastatic deposits in the liver & bones (stage IV lung cancer). Endobronchial tumor biopsy revealed adenocarcinoma that was negative for epidermal growth factor receptor (EGFR) mutation. Patient was absolutely unwilling for anti neoplastic chemotherapy so palliative treatment was considered.

Figure 1: (a) chest radiograph showing right paratracheal opacity (right upper lobe collapse), prominent right hilum and raised right hemidiaphragm; (b & c) initial CECT chest images showing right upper lobe nodule and mediastinal lymphadenopathy

(a) (b) (c)

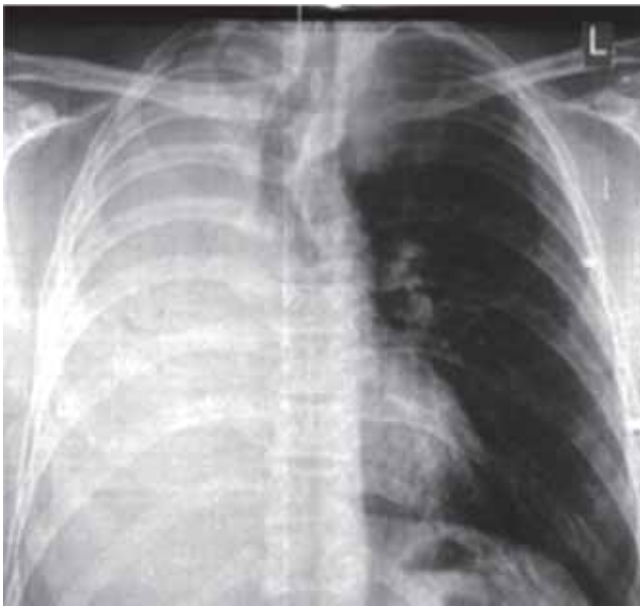
After five months, he followed up with worsening dyspnea (mMRC grade 3) and his chest radiograph revealed opaque right hemithorax with ipsilateral tracheal shift (figure 3a). Bronchoscopy showed large infiltrating tumor completely obstructing RMB. Multiple sessions of tumor debulking and its distal extensions into bronchus intermedius, right middle lobe (RML) and lower lobe bronchus (RLL) was done using EC. The high frequency current generator was adjusted to automatic control of soft coagulation, with a power setting between 40 and 60 watts. Blunt unipolar electrode was used to deliver electrical current to cause electrodestruction of the tumor tissue. Oxygen inhalation was stopped intermittently during application of electrocautery probe to avoid airway fire; smoke and blood oozing through the coagulated tissue required frequent suctioning and biopsy forceps was used to remove the debrided tissue fragments. The procedure was done using conscious sedation and analgesia with midazolam (1 mg) and fentanyl (12.5 mcg) boluses and lignocaine 2% topical application was used intrabronchially for cough suppression. At the end of the procedure, right sided airways (figure 2) were fully patent (except right upper lobe (RUL) bronchus that could not be opened due to extensive malignant infiltration) with almost complete expansion of lung (other than RUL) on the chest radiograph (figure 3b). After bronchoscopic intervention, he was symptomatically better (dyspnea grade mMRC 1-2) and went home with the advice to consult the oncologist for which he was reluctant.

Figure 2: (a) tumor in RMB, (b & c) tumor debulking using electrocautery and d patent RMB post



(a) (b) (c) (d)

Figure 3: (a) Opaque right hemithorax with ipsilateral mediastinal shift; (b) Post electrocautery tumor debulking (ignore light artifact) with almost complete expansion of right lung; right paratracheal opacity is persistent with raised right hemi diaphragm suggestive of right upper lobe collapse



