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CLINICAL INFORMATION

Selective lobar blockade with a Coopdech blocker combined with a double-lumen endotracheal tube for lung metastases resection by laser



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Abstract In recent years, laser resection of lung metastases has been established as the standard procedure worldwide. To avoid airway fire, it is necessary to collapse the surgical lung. The selective lobar bronchial blockade is a technique that allows one-lung ventilation while the operated lobe is collapsed in patients with previous pulmonary resection requiring subsequent resection or with limited pulmonary reserve. We report a clinical case about our experience of a selective lobar bronchial blockade technique with a bronchial blocker (Coopdech endobronchial blocker) that was employed successfully with a double-lumen endotracheal tube in a patient with previous contralateral pulmonary resection who was scheduled for atypical resections of pulmonary metastases by laser. We selectively blocked the right intermediate bronchus for management of hypoxemia during one-lung ventilation. This technique provided adequate ventilation and oxygenation during surgery, avoiding the need of two-lung ventilation during lung metastases resection by laser.

Conclusion: This case shows that if a properly positioned double-lumen tube was already in place and the patient does not tolerate one-lung ventilation because of hypoxemia, it would be possible to provide selective lobar blockade by placing a bronchial blocker through the lumen of the double-lumen tube, avoiding the use of continuous positive airway pressure during laser surgery. This technique does not disturb the operative field or interrupt the operative procedure during resection by laser, which would occur during two-lung ventilation or used of continuous positive airway pressure.

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PALAVRAS-CHAVE

Bloqueador
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Ventilação
monopulmonar;
Laser;
Cirurgia torácica

Bloqueio lobar seletivo com um bloqueador Coopdech combinado com um tubo endotraqueal de duplo lúmen para ressecção de metástases pulmonares com laser

Resumo Nos últimos anos, a ressecção de metástases pulmonares com o uso de laser foi estabelecida como o procedimento padrão em todo o mundo. Para evitar queimadura das vias aéreas, o colapso cirúrgico do pulmão é necessário. O bloqueio brônquico seletivo é uma técnica que permite a ventilação de um lobo, enquanto o lobo operado é colapsado nos pacientes com ressecção pulmonar anterior que requerem ressecção subsequente ou que possuem reserva pulmonar limitada. Relatamos um caso clínico de nossa experiência com a técnica de bloqueio brônquico seletivo com bloqueador brônquico (bloqueador endobrônquico Coopdech), usado com sucesso com um tubo endotraqueal de duplo lúmen em um paciente com ressecção pulmonar contralateral prévia, agendado para ressecção atípica de metástases pulmonares com o uso de laser. Seletivamente bloqueamos o brônquio intermediário direito para o controle de hipoxemia durante a ventilação monopulmonar. Essa técnica proporcionou ventilação e oxigenação adequadas durante a cirurgia, evitando a necessidade de ventilar os dois pulmões durante a ressecção de metástases pulmonares com o uso de laser.

Conclusão: Este caso mostra que, se um tubo de duplo lume estiver corretamente posicionado e o paciente não tolerar a ventilação monopulmonar devido à hipoxemia, seria possível fornecer bloqueio lobar seletivo com a colocação de um bloqueador brônquico através do lume do tubo de duplo lume, evitando o uso de pressão positiva contínua de vias aéreas (PPCVA) durante a cirurgia a laser. Essa técnica não interfere no campo operatório ou interrompe o procedimento durante a ressecção por laser, que poderia ocorrer durante a ventilação dos dois pulmões ou uso de PPCVA.

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Introduction

Patient reviewed the case report and gave permission to publish it.

Surgical resection of pulmonary metastases is today considered a standard therapeutic procedure and is routinely performed in many departments of thoracic surgery for curative potential.^{1,2} In recent years, laser resection of lung metastases has been established as the standard procedure worldwide. Laser system facilitates the resection of a significantly higher number of metastases with preservation of lung lobe. Furthermore, the eligibility of patients for metastasectomy can be expanded. Although, laser system also has complications as airway fire because of use high concentrations of oxygen, this complication can be avoided with nondependent lung collapsed.

