EDITORIAL

COMPLICATIONS FOLLOWING DIFFERENT TECHNIQUES OF ONE-LUNG VENTILATION

- Tracheal tube versus univent, or double-lumen tube -

One-lung ventilation (OLV) is recommended in patients undergoing thoracoscopy or thoracotomy. This can be achieved by contralateral ventilation of the non-operated lung using the traditional single-lumen tracheal tube, the univent tube, or the double-lumen tube. The present Editorial reports serious complications which may follow the three techniques of one-lung ventilation.

Using a single-lumen tracheal tube, collapse of the nonventilated lung can be achieved by carbon dioxide insufflation into the contralateral closed intrapleural chest cavity to a pressure as low as 5 mmHg. However, this technique may create a physiological response very similar to that of a unilateral tension pneumothorax, with a consequent hemodynamic instability secondary to decreased venous return, and/or mediastinal shift.

Another technique of achieving OLV is using the univent tube, while collapsing the nonventilated lung by applying suction via the bronchial blocker before thoracotomy. However, applying suction, with the chest closed, can result in a marked negative intrathoracic pressure that diverts blood from the ventilated lung to the nonventilated lung with a consequent decrease of cardiac output and development of hypoxemia.

Our present anesthetic technique for one-lung ventilation during thoracotomy or video-assisted thoracoscopy depends on double-lumen intubation which provides selective ventilation of the contralateral lung, while allowing collapse of the ipsilateral lung without the need of intrapleural carbon dioxide insufflation.

Partial collapse of the lung on the thoracoscoped side occurs when the air enters the pleural cavity. To augment collapse, the lumen of the double-lumen tube on thoracoscoped side is opened to room air, while suction is applied intermittently as indicated. The technique provides a quiet field on the thoracoscoped side, without the need for carbon dioxide insufflation into the ipsilateral pleural space, or direct tracheal suctioning, and hence will not be complicated by inadvertent tension pneumothorax or negative pressure pulmonary edema.

During one-lung ventilation, it is advisable to use the double-lumen tracheal tube. The right upper lobe bronchus arises near the carina as an offshoot from the right main stem bronchus, while the left upper lobe bronchus arises further away from the carina as a bifurcation of the main trunk. In addition, the right main bronchus is only 2cm long or may be shorter, and occasionally, the right upper lobe bronchus arises from the lower end of the trachea. That is why, right bronchial intubation can occlude the opening to the right upper lobe bronchus, with a consequent decrease of PaO₂. In contrast, the left main stem bronchus is longer than the right main stem bronchus, and hence right bronchial intubation should be only used if left bronchial intubation is contraindicated. The use of a small double-lumen tube can facilitate overinflation of the bronchial cuff and/or down displacement of the tube which results in obstruction of the right or left upper lobe bronchus.
Owing to the greater length of the left main stem bronchus, it is always advisable to use left bronchial intubation unless contraindicated by certain procedures such as left pneumonectomy, and to select the largest possible sized tube in order to avoid placing the bronchial limb too far into the bronchus.

Adequate fixation of the double-lumen tube and repeated checking by chest auscultation and fiberoptic bronchoscopy are required to detect malposition. Despite all these precautions, we came across two cases of left upper lobe bronchus blocking following left bronchial intubation, with a consequent ventilation limited to one lobe, resulting in severe hypoxemia in one patient, and in lung rupture with a consequent tension pneumothorax in the second patient.

To optimize oxygenation during OLV, the original proposed ventilation strategy was based on maintaining a large tidal volume of 10 ml.kg, while applying continuous positive airway pressure (CPAP) using 100% oxygen to the non-ventilated lung. However, applying CPAP to the non-ventilated lung on the operative side disturbed the surgeon during video-assisted thoracoscopy.

Also, recent studies have shown that ventilation with large tidal volume can result in lung injury. So, a revision of these guidelines has been necessary. The present recommended ventilation strategy during OLV is to use normal tidal volume, associated with PEEP. The use of PEEP is associated with an increase of oxygenation, without any other change of ventilation strategy. Thus, a normal tidal volume, associated with PEEP should be considered as a prevention strategy against both hypoxemia and lung injury. The present strategy during OLV is to use a normal tidal volume, associated with a low level PEEP.

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References

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Volunteer studies have demonstrated a slight (17%-22%) and transient (<30 minutes) prolongation of the prothrombin time/activated partial thromboplastin time (PT/aPTT) with BRIDION; however, clinical studies have demonstrated no clinically relevant effect on peri- or postoperative bleeding complications with BRIDION alone or in combination with anticoagulants. As BRIDION has demonstrated an in vitro pharmacodynamic interaction with anticoagulants, caution should be exercised in patients on anticoagulation for a pre-existing or concomitant condition. This pharmacodynamic interaction is not clinically relevant for patients receiving routine postoperative prophylactic anticoagulation. Although formal interaction studies have not been conducted, no drug interactions were observed in clinical trials. Preclinical data suggest that clinically significant drug interactions are unlikely with the possible exceptions of toremifene, fusidic acid, and hormonal contraceptives.

¹ Time-of-four
² Post-tetanic counts
³ Second twitch

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References:
2. MAD (Mucosal Atomization Device) Medical Atomizer In Vitro Spray Characterization, 2011