CASE REPORT

Use of i-gel for laser ablation of a bronchial lesion

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SUMMARY

The use of laser for airway lesions requires airway management. Usual options include special laser-resistant endotracheal tubes. The use of supraglottic devices have been described in the literature. Laryngeal mask airway carries the risk of cuff damage during the use of laser. i-gel is made of thermoplastic material and does not require air inflation and thus potentially reduce the risk of cuff rupture. i-gel use in laser surgeries has not been described in the literature. We present successful airway management in laser surgery for bronchial tumour using i-gel.

BACKGROUND

Light amplification by simulated emission of radiation (laser) has been used for treatment of benign (colon and rectal polyps) and malignant conditions (head and neck cancers, lung cancer, liver tumours). The use of laser for airway lesions requires anaesthesia and a secured airway. Various options for securing the airway include laser-resistant endotracheal tubes, wrapped tubes and jet injector. Laryngeal mask airway (LMA) has also been described for airway management.¹ LMA allows uninterrupted ventilation along with the use of fiberoptic bronchoscope through it.^{1 2} In spite of the benefits, LMA carries the potential risk of cuff damage during laser use leading to inadequate ventilation and thus risk of hypoxia. i-gel has the specific advantages of non-inflatable cuff and the possibility of tracheal intubation through it, if required. Until now, i-gel use in laser surgeries has not been described in the literature. We describe successful airway management in laser surgery for bronchial laser ablation of a lung tumour using i-gel. Written consent was taken for publication of this case from the patient.

CASE PRESENTATION

A 61-year-old man presented with chief complaints of cough, haemoptysis and fever since 1 year. Contrast enhanced CT scan revealed heterogeneously enhancing mass lesion in lingular lobe of left lung, upper lobe collapse and multiple enhancing mass lesions in both lobes of liver. Positron emission tomography CT findings revealed somatostatin expressing disease in left upper lobe bronchus and liver metastasis. Flexible video-bronchoscopy performed under local anaesthesia revealed left upper lobe occluded by a vascular tumour along with purulent secretions. Bronchial washings confirmed the diagnosis of neuroendocrine tumour of left upper lobe bronchus.

DIFFERENTIAL DIAGNOSIS

In view of respiratory distress caused by proximal bronchus obstruction by tumour mass, laser debulking of tumour was planned. Pulmonary function test demonstrated moderately restrictive defect.

TREATMENT

In the bronchoscopic suite, after securing the intravenous access, intravenous hydrocortisone 100 mg was administered. Standard monitors including 5-lead ECG, pulse oximeter (SpO₂) and non-invasive blood pressure were attached. The patient was preoxygenated with 100% oxygen for 5 min at a flow rate of 15 L/min in 40° head up position. Anaesthesia was induced in head up position (40°) using intravenous fentanyl 100 µg, propofol 100 mg and rocuronium 60 mg. A continuous intravenous infusion of propofol 200–300 µg/kg/min was started. Lungs were ventilated using positive pressure ventilation. Three minutes later, rigid bronchoscope was inserted. On evaluation, growth was visualised in left upper lobe bronchus. Intermittent manual jet ventilation was started through side port (ventilating port) of rigid bronchoscope. Because of excessive air leak from and around the rigid bronchoscope, ventilation was ineffective. The pulmonary interventions of laser ablation required period of apnoeas and low inspired fraction of oxygen (FiO₂). So the ventilatory strategy was required to be changed. We modified our plan to perform ventilation through i-gel (supraglottic airway device) and perform laser ablation of tumour by inserting laser probe through flexible fiberoptic bronchoscope which is in turn inserted through the i-gel using an swivel connector (figure 1). I-gel (figure 2) of size 4 was inserted and positive pressure ventilation was initiated. The procedure was started with continued ventilation. During laser ablation, to minimise the risk of airway fires, FiO₂ was reduced to 0.30 and fresh gas flow was increased to 10 L to expedite clearance of oxygen in the airway. All routine laser safety precautions were followed including draping the patient with moist towels and eye pads, and antiglare glasses were worn by all the personnel. Flexible fiberoptic bronchoscopy was performed through swivel catheter mount and endobronchial neodymium-doped yttrium aluminium garnet (Nd:YAG) laser (23 W/cm², continuous mode) applied. During laser ablation, intermittent apnoea was provided. High-force suction was applied through bronchoscope to remove laser fumes. During desaturation episodes below 90% of oxygen saturation as assessed by SpO₂, use of laser was stopped and intermittent positive

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Figure 1 Use of i-gel during laser.

pressure ventilation was resumed. After adequate oxygenation, above steps were repeated until complete tumour carbonisation was achieved. Laser ablation lasted for 45 min and remained uneventful. After the procedure, the residual neuromuscular blockade was reversed with neostigmine 2.5 mg and glycopyrrolate 0.4 mg. Tracheal extubation was performed after adequate spontaneous respiratory efforts and when the patient regained consciousness.

OUTCOME AND FOLLOW-UP

Patient was shifted to high-dependency unit uneventfully for further management and observation. The patient was discharged on third postoperative day uneventfully.

DISCUSSION

Different types of lasers are used in clinical practice. Some lasers use a gaseous lasing media such as carbon dioxide, argon, krypton or helium–neon, while other lasers use solid rods of laser-passive material containing small quantities of ionic impurities, known as dopants. Dopants commonly used for their laser potential include chromium (as in the ruby laser), neodymium or holmium. Energy of an Nd:YAG beam is more widely disseminated, producing less vaporisation and more thermal coagulation. It can go deeper into tissue than light from other types of lasers, and it can make blood clot quickly. Nd:YAG lasers can be used through thin flexible tubes or optical fibres. Nd:YAG laser is used for lesions distal to larynx and for bulky, vascular endobronchial neoplasms because it can be used with a rigid

bronchoscope or a flexible bronchoscope. In our case, we used it for debulking of neuroendocrine tumour of bronchus.

