Endoscopic argon plasma coagulation for the management of solid, centrally located lung cancer

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SUMMARY

Argon plasma coagulation (APC) is one of the interventional pulmonology techniques primarily aimed at the treatment of hemoptysis. It represents a form of non contact electrosurgey that uses ionized argon gas in order to produce electrical current that affects soft tissues. APC is reported to be effective in the treatment of early stage lung cancer, in the treatment of benign granulation tissue surrounding tracheal stents and in palliative treatment of malignant airway obstruction. Major indication for APC is hemostasis in severe hemoptysis, it can also be used as an alternative technique for laser resection or electrocautery, in urgent removal of tumors situated in large airways. The present article reports successful use of APC in the treatment of centrally located squamous cell lung cancer that caused complete right lung atelectasis. The use of APC led to complete reexpansion of the right lung and improvement in dyspnoea and chest discomfort of the patient. Significant improvement was observed in lung function parameters and blood gas analysis. With the use of APC solid tumor was completely removed from the right main bronchus and airway integrity was restored. From this case we can conclude that APC can be safely and successfully used for urgent debulking of malignant central airway obstruction.

Key words: *Lung Neoplasms; Electrocoagulation; Argon; Bronchoscopy; Airway Obstruction; Endoscopy*

INTRODUCTION

Argon plasma coagulation (APC) is one of the interventional pulmonology techniques with immediate effect aimed at urgent debulking of major airways. APC is a form of non contact electrosugrery that uses argon gas ionized into plasma in order to accomplish coagulative tissue effect (1,2). Created electrical current, affects soft tissues in the form of heat and, leads to coagulation. Argon plasma seeks the way of least resistance and that is why it affects soft spots on the mucosal surface, however with the appearance of coagulated tissue electrical resistance to current rises, and argon plasma affects the target tissue with less effect. That is the reason why this procedure is, in a way, self limiting. Removal of coagulated masses with the use of forceps or suction is necessary to proceed with the airway debulking.

Equipment needed for APC consists of high frequency electrical generator, insulated flexible bronchoscope (recommendable with ceramic tip), rigid bronchoscope, grounding plate, different sets of APC probes and a tank with argon gas. Various effects on the target tissue are accomplished with the adjustment of argon gas flow, time of application and power setting. Settings usually used for coagulation include power at 30-80W, burst time 3 sec and argon flow up to 2L/min (3,4). In order to create electrical current and tissue effect the tip of the probe for APC must be less than 1 cm from the target tissue. The tip of the probe must protrude at least one cm away from the tip of the bronchoscope in order to avoid instrument damage. European Respiratory Society, American Thoracic Society and American College of Chest Physicians published guidelines for interventional pulmonology procedures including argon plasma coagulation (5,6). APC can be carried out via flexible bronchoscopy alone, or combination of flexible and rigid bronchoscopy. The latter combination ensures better ventilation of the patient and better visualization of target tissue. Usually APC is performed under general anesthesia, such procedure requires specific precaution measures which include: oxygen concentration under 40%, proper grounding, avoiding of flammable materials (silicone and hybrid tracheobronchial stents, endotracheal tube) (1-3). Major indications for APC include: palliative debulking of malignant endobronchial masses, treatment of benign endobronchial tumors, and treatment of unresectable or inoperable postintubation, postresection and posttransplantation tracheobronchial stenoses. APC is indicated as curative technique for visible superficial lung cancer (carcinoma in situ or microinvasive lung cancer). The only absolute contraindication is extraluminal compression, relative contraindications include: hemodynamic instability, shock, unresolved coagulopathies, arrhythmias, recent acute myocardial infarction. Complications of APC include bleeding, airway burns, perforation, pneumothorax, pneumomediastinum and restenosis (5,6).

As a technique for urgent debulking of large malignant masses in the airways APS has proven to be more than successful. However in some of the urgent conditions, as hemoptysis (usually due to lung cancer), APC is most preferable technique. With the help of APC airway bleeding can be stopped in matter of minutes. That is how this life threatening condition can be comfortably resolved.

The competency standards required for practicing APC include experience with flexible and rigid bronchoscopy; trainees must perform at least 10 procedures under supervision. In order to maintain competence 10 procedures per year must be performed (5-6).

CASE REPORT

A 58-year old patient was admitted to hospital for diagnostic evaluation of solid tumorous mass situated in the upper right lobe. CT scan of the thorax performed during previous hospitalization in the regional hospital revealed homogeneous solid infiltration of the abovementioned localization. At the time of admission the patient was in good general condition, complaining of dry cough, dyspnoea, malaise, weakness and loss of appetite. Partial respiratory insufficiency was verified by blood gas analysis (PaO2 7.72 KPa, PaCO2 4.91 KPa, SaO2 90.7%, PaO2 – oxygen partial pressure in arterial blood, PaCO2 – carbon dioxide partial pressure in arterial blood, SaO2 – oxygen saturation of arterial blood). Lung function tests revealed mixed (obstructive and restrictive) disorder of ventilation, with total resistance in airways (RAW) 0.35, vital capacity (VC) 57.1%, forced vital capacity (FVC) 59.9%, forced expiratory