Actually, lung separation is achieved most commonly with the use of a double-lumen endotracheal tube (DLT) due to DLT allows relatively easy collapse of the nonventilated lung and the ability to suction each lung independently. Another option is a single lumen tube (SLT) with a bronchial blockade (BB). One of the advantages of BB is that they allow selective lobar bronchial blockade (SLBB). The SLBB is a technique that allows one lung ventilation (OLV) while the operated lobe is collapsed during thoracic surgery in patients with previous pulmonary resection requiring subsequent resection or in patients with limited pulmonary reserved resulting from severe pulmonary disease.³⁻⁵ We report a case of a patient who was undergoing a right thoracotomy for atypical pulmonary resections because of lung metastases. This patient had multiple pulmonary

resections in both lungs. We successfully used a SLBB with the combination of a DLT and BB on the intermediate bronchus for management of hypoxemia during OLV.

Case report

A 41-year-old man, ASA II, with multiple pulmonary nodules in right middle and lower lobes was scheduled for atypical resections by laser by right thoracotomy. He had a history of resection of a sarcoma synovial in elbow and he underwent atypical resections in the left lower lobe and right upper lobe and left upper lobectomy five years ago. He had a forced vital capacity of 5290 mL (110% of predicted value) and a forced expiratory volume in 1 s of 4190 mL (106% of predicted value).

In the operating room, routine monitors and a radial artery catheter were placed. The patient underwent general anesthesia with IV propofol (2 mg.kg⁻¹), fentanyl (3 µg.kg⁻¹) and rocuronium (1 mg.kg⁻¹). A 41 left-sided DLT (Broncho-Cath, Mallinckrodt Medical, St. Louis, MO, USA) was placed in the trachea, and the bronchial lumen was advanced toward the left mainstem bronchus. Its correct placement was assessed by fiberoptic bronchoscopy; both with the patient supine and lateral decubitus position. The patient was turned onto the left lateral position, a right paravertebral catheter was placed at the level of the T5–T6 interspace and we injected an initial bolus dose of 15 mL of 0.5% bupivacaine and subsequent continuous infusion of 0.5% bupivacaine at 0.1 mL.kg⁻¹.h⁻¹. General anesthesia was maintained with continuous perfusion of propofol and rocuronium.

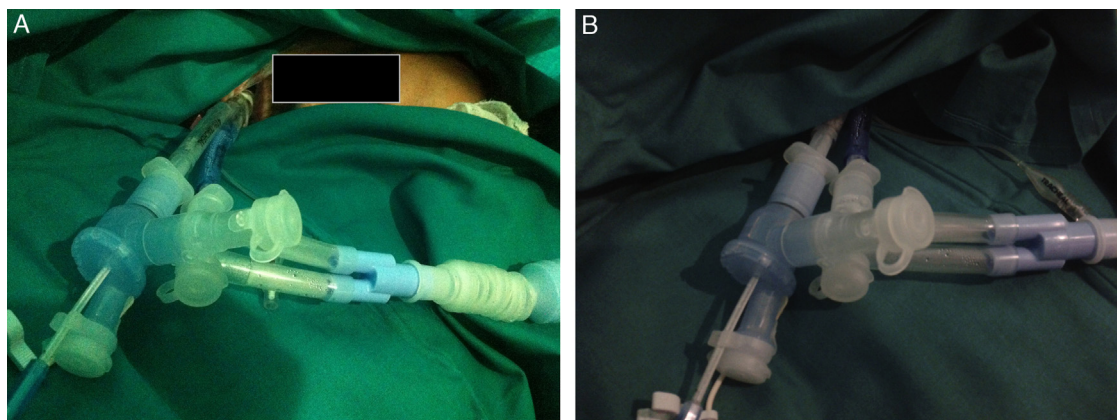


Figure 1 (A, B) Illustrations of selective lobar bronchial blockade. Bronchial blocker placed through the tracheal lumen of double-lumen tube.