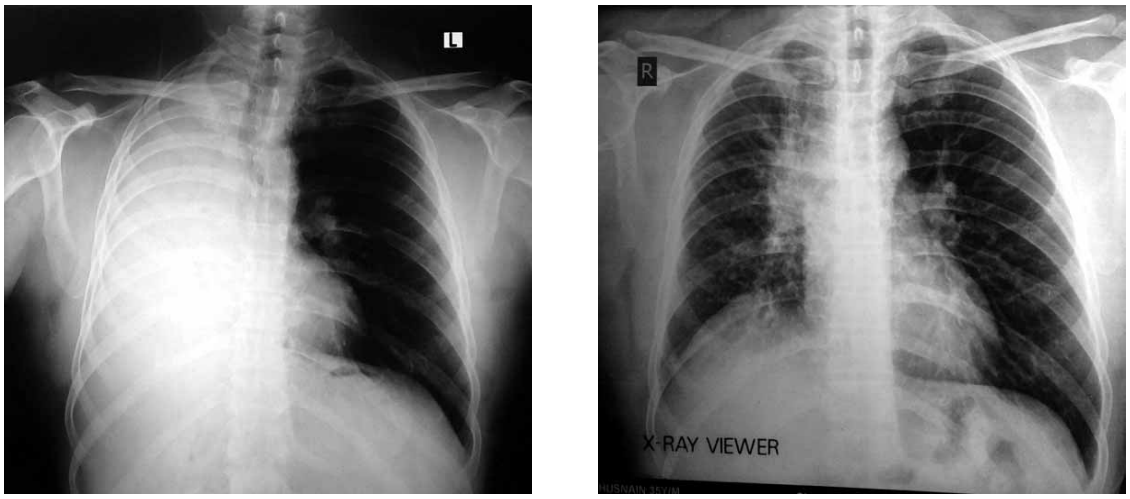
(a)

(b)

After another 4 months of asymptomatic period, he again presented with worsening dyspnea (mMRC grade 3) and opaque right hemithorax on chest radiograph (figure 4a). This time, bronchoscopy and tumor debulking was successfully done using endobronchial laser therapy. Through the working channel of the fibreoptic bronchoscope laser probe was passed and laser beam was fired repeatedly aiming at the tumor. Oxygen inhalation was minimized or intermittently stopped during application of intrabronchial laser to avoid airway fire and biopsy forceps was used to remove the debrided tissue fragments. Debulking and hemostasis over the tumor tissue were achieved simultaneously in the same procedure compared to EC which sometimes lead to continuous oozing of blood requiring cold saline and topical epinephrine flushes. Compared to EC that utilized almost 5 bronchoscopic sessions (1.5 hours each), endobronchial laser photocoagulation of tumor required only 2 sessions and utilized less time (1.5 hours total) to successfully debulk tumor from RMB with its distal extensions into intermediate bronchus, RML and RLL bronchus. At the end of the procedure, RMB was patent and distal airway divisions of RML and RLL segments could be intubated with the flexible bronchoscope. There was complete expansion of right lung (except RUL) on chest radiograph (figure 4b) at the end of the procedure.

He remained minimally asymptomatic and continued to do his routine works and described his quality of life as good. After another 5 months, he again experienced worsening dyspnea and had right opaque hemithorax on chest radiograph. This time, bronchoscopy and tumor debulking was successfully done using endobronchial APC therapy. Once the patient was sufficiently sedated using a combination of midazolam and fentanyl, flexible bronchoscope was directed to the target lesion in RMB. A grounding pad was placed on the patient's right leg and a power of 30-60 Watts and argon gas flow rate of 1 L/min was used during the procedure. A flexible probe of 2.3 mm in diameter and 220 cm in length was passed through the instrument channel of the bronchoscope and advanced until its tip reached a few millimeters above the tumor. Repeated bursts (for 2-3 seconds) of argon gas were expelled from the probe in combination with high voltage monopolar electric current directed to the underlying tumor tissue. The eschar was removed with the bronchial biopsy forceps and then APC was applied to the underlying fresh tissue until the tumor was debulked sufficiently. Two sessions of 2 hours each were carried out that lead to complete tumor debulking from RMB, bronchus intermedius, RML and RLL. This time there was no significant improvement on the chest radiograph, still showing huge opacification on right side with some area of aerated lung in right perihilar region (figure 5a). CECT chest was repeated that showed massive pleural effusion on right side responsible for the opacification (fig 6a, b, c). Pleural fluid analysis was negative twice for malignant cytology and biochemical picture showed

Figure 4: (a) Opaque right hemithorax with ipsilateral mediastinal shift; (b) post laser tumor debulking with almost complete expansion of right lung



(a) (b)

LDH 1100 U/L, albumin 3.0 g/dl, protein 4.5 g/dl and glucose 92 mg/dl) and WBC count 900/cmm; 20% neutrophils and 80% lymphocytes (exudative lymphocytic).

