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CASE REPORT Open Access

Laser ablation for complete obstruction of bronchus—an anaesthetic challenge (two case report)

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Abstract

Background: Precise tissue destruction, minimal local inflammation and oedema with laser play useful role in the treatment of life-threatening paediatric airway lesions. Risk of fire in O_2-enriched atmosphere makes anaesthesia challenging. Fewer options are available for anaesthetic management of laser ablation for bronchial obstruction in children. Very few reports regarding the use of laser for bronchial obstruction in children are available.

Case presentation: Two paediatric patients admitted with difficulty in breathing and coughing. They were diagnosed having unilateral bronchial obstruction. They were posted for bronchoscopic laser ablation of blocked tissue. Anaesthesia was managed with total intravenous anaesthesia and ventilation through side arm of bronchoscope. Complications bleeding and pneumothorax happened in one child. Temporary rise in $PaCO_2$ with fall in PH and PaO_2 was also observed. Successful management is presented.

Conclusion: Careful preoperative evaluation, use of low Fio_2, measures to avoid fire hazards due to laser, monitoring SpO_2 and $EtCO_2$ and maintaining haemodynamic parameters play key role for successful management of laser for bronchial obstruction.

Keywords: Bronchoscopy, Laser, Paediatrics, Bronchus obstruction

Introduction

For airway, surgery goals for anaesthesia are to provide oxygenation, carbon dioxide elimination, adequate anaesthesia, rapid return of consciousness and airway reflexes after surgery along with unobstructed and immobile operative field during surgery (English et al. 2006). Lasers can ignite flammable material so risk of fire is enhanced in oxygen (O_2)- and nitrous oxide (N_2O)-enriched atmosphere (Hermens et al. 1983). Non-intubation technique of ventilation is preferred during laser ablation. In children, anaesthesia techniques for laser in bronchial obstruction are limited. We report anaesthetic management of two cases having complete one-sided bronchial obstruction for CO_2 laser ablation.

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Case reports

These case reports involve human participants and after informed and written consent procedure was done.

First case

A 7-year-old male child, weighing 18 kg, had past history of accident before 2 months. For respiratory distress and bilateral pneumothorax, bilateral intercostal drain (ICD) insertion was done. As his condition improved, he was discharged after removing bilateral ICD. After 6 weeks on follow-up, he had complaint of dyspnea on routine activity. On examination, he had tachypnoea with respiratory rate of 28/min and oxygen saturation 92% on air. On chest examination, there was reduced chest movement and absent air entry on the right side. His chest X-ray (CXR) showed the right lung collapse with compensatory hyperinflation of the left lung and right side mediastinal shift (Fig. 1).

CT thorax showed complete obstruction of the right main bronchus. Findings of rigid bronchoscopy were

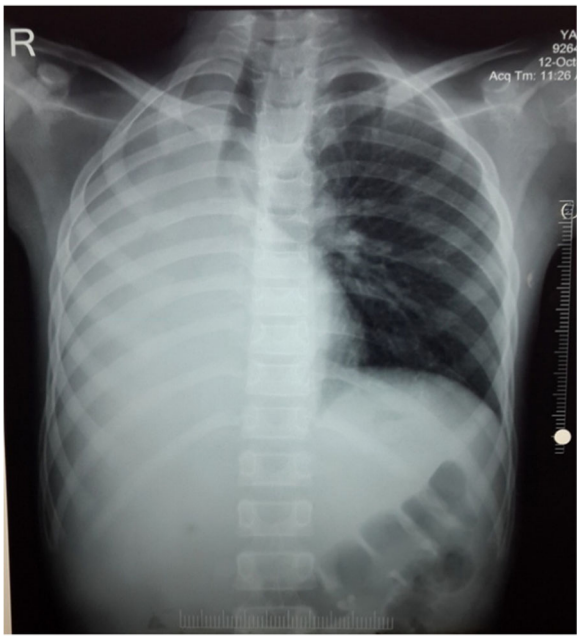

Fig. 1 Preoperative X-ray chest

complete obstruction of right main bronchus, few millimetres from the carina (Fig. 2).

