



Procedures to avoid postoperative prolonged air leak in thoracic surgery

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Postoperative prolonged air leak (PAL) is a common complication during pulmonary resection and should be avoided to achieve faster postoperative recovery. Most studies describing enhanced recovery after surgery (ERAS), for lung surgery, emphasized the importance of early removal of the drainage tube, although ERAS can still be uncommon in thoracic surgery (1-3). In guidelines advocated by the ERAS Society and the European Society of Thoracic Surgeons, early chest drain removal was involved in 45 enhanced recovery items (2). Postoperative PAL can trigger pneumonia or atelectasis (caused by pain), and slow patient mobilization. Attaar *et al.* reported that PAL is associated with pulmonary complications, re-admission, and delayed hospital discharge (4). Konstantinidis *et al.* found that 18 of 59 patients requiring readmission within 90 days of discharge exhibited prolonged chest drainage (5). Improvements in surgeons' surgical skills and surgical instruments, including the stapler, play an important role in avoiding PAL. Lim *et al.* focused on the pre-attached stapler reloads and investigated their safety and efficacy in a prospective single-arm study (6).

The usefulness of a buttressed stapler to avoid postoperative PAL during lung volume reduction surgery was frequently reported in the early 2000s. Stammberger *et al.* showed a significant decrease in postoperative drainage time and rate of PAL of a buttressed staple line in the bovine pericardium group, compared to the non-buttressed group, in a randomized comparative three-center study (7). In contrast, Miller *et al.* described no significant difference

between buttressed and unbuttressed staple lines for pulmonary resection in a prospective multicenter trial (8). Guislain *et al.* reported a meta-analysis that included 13 trials that described stapling with glue, patches, or buttresses to avoid air leaks on the stapler line (9). They insisted that their conclusions should be interpreted with caution due to publication bias, although the use of surgical sealants and buttressing decreased the risk of PAL after pulmonary resection. Based on those results, the utility of using a buttressed stapler to reduce PAL is unclear.

Covering the staple line with a polyglycolic acid (PGA) sheet has been frequently adopted during pulmonary bullectomy to reduce the postoperative recurrence of primary spontaneous pneumothorax (10). Hirai *et al.* reported a significant difference in postoperative recurrence between the coverage and non-coverage groups (coverage: 3.3% *vs.* non-coverage: 16.3%, $P=0.0003$), and staple line coverage was the only contributing factor reducing postoperative recurrence among the patients with a primary spontaneous pneumothorax (hazard ratio: 0.212, 95% confidence interval: 0.082–0.547, $P=0.0003$). The covering material in Lim's report was the same. However, the PGA sheet was pre-attached, which eliminated the labor of the operating nurse staff. This is one of the advantages of using a pre-attached type stapler.

Lim *et al.* evaluated the safety of pre-attached reinforced stapler reloads in a single-arm prospective study (6). The primary outcome was the incidence of device-related adverse events, particularly bleeding and air leaks. Two of

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the 40 patients (5%) revealed bleeding at the staple line, while an air leak was intraoperatively found in three of the 40 patients (8%) although all air leaks were minor and managed conservatively. These results make it difficult to confirm that this type of stapler is safe because this study contained only a single arm group. Although the results were partially acceptable, a prospective comparative study should be performed for confirmation.

Among the methods to avoid PAL, our group insists on the usefulness of fissureless lobectomy for a dense fissure because a dense fissure is usually a prime cause of postoperative PAL (11). Similarly, several studies have revealed positive effects of fissureless lobectomy on postoperative drainage time, although most of them were retrospective (12-14). Among them, the only study prospectively conducted by Stamenovic *et al.* demonstrated that significantly less PAL was observed in the thoracoscopic fissureless lobectomy group than in the conventional thoracoscopic lobectomy group due to the duration of chest tube drainage and the length of hospital stay with the equivalent operative time (14). In addition to lobectomy, we do not usually dissect a dense fissure during pulmonary segmentectomy. Our group previously described how to perform this in a case report, but there are no original manuscripts (15,16). It is crucial not to dissect such a dense fissure, to avoid PAL during lobectomy or segmentectomy.

Unfortunately, staple line buttressing is more expensive than the non-reinforced type. However, Deguchi *et al.* explained that the use of a preloaded absorbable buttressing stapler does not significantly increase total material costs, compared with the use of a non-reinforced stapler, because the use of a preloaded absorbable buttressing stapler reduces the material costs (17). As described in their report, postoperative PAL can cause additional morbidity or a longer postoperative hospitalization time, which increases medical costs. Therefore, the use of a reinforced stapler might be reasonable to reduce total medical costs. However, not all patients require this type of stapler, although it is useful in patients with underlying pulmonary disease, including emphysematous changes or interstitial lung disease. It is an over-indication to use a reinforced stapler on any patient. This type of stapler should be used for selected patients who are likely to suffer from postoperative PAL on the staple line.

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