volume in first second (FEV1) 46.9%. Chest X ray (CXR) of the thorax showed solid infiltrative shadow in the projection of right upper lobe and shadow of pleural effusion on the right hemithorax. Thoracocenthesis was performed, cytology examination of pleural effusion revealed mixed cellular composition. Diagnostic bronchoscopy followed, endoscopic finding verified tumorous infiltration of the distal part of trachea extending to the right main bronchus. Biopsy of the infiltration confirmed squamous cell carcinoma. In the following treatment Nd:YAG laser resection in combination with brachytherapy was indicated. The patient was further treated due to respiratory insufficiency and infection. Nine days after diagnostic bronchoscopy the patient complains on chest discomfort, pain and severe dyspnoea. Physical examination revealed diminished breathing on the right chest side, tachypnoea and tachycardia. Complete right lung atelectasis was seen on CXR (Figure 1).

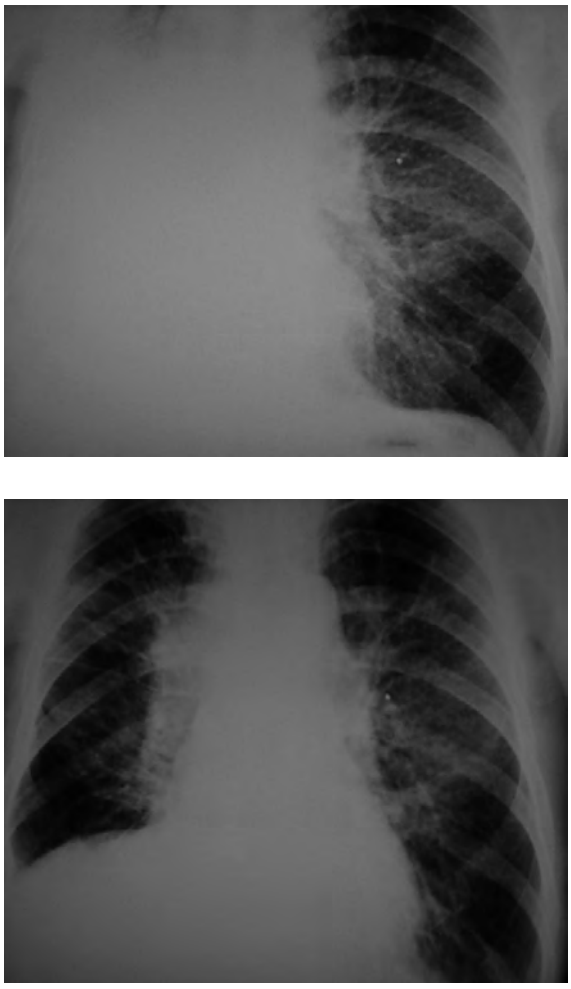

Figure 1A Complete right lung atelectasis, and 1B Reopening of the right main bronchus after the APC led to the resolution of right lung atelectasis

Blood gas analysis was aggravated, global respiratory insufficiency manifested, with PO2 6.7 kPa, PCO2 6.6 kPa, SaO2 84%. Lung function test were worsened too, with increase in obstruction (RAW 0.55) and restriction (VC 48%, FVC 46%, FEV1 38%). Urgent bronchoscopy was performed, and was confirmative for tumor penetration and obturation of the right main bronchus. Indication for application of interventional pulmonology technique for immediate desobstruction followed. Considering the fact that at the moment only available interventional technique was argon plasma coagulation, it was decided to perform APC in order to restore airway patency and reopen right main bronchus.

APC was performed using the probe, an argon gas source and electrosurgical unit Endoplasma PSD-60 (Olympus). Technique was conducted under general anesthesia using combination of flexible and rigid bronchoscopy. Patient was previously premedicated using midazolam and fentanyl, propofol induced general anesthesia followed. Flexible bronchoscope (Olympus T60) was introduced via rigid Friedel's rigid bronchoscope. Combination of these two techniques allows better ventilation and introduction of forceps for removal of coagulated debris. Initial APC setting included power of 25W, argon gas flow 0.8 L/min and application time of burst of average 3 sec. Bronchoscopic scheme before and after intervention is presented on Figure 2. Figure 3 is endoscopic image of APC burst in the distal part of the trachea.

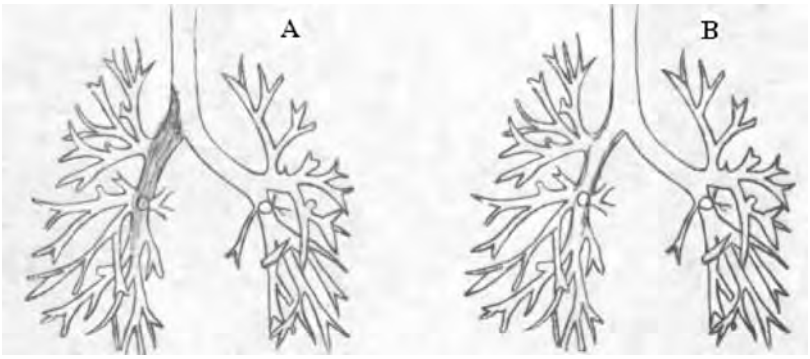

Figure 2. Scheme of bronchoscpic findings before (A) and after APC (B).