Second case

An 11-year-old male child, weighing 20 kg, had past history of cough since 2 years. He was on Antikochs' treatment—a treatment for pulmonary tuberculosis (AKT) for 9 months. He had tachypnoea with respiratory rate 30/min and oxygen saturation 89% on air. On chest examination, there was reduced chest movement and absent air entry on the left side. CXR showed the left lung collapse with compensatory hyperinflation of the right lung and left side mediastinal shift. CT thorax showed intraluminal soft tissue opacity with near total obstruction of the left main bronchus. Bronchoscopy revealed soft tissue mass occluding the left main bronchus.

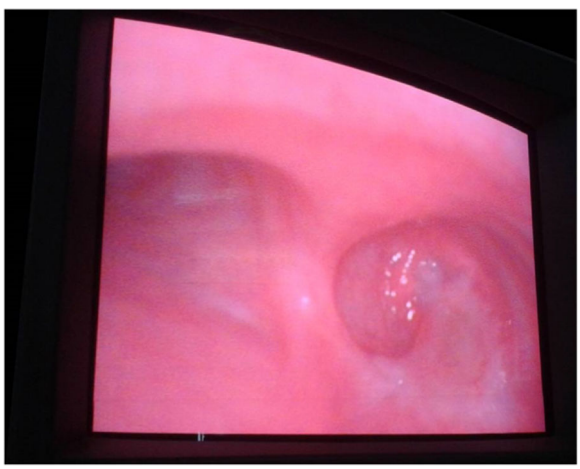

Fig. 2 Complete obstruction of the right bronchus

In both cases, blood investigations were within normal limit. ECG, NIBP, SpO_2, $EtCO_2$ and temperature were monitored. Both patients received general anaesthesia and ventilation through side arm of bronchoscope. They were premedicated with intravenous glycopyrrolate 0.004mg/kg, fentanyl 1microgm.kg and dexamethasone 4mg. After pre-oxygenation with 100% oxygen for 5 min with Jackson Rees circuit, induction of anaesthesia was done with intravenous inj. propofol 1.5 mg/kg. Bronchoscope introduction was facilitated by intravenous inj. succinylcholine 1.5 mg/kg. Lungs were ventilated with 100% oxygen by face mask and later through bronchoscope side arm till laser ablation was initiated. During CO_2 laser ablation, anaesthesia was maintained with intermittent intravenous doses of propofol and atracurium. During bronchoscopy, spontaneous breathing was avoided to prevent unacceptable depth of anaesthesia, bucking, airway reflexes, desaturation and arrhythmias and to avoid injury to surrounding normal tissue by laser beams. Also surgeon satisfaction was higher with controlled ventilation. Ventilation was done with air using self-inflatable bag through side arm of bronchoscope. During laser ablation, when oxygen saturation dropped below 80%, ventilation was switched over to 100% oxygen by connecting Jackson-Rees circuit to the side arm of bronchoscope. Procedure was stopped temporarily till saturation increased above 95%.

Intra-operative bradycardia was treated with intravenous inj. atropine and fall in oxygen saturation and hypercarbia by hyperventilation using 100% O_2. $EtCO_2$ was measured throughout the procedure. At the end of procedure, $EtCO_2$ was above 45 which were corrected by hyperventilation. The procedure lasted for 90 to 120 min in both cases.

In the first case, fibrous tissue was blocking the right main bronchial lumen that was ablated with laser (Fig. 3).

First patient could not maintain oxygen saturation at the end of procedure. CXR showed pneumothorax. After ICD insertion, the right lung expanded fully (Fig. 4).

Post-operatively, nebulisation with asthalin and steroids was given every six hourly.

In the second case, foreign body (betel nut) embedded in the soft tissue was removed. Post-operative courses were uneventful in both cases.