During OLV, volume controlled ventilation was used with a tidal volume of 6 mL.kg^{-1} , a respiratory frequency for maintaining PaCO_2 between 35 and 40 mmHg, relation I:E of 1:2 and a FiO_2 of 0.6–0.8. At the beginning of OLV, a decrease in lung compliance from $48 \text{ mL.cmH}_2\text{O}^{-1}$ to $9 \text{ mL.cmH}_2\text{O}^{-1}$, a significant increase in airway pressure with peak pressure values of more than $40 \text{ cmH}_2\text{O}$, pressure plateau of $35 \text{ cmH}_2\text{O}$ and a decrease of arterial oxygen saturation (SpO_2) from 98% to 87% under a FiO_2 of 1 happened. We reinicied two lung ventilation and accuracy of TDL placement was using fiberoptic bronchoscopy. Then, we decided to make a SLBB with a BB (Coopdech endobronchial blocker tube, Daiken Medical Corp, Osaka, Japan) placed in the tracheal orifice of the DLT under bronchofiberscopic guidance and advanced toward the intermediate bronchus. The steps for the insertion of the BB during lung separation are as follows. The fiberoptic bronchoscope (diameter of 4mm; Olympus ENF/P3, Tokyo, Japan) and the BB were passed through the hole of the connector of tracheal part of the left-sided DLT (Fig. 1A and B). First, the tip of the BB was easily placed into the right mainstem bronchus and then was advanced until the desired position bypassing the takeoff of the right upper bronchus (Fig. 2A and B). A

Table 1 Oxygenation and ventilatory mechanics.

	TLV	OLV AND SLBB
Compliance	48	44
$\text{PaO}_2/\text{FiO}_2$	160/0.45	90/0.5
pH	7.42	7.35
PaCO_2	38	47
SaO_2	100	96

OLV, one lung ventilation; SLBB, selective lobar bronchial blockade; TLV, two lung ventilation.

10 mL syringe was connected to the BB and the balloon was inflated.

The oxygenation and ventilatory mechanics improved with the use of SLBB (Table 1). The surgical procedure proceeded uneventfully with excellent visualization of the operative field without ventilation of surgical lobes (Supplementary Material, Video S1). This would be a risk when lung resection is performed by laser. The oxygenation was provided via the ventilated left lower lobe and upper right lobe. The middle and lower right lobes remained quiescent and isolated during the surgery.

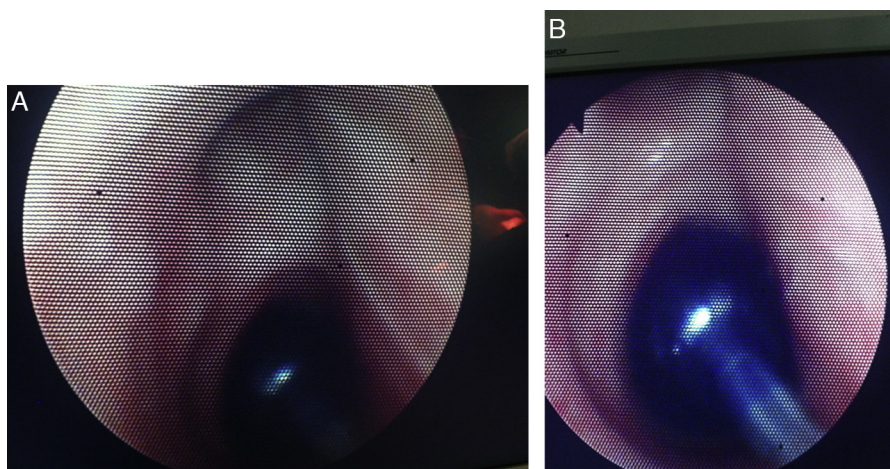


Figure 2 (A, B) Bronchoscopy images with a bronchial blocker in bronchus intermedius of right main bronchus.

Discussion

Among the potential complications of OLV is the development of intraoperative hypoxemia because intrapulmonary shunt. Patients with previous lobectomy requiring another surgery in the contralateral lung may be at risk of developing hypoxemia during OLV, barotrauma or lung overdistension.⁴ In these conditions, increasing the proportion of the ventilated parenchyma would be of extreme importance; so, one alternative is the use of a SLBB.