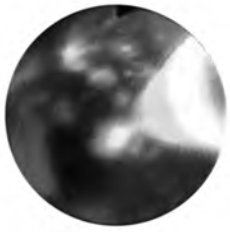

Figure 3. APC burst in the distal part of the trachea surrounded with coagulated necrotic debris.

During the procedure that lasted 45 minutes necrotic debris was removed with forceps and suction. Inspiratory oxygen fraction was kept under 40% in order to avoid airway fire. After the procedure and removal of the debris, airway integrity was restored. Brochoscopic finding confirmed reopening of the distal part of the trachea and right main bronchus. We have accomplished complete reaerisation of the right lung and resolving of atelectasis. CXR after the APC application is shown on figure 1B.

After the APC we have observed significant improvement in arterial blood gases analysis and disappearance of respiratory failure (PaO2 9.77 kPa, PaCO2 4.70 kPa, SaO2 93.8%). Lung function tests improved also significantly, obstructive component was completely resolved (RAW 0.28) and restrictive component was improved.

Control bronchoscopy was performed 2 weeks after the APC treatment, after 2 additional weeks at the moment of insertion of the first catheter for brachytherapy and then after one month during the insertion of a catheter for the second brachytherapy treatment.

In further course of the treatment patient received complete brachytherapy (two fractions of 7 Gy each) and chemotherapy (cisplatin plus etoposide), followed by split course external beam radiotherapy.

DISCUSSION

Numerous studies report successful use of APC in the treatment of non malignant CAO. That treatment usually means coagulation of benign granulation tissue of various origins. Keller et al. report 5 cases of successful use of APC in the treatment of airway complications after solid organ transplantation (7). Sato et al in 2000 have reported successful use of APC and Tranilast (an antiallergic agent used to prevent hypertrophic scars and keloid) in the treatment of granulation tissue obstructing the airways after tracheal anostomosis (8). Recent in vitro study conducted by Colt et al. confirmed usefulness and safety of APC use in the presence of airway stents. In this study APC setting that included power at 40W, argon gas flow of 0.8 L/min and FiO2 21%, was the safest one (9). Yasuo et al. used APC in the treatment of postintubation tracheal stenoses in patients who were inoperable or had unresectable disease or refused surgery for personal reasons. In this study it was pointed that successful treatment required repeated use of APC (2-3 times in a few weeks) (10).

There are not too many reports of successful use of APC in urgent debulking of malignant CAO. As stated earlier, APC is recommended for the treatment of hemoptysis or in some cases for the treatment of early stage lung cancer. Vonk-Noordegraaf et al. (11) published a study that evaluates bronchoscopic treatment of radiographically occult lung cancer (ROLC). They have evaluated the effects of Nd:YAG laser resection, electrocautery and APC in the treatment of ROLC. Only two of their patients were treated with APC, and the data on the outcome of these patients is lacking. However in that study the success rate of bronchoscopic treatment is 97%, compared to 70% success rate for surgical treatment in stage I lung cancer. Cappacio et al. (12) reported effective use of APC in the treatment of centrally located malignant melanoma metastases; reminding us of palliative APC use. The effectiveness of APC in palliative treatment of lung cancer has been reported in several studies. Morice et al. (13) used APC to treat hemoptysis and central airway obstruction (CAO), prompt relief of symptoms was achieved in all but one patient and mean follow up for hemoptysis was 97±92 days and for dyspnoea 53 days. Major indication for APC in study conducted by Reichle et al. (14) was airway obstruction (186 pts, 51%) and hemoptysis (119 pts, 33%), they have performed 482 interventions, with overall success rate of 67% (full or partial recanalization, hemostasis, or both). Success rate of 91% in the treatment of airway obstruction and hemoptysis is reported from Crosta et al. (15), however in order to obtain this success rate of mean 3.5 interventions per patient was required.

All of the studies that have evaluated the use of APC in the palliative treatment of lung cancer suggest that this technique is safe and efficient. Our case report confirms that APC can and should be utilized as a technique for urgent reopening of major airways. When other procedures are not available (such as laser resection or electrocautery) APC can be safely used for endobronchial tumor resection.

CONCLUSION

Argon plasma coagulation may be used as an alternative to laser resection or electrocautery in the treatment of malignant CAO. If used by experienced bronchoiscopist and with all precaution measures taken, APC can be performed without any complications. In regard to the published guidelines, APC should be more popularized as a technique for urgent debulking of central airways.

Conflict of interest
We declare no conflict of interest.

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