Discussion

With CO_2 laser precise tissue destruction, with minimal local inflammation and oedema of the narrow airway is possible which is helpful in life-threatening paediatric airway lesions (Roberts and Thornington 2005). Lasers

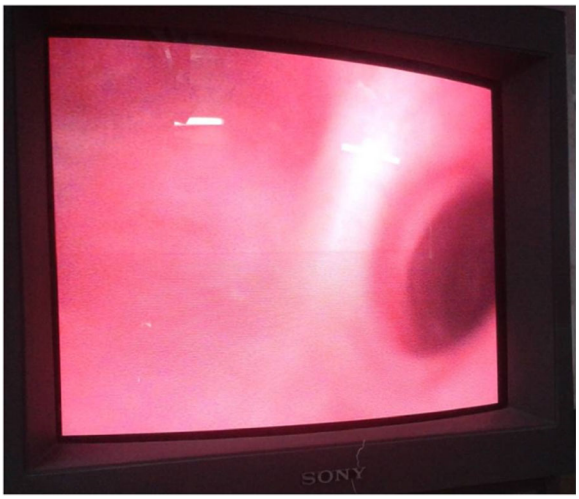

Fig. 3 Right bronchus after laser ablation

provide a source of intense energy. Flammable material like tracheal tubes, sponges, or latex gloves, in the operative field can ignite. Air and O_2 mixture reduce inspired concentration of O_2. Oxygen- and nitrous oxide-enriched atmospheres increase the risk of fire (Hermens et al. 1983; Brodsky 2003).

Anaesthesia technique is decided by airway assessment, degree of airway obstruction, type of lesion, presence of hypoxia, bronchospasm and physical status (English et al. 2006; Hermens et al. 1983; Brodsky 2003). Our both paediatric patients were dyspnoeic, tachpnoeic and reduced movement of chest on the bronchial obstruction side with absent air entry. Both were fairly built and had SpO_2 less than 92%. Both cases were given glycopyrrolate and steroid premedication. Anticholinergic drugs prevent bradycardia, reduce secretions, oedema and broncho-constriction during airway manipulation and intravenous dexamethasone or methylprednisolone reduces airway oedema. Preoperative bronchodilator improves oxygen saturation and alveolar ventilation (Brodsky 2003). While managing such case along with ECG, NIBP, SpO_2 and temperature, monitoring it is also important to monitor skin colour and signs of airway obstruction.

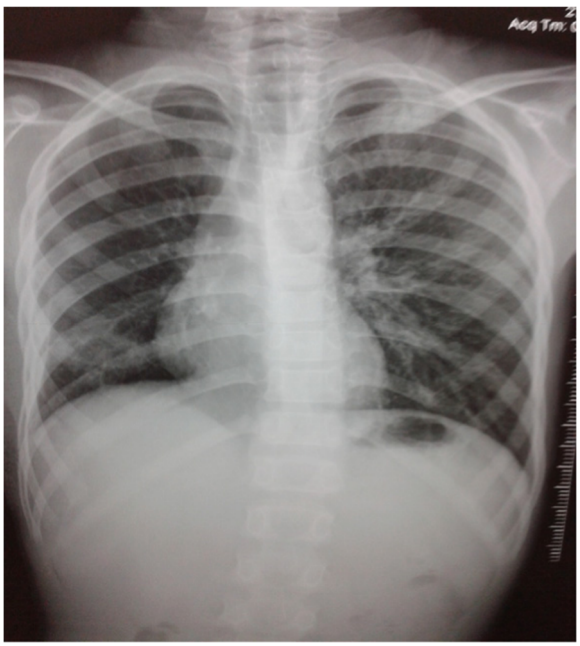

Fig. 4 Postoperative X-ray chest

Preferred technique during laser surgery is general anaesthesia with muscle relaxant as it prevents movements of patient and prevents misdirection of laser beam (EI-Dawlatly et al. 2011; Conacher et al. 1998). In both paediatric patients, the anaesthesia technique used was general anaesthesia with muscle relaxant and ventilation through side arm of bronchoscope. Induction was done with intravenous inj. propofol. Introduction of bronchoscope was facilitated by succinylcholine. Ventilation was done with air using self-inflatable bag during laser ablation. When O_2 saturation fall below 90%, ventilation with 100% O_2 was done by connecting Jackson Rees circuit to the side arm of bronchoscope.