He underwent medical thoracoscopy using rigid thoracoscope under conscious sedation and analgesia; three liter of straw colored pleural fluid was aspirated during procedure and multiple yellowish raised different sized nodules were seen over parietal (more in lower zones), visceral & diaphragmatic pleurae (figure 7a, b, c, and d). Parietal pleural nodules were biopsied and 4 grams of sterile talc was sprayed over visceral and parietal pleurae (talc poudrage). Chest drain 28 Fr was inserted at the end of the procedure that was removed after 48 hours because there was no air leak, only 100 ml of fluid was drained and the lung was fully expanded to the chest wall. He was discharged and counseled again for oncologist consultation which he agreed and is now receiving chemotherapy.

Figure 5: (a) Opaque right hemithorax with slight aerated lung in right perihilar region; (b) image taken post thoracoscopy showing partial expansion of right lung with chest tube in place

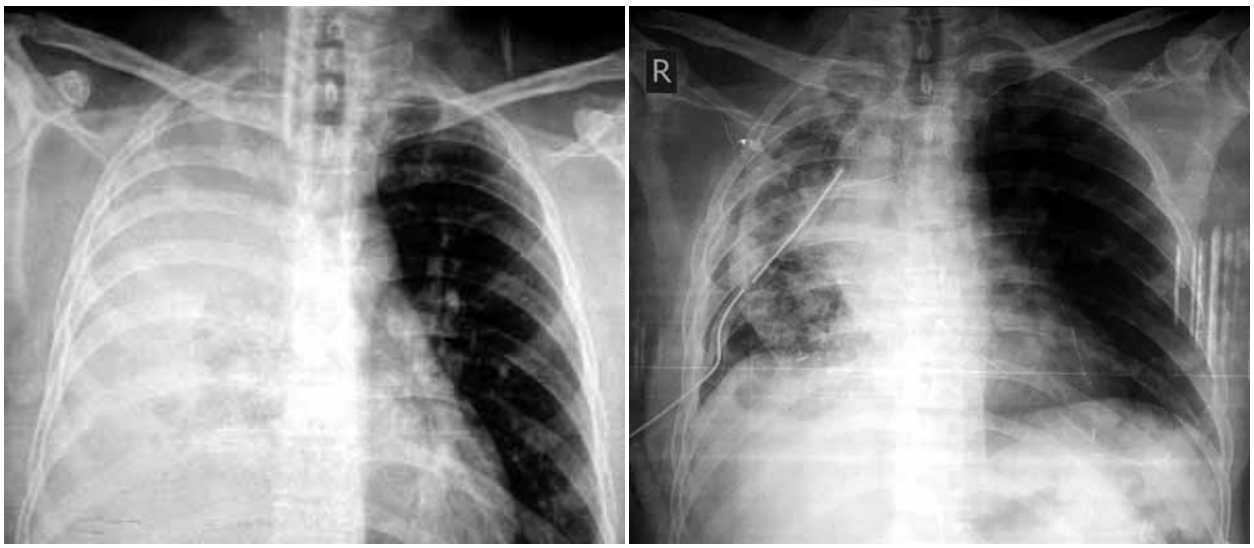
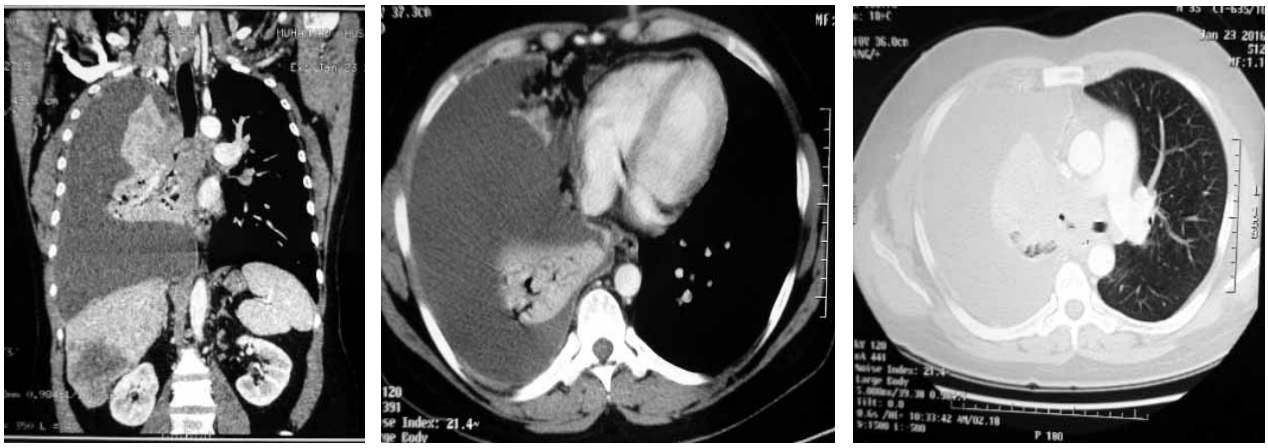