Laser surgeries are associated with specific hazards like airway fires, tissue and vascular perforation, eye injury, gas embolism, atmospheric contamination with laser fumes. Laser safety precautions should be used. Deposition of laser fume particulates in rat lung appears capable of producing interstitial pneumonia, bronchiolitis, reduced mucociliary clearance, inflammation and emphysema.^{2,3} Nitrous oxide exothermically dissociates releasing heat and free oxygen. Nitrous oxide is thus a powerful oxidiser, and adding nitrous oxide as a diluent for oxygen is just as dangerous as having high FiO_2 .⁴ We avoided nitrous oxide for anaesthesia in our patient. Using an air–oxygen mixture appears to be acceptable. We used air–oxygen mixture to reduce the FiO_2 to prevent airway fires. Volatile anaesthetics when exposed to flame may pyrolyse to potentially toxic compounds.⁵ Hence, we used propofol infusion rather than volatile agents to maintain anaesthesia.

Various airway management options are available which include jet ventilation with a modified Sanders venturi coupler, laser guard wrap around endotracheal tube, laser-resistant tubes like Norton, Laser-Flex tubes, Bivona Fome-Cuf and LMA. Studies with Nd:YAG laser has shown polyvinyl chloride, silicone and red rubber tubes to be vulnerable for damage because of ignition.^{4–7} Covering of tubes with laser safe material such as copper and aluminium foil is an option, but wrapping is to be done very carefully with a 30% overlap, with no exposed tube, and adhesive used to stick foil is also flammable.⁷ Commercially available laser-resistant tracheal tubes are expensive and their cuff is inflammable. Use of a metal endotracheal tube does not imply absolute protection from ignition as 50 W of Nd:YAG beam focused to 0.68 mm ignited a laser flex in 6 s.⁶ Use of low FiO_2 (<30%) in lung with poor functional capacity poses a specific risk during laser surgery of a lung tumour as occurred in our case. Intermittent apnoea during use of laser also increases risk of desaturation. Jet ventilation is one of the modality in such situations but has the potential to produce barotrauma, pneumothorax or crepitus specially where in bronchial tumours require ablation. All these issues can be circumvented to large extent by using LMA. LMA has additional advantages of low frequency of coughing, better haemodynamic stability during insertion and improved oxygen saturation during emergence. LMA is an effective way to manage ventilation while simultaneously allowing unencumbered flexible bronchoscopic access for laser surgery.^{1,6,7} Only few studies are performed about LMA in laser surgeries and use of i-gel is not reported yet.^{7,8} The LMAs with air-filled cuffs are liable to get damaged with lasers.⁹ Though silicone base cuff are reported to be more resistant to laser burns, but they are still not burn proof.⁹ The use of saline for cuff inflation has been reported and may be of some use in laser surgery for prevention of cuff damage.¹⁰ The occurrence of air leak from LMA damaged cuff would lead to difficulty in ventilation. i-gel has soft gel-like non-inflatable cuff which naturally positions itself over laryngeal framework providing a reliable perilaryngeal seal without the need of inflating cuff. It also provides conduit for intubation. It appears that the risk of cuff leak due to laser burn of the cuff should not be a concern as i-gel is made up of thermoplastic polymer (medical grade thermoplastic called styrene ethylene butadiene styrene) and does not require air inflation for making a good laryngeal seal. This technique would provide uninterrupted exposure to the airway lesion for ablation without compromising lung ventilation. The robust airway and gastric channel along with buccal cavity stabiliser of the i-gel would help in preventing potential of rotation

Figure 2 I-gel used for airway management.

and stability and its robust channel would prevent any accidental burn to it during the laser insertion or its removal. i-gel would easily accommodate the flexible fiberoptic scope for the laser procedures of the airway. The flammability of the i-gel itself has not been reported. The previous reported studies for use of LMA are usually with first generation device and has issues related to seal pressures, leak, prolonged positive pressure ventilation specially when airway pressure are high like in our case with bronchial lesions. The second-generation devices like i-gel have a better profile of its placement, better seal pressures and thus use of positive pressure ventilation effectively. The bronchial and lung tumours have increased airway resistance and thus require higher ventilatory pressures. Also, the better surgical condition with use of device would allow optimal tumour ablation and lesser chances of recurrence leading to airway compromise. The device not only provides continuous ventilatory support but also remains away from the surgical site of laser ablation and potentially lesser risk of fire. The conventional laser-resistant tubes are safer but would interfere in the laser ablation as they remain near to site of laser ablation and may interfere in optimal resection.

Learning points

- ▶ Patient undergoing laser surgery under anaesthesia remains challenging
- ▶ Airway management in patient requiring laser for bronchial tumour requires cautious selection of airway device.
- ▶ i-gel could be considered an airway management device for patients requiring neodymium-doped yttrium aluminium garnet (Nd-YAG) laser ablation of bronchial lesion in patient with lung cancer.
- ▶ Further testing may be warranted to evaluate the fire-resistant characteristics of the i-gel for its use during Nd-YAG laser surgery.

We conclude, the i-gel could be considered an airway management device for patients requiring Nd:YAG laser ablation of bronchial lesion in patient with lung cancer. It would be a good substitute for patients requiring laser ablation distal to glottis and other lower airway laser ablations. However, further testing may be warranted to evaluate the fire-resistant characteristics of the i-gel for its use during Nd:YAG laser surgery.

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