

# Awake thoracoscopic surgery under epidural anesthesia: is it really safe?

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Thoracoscopic surgeries usually require single-lung ventilation under general anesthesia because of the need to obtain a sufficient working space. In patients with impaired pulmonary function, if the patient can undergo general anesthesia, a more selected collapse of the lung is considered to be beneficial for intraoperative oxygenation. The selective bronchial blockade of the lobe to be resected has been reported by several investigators (1-3). Mukaida and coworkers first reported thoracoscopic surgery for pneumothorax under local and epidural anesthesia in 1998 in high-risk patients contraindicated for general anesthesia (4). They reported that their patients experienced well-managed pain and cough reflex and well-maintained breathing and hemodynamics during the surgery, and demonstrated that thoracoscopic surgeries can be performed safely under epidural anesthesia without tracheal intubation. Subsequently, Pompeo and colleagues conducted a randomized trial comparing the result of awake thoracoscopic resection of solitary pulmonary nodules versus a control group treated under general anesthesia with single-lung ventilation (5). They concluded that the awake thoracoscopic approach was superior to the conventional thoracoscopic approach under general anesthesia in terms of the global in-operating room time, postoperative recovery, need for nursing care and overall hospital stay. Moreover, Mineo's group showed the superiority of the awake thoracoscopic surgery versus conventional thoracoscopic surgery in the treatments of spontaneous pneumothorax (6), metastatic tumors (7), empyema thoracis (8) and emphysematous bulla (9). Moreover, they demonstrated that awake thoracoscopic surgery attenuated the surgical stress responses and had a smaller impact on the postoperative lymphocyte

responses when compared with conventional thoracoscopic surgery under general anesthesia with single-lung ventilation (10,11). The awake approach may attenuate the impact on the endocrine and immune systems of the patients compared with the conventional anesthetic option. Based on this background, the use of awake thoracoscopic minor lung surgery has been expanding worldwide (12-15).

Regarding major lung surgery, there have been three studies reported from Taiwan. Chen and coworkers first reported that awake thoracoscopic lobectomy is safe and technically feasible in selected patients with early-stage non-small cell lung cancer (16). They demonstrated that the surgical results of the awake approach were comparable to those of historical controls treated under general anesthesia, while the awake group showed less intubation-associated discomfort and a quicker return to daily activities, including drinking and eating. They also revealed that three (10%) of the 30 subjects in the awake group required conversion to general anesthesia with single-lung ventilation because of persistent hypoxemia, poor pain control or bleeding. They also reported the feasibilities of non-intubated thoracoscopic segmentectomy (17) and lobectomy with the same procedures for geriatric lung cancer patients (18).

Recently, Liu and coworkers conducted a randomized trial comparing the results of awake thoracoscopic surgery, including bullae resection, wedge resection and lobectomy, versus those of a control group treated under general anesthesia with single-lung ventilation in 354 patients treated at a single institution (19). In their study, 174 patients underwent the awake approach, while the remaining 180 patients served as a control group. Seven (4%) of the 174 subjects in the awake group required

conversion to general anesthesia with single-lung ventilation because of persistent hypoxemia (n=2), unsatisfactory lung collapse (n=2), diffuse pleural adhesion (n=1), unexpected conversion of the surgical procedure (n=1) and bleeding (n=1). Four (13%) of the 30 patients undergoing lobectomy were converted. The surgical results of the awake group (n=167) excluding the seven conversions were compared with those of the control group (n=180), because this study was not based on an intention-to-treat method. The authors demonstrated that the rates of postoperative complications, including respiratory complications, in the awake group were significantly lower than those of the control group, while there were no mortalities in either group.

Regarding the postoperative fasting time and duration of postoperative antibiotic use (which was dependent on the time when the white blood cells decreased to normal levels), the awake group was superior to the control group. The awake group also showed shorter hospital stays after bullae resection and lobectomy than the control group. Moreover, the authors of that study reported that the awake group was associated with decreased levels of inflammatory cytokines, including tumor necrosis factor- $\alpha$ , in the bronchoalveolar lavage fluid and a lower serum high-sensitivity C-reactive protein level after bullae surgery, compared with the control group. This additional study regarding the differences between the pre- and post-operative concentrations of inflammatory cytokines after bullae surgery clearly demonstrated that the awake approach decreased the postoperative complications. Therefore, an additional study should be conducted in all subjects because postoperative complications were compared between the two groups for all subjects, irrespective of the surgical procedures.

However, in this paper, the awake group tended to have an increased intraoperative blood loss during major surgery compared to the conventional group. Although the inclusion of a complicated sub-analysis of minor and major surgeries, the lack of an intention-to-treatment study and the lack of comparisons of the patient characteristics, length of the operation and global in-operating room time decreased the importance of that study, there were several laudable aspects associated with the article. The first is that it was a randomized controlled trial that recruited a relatively large number of patients. The second is that the conversion rate was relatively low at 4%. That shows the experience of the surgical team and their motivation to complete the awake thoracoscopic surgery. The third is the low morbidity rate of 6.7%. Of note, the investigators report a 1.2% incidence

of pulmonary infection, which is a remarkably low rate. The smaller number of pulmonary infections may be associated with attenuated surgical stress responses and the preserved function of natural killer cells in patients undergoing awake thoracoscopic surgery (10,11).

Although all of the researchers reported that the least invasive procedures consisting of thoracoscopic surgery under local and epidural anesthesia are safe and feasible (4-9,12-19), collaboration between thoracic surgeons and anesthesiologists is absolutely essential for successful results. Because the frequency of conversions to general anesthesia needing intubation was 10% or more during major lung surgery (16,19), anesthesiologists will need to make provisions for such conversions. For thoracic surgeons, the accumulation of experience by performing minor awake thoracoscopic procedures is very important. Especially in major lung surgeries, including lobectomy, it seems to be difficult to strip the interlobal vessels and treat the incomplete fissures despite inflation of the affected lung. If bleeding from the pulmonary artery occurs, it is extremely difficult to control in such a limited working space. Therefore, a prompt conversion to intubated general anesthesia should be performed without hesitation if such bleeding develops.

In conclusion, this innovative technique consisting of less invasive surgery and anesthesia is associated with a faster postoperative recovery and lower complication rates, compared with conventional thoracoscopic surgery under general anesthesia. However, the safety of major surgery, including lobectomy, performed using this approach is still unclear.

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