Figure 6: (a, b, c) Massive right sided pleural effusion with collapsed right lung & hepatic metastasis



(a) (b) (c)

Figure 7: (a) Collapsed lung, (b) Parietal pleural nodules and (c) Pleural biopsy under pleuroscopic vision

(a) (b) (c)

DISCUSSION

With the development of interventional pulmonology in the last 20 years, here are an increasing number of interventional bronchoscopic therapies available (although optimal treatment remains undefined) to locally treat advanced stage inoperable lung cancer involving the central airway (tracheal and major bronchi) including EC, laser, APC, cryotherapy, brachytherapy, photodynamic therapy and stenting.[1] Choosing among these modalities depends upon a number of factors including tumor location and characteristics, degree of obstruction, general health status of the patient and above all is the availability of local expertise. For patients with extraluminal lesions (eg enlarged lymph nodes compressing the airways), dilation and stenting are often the only therapies that can result in immediate patency and symptomatic improvement.[2] For patients who have non-life-threatening airway obstruction from an intraluminal mass, all bronchoscopic ablative techniques including APC, EC, laser, cryosurgery, endobronchial brachytherapy, and photodynamic therapy, external beam radiation therapy, airway debridement/coring, airway dilation, and airway stenting can be used.[1,2]

Endobronchial electrocautery (EC) is used to remove endobronchial lesions in the trachea and bronchi, using either a rigid or a flexible bronchoscope.[1,2] EC, or electrotherapy are terms often used when referring to the use of heat for tissue destruction. The immediate effects include vaporization (boiling intracellular water and subsequent cellular explosion that disrupts the cells), coagulation (denaturization of proteins with occasional creation of a white hyalinized coagulum), and fulguration (high heat propagation and carbonization).[4] In contrast to EC, APC is an electrosurgical method whereby argon gas is ionized by an electric current to create a noncontact, homogeneous "bridge" to target tissue for coagulation or ablation.[5] Laser photoresection of central airway obstruction is another useful tool for an interventional pulmonologist.[5] Laser photoresection is frequently and usually performed via the rigid bronchoscope, but

can be safely performed with the flexible bronchoscope by experienced bronchoscopists.[6] This technique has the highest risk of airway perforation compared to EC and APC.[5,6] For patients with lung cancer who may be suitable for a thermally ablative technique (APC, EC, and laser), the fraction of inspired oxygen (FiO_2) should preferably be kept below 0.4 to avoid an airway fire, and a non-thermal ablation (eg, cryosurgery) may be preferred for patients requiring high-flow FiO_2.[1,2,5] As another example, APC may be more efficient than electrocautery or laser in achieving hemostasis and may be more suitable for patients with central airway obstruction who also have significant hemoptysis.[5]

Cryotherapy (cryoablation) delivered via fibreoptic bronchoscope using cryoprobe involves freezing the tumor tissue to -20ºC or below, at a rapid rate (-100ºC per minute) resulting in the development of intracellular ice crystals which induce more than 90 percent cell death.[7] Photodynamic therapy is a non-thermal modality that involves administration of light therapy bronchoscopically after the intravenous injection of a photosensitizing agent (typically 72 hours).[8] Its major disadvantage over the other local ablative therapies is that follow-up bronchoscopy is necessary to remove debris and secretions and that patients' skin is photosensitized for at least six weeks after the procedure.[1,2,8]

The major role of these interventional procedures remains palliative in symptomatic lung cancer patients and the choice of therapy is often dependent on the preference of the physician and local resources and most importantly, for each patient the decision should be individualized.

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