Different methods have been used to improve arterial oxygenation during OLV; such as ventilatory mode adjustments, recruitment maneuvers, intermittent ventilation of the nondependent-exposed lung, early clamping of the pulmonary artery branch and continuous positive airway pressure (CPAP) application to the nondependent-exposed lung.⁶

The surgical resection of metastases has two features that makes CPAP application is not advisable: first, adequate lung collapse is required to palpate the lesions and to detect others that have not been seen on imaging tests, and second the CPAP application with high concentrations of oxygen to the operative lung is at risk of fire. Therefore, we decided to place a SLBB to collapse the surgical lobe while arterial oxygenation was improved.

SLBB increases the proportion of the ventilated parenchyma.⁴ This has been performed more frequently through a SLT in thoracic surgical procedures in patients who previously underwent a contralateral resection⁷ or pneumonectomy,^{8,9} for control of pulmonary bleeding,³ to avoid pulmonary contamination, reduced air leak through a fistula,⁹ and for improve arterial oxygenation in patients with marginal pulmonary reserve¹⁰ or patients unable to tolerate OLV.^{11,12} Campos¹³ showed that SLBB with the Univent bronchial blocker improved arterial oxygenation during OLV and resulted in greater PaO₂ value than total lung collapsed, regardless of CPAP application to the nonventilated lung. SLBB with a Univent bronchial blocker has also been successful in patients with compromise lung function undergoing minimally invasive video thoracoscopic surgery.¹⁴

However, in our knowledge, there are few case reports of usefulness of a SLBB with a DLT. Otruba et al.¹⁵ used a SLBB with a 6Fr Fogarty catheter inserted through a DLT as a secondary troubleshooting option in an intensive care unit in a patient with an air leak. Capdeville et al.¹⁶ placement of a Fogarty catheter down the bronchial lumen of a left-sided DLT in a patient in whom unanticipated anatomical constraints prevented the advancement of a left-sided DLT into the left mainstem bronchus. Another authors¹⁷ performed a bilobar blockade with the insertion of an embolectomy catheter via the tracheal part of the left-sided DLT. Sumitani et al.¹⁸, presented three cases of a SLBB with BB (Coopdech endobronchial blocker tube) and DLT for a lobectomy procedure in patients with infectious lung disease, and for various VATS procedures. Mc Glade et al.¹⁹ report a combination of a DLT and BB (Arnt bronchial blocker, Cook Inc, Bloomington, IN) to provide suitable conditions for right upper lobe surgery in a patient who had recently undergone a left upper lobectomy.

Our case report differs from previously reported DLT-BB combinations in which we placed BB through the lumen of DLT under fiberoptic guidance, while other authors passed it

blindly,¹⁶ advanced it through the vocal cords under direct laryngoscopy¹⁹ or used Fogarty catheters as BB.¹⁵⁻¹⁷ A 41F DLT allowed enough space in the DLT to accommodate both the BB and the FOB, avoiding to pass blindly the BB (Fig. 1A and B).

In our case report, selective lobar blockade with a BB through a DLT could be performed with minimal interference with the surgical field and motionless right chest. In addition we demonstrated that the PaO₂ improves with the selective lobar blockade.

This case shows that if a properly positioned DLT was already in place and the patient does not tolerate OLV because of hypoxemia, it would be possible to provide selective lobar blockade by placing a BB through the lumen of the DLT, although a minimum of 39F DLT is necessary to pass a bronchoscope of 4mm. In this way, the use of CPAP or pulmonary reexpansion in laser surgery is avoided.

In the future, it is likely that the number of patients presenting for a subsequent, often contralateral, pulmonary resection will increase. Anesthetists managing these complex thoracic cases must be able to use the wide range of airway devices, and in a manner that involves adaptation to the individual anatomic variations presented by each situation. The blocking lobes improved oxygenation without disturbing the operative field or interrupting the operative procedure by intermittent ventilation of both lungs.

Conflicts interest

The authors declare no conflicts of interest.

Appendix. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.bjane.2016.02.005](https://doi.org/10.1016/j.bjane.2016.02.005).

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