Non-intubation technique of ventilation reduces risk of fire as flammable material is not present. Also, surgical field remains clear and airway trauma can be avoided (English et al. 2006; Hermens et al. 1983; Brodsky 2003). TIVA with jet ventilation through a small-gauge needle or ventilation through side arm of bronchoscope is commonly used anaesthetic techniques (English et al. 2006; Hermens et al. 1983; Brodsky 2003). In apneic technique, ventilation is done via bronchoscope. Anaesthesia may be maintained with inhalational or intravenous agents, muscle relaxant and regional anaesthesia for the airway. During laser resection, ventilation is temporarily discontinued. Disadvantages are hypoventilation leading to hypercarbia, pulmonary aspiration of laser plume and surgical debris (English et al. 2006). Another technique is jet ventilation in which high-velocity jet of O_2 is directed into the airway. Lungs are ventilated by entrained air and oxygen (English et al. 2006; Hermens et al. 1983; Brodsky 2003). Disadvantages are hypoventilation, hypercarbia (EI-Dawlatly et al. 2011), pulmonary aspiration, gastric distension or barotraumas including pneumothorax and pneumomediastinum. Adequacy of ventilation cannot be assessed by spirometry or capnography (English et al. 2006; Hermens et al. 1983; Bagwell 1990).

Hazards of laser surgery are risk of airway fire, damage to healthy tissue and injury to theatre staff (English et al. 2006). Risk of fire can be minimised by reducing concentration of FiO2, using non-inflammatory anaesthetic agents and avoiding N2O (Bagwell 1990).

Our first patient had past history of bilateral chest injury. He developed right bronchial obstruction thereafter. After laser surgery, postoperatively, he developed right-sided pneumothorax. When there is total obstruction of bronchus, damage to wall of bronchus can occur as direction of lumen cannot be identified (Warner et al. 1984). Other complications are laryngospasm, bronchospasm and hypoxia. Hypoxia can be aggravated by the presence of blood or secretion in an airway, excessive suctioning, prolong bronchoscopy, bronchospasm or fall in cardiac output (Spiess and Ivankovich 1990). Study comparing manual ventilation through side port of bronchoscope and Sander's jet injector showed higher $PaCO_2$ level when manual ventilation through side port of bronchoscope is done (Duckett et al. 1985). Hypercarbia can be due to air trapping, decrease venous return and reduce cardiac output (Spiess and Ivankovich 1990). Visibility and suctioning is easy when laser is used through rigid metal bronchoscope. Laser beam reflecting from metal surface and damage the tissue (Brodsky 2003).

Nebulization with epinephrine is useful in stridor. Postoperatively humidified oxygen reduces drying of the oral mucosa and the inspissations of secretions (English et al. 2006).

In conclusion, anaesthesia for laser procedure in paediatric patients having bronchial obstruction is always challenging to the anaesthesiologists. Careful preoperative evaluation, use of low FiO_2 during laser and adequate ventilation through side port of bronchoscope allow unobstructed view and reduce concern of airway fire. Close communication between surgeon and anaesthesiologist is also important during endoscopy for better outcome.

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Authors' contributions
SRE and NMS both contributed to the anaesthetic management and follow-up and prepared the manuscript. Both authors read and approved the final manuscript.

Ethics approval and consent to participate
Ethics approval is not applicable. Procedure is done after informed and written consent of patient's relatives.

Consent for publication
Written informed consent was obtained from the patient's relative for publication of this case report and accompanying images.

Competing interests
The authors declare that they have no competing interests.

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