Technique to reduce air leaks after pulmonary lobectomy

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Abstract

Objective: Patients undergoing pulmonary resections often present postoperative air leaks of varying magnitude and duration; this complication is more frequent with incomplete or absent interlobar fissures. Small leaks close spontaneously within 5–7 days; larger leaks may persist longer and could be associated with increased morbidity and prolonged hospitalization. We evaluated the role of different techniques to complete interlobar fissures before pulmonary lobectomy to prevent postoperative air leaks and reduce hospital stay and costs. Methods: A total of 30 patients undergoing pulmonary lobectomy for lung cancer and presenting incomplete interlobar fissures that needed to be opened both anteriorly and posteriorly were randomized into three groups. In Group I, fissures were created with a GIA stapler and buttressed with bovine pericardial sleeves. In Group II, we used TA 55 staplers alone; in Group III we used the ‘old fashion’ cautery, clamps and silk ties. The three groups were homogeneous for age, type of pulmonary resection and stage of the tumor. The duration of postoperative air leaks and hospital stay were compared with the one-way variance analysis. Results: Postoperative air leaks for Groups I, II and III persisted for 2.9 ± 0.94, 5.3 ± 2 and 5.3 ± 1.7 days, respectively. Mean hospital stay was 4.4 ± 0.96, 7.8 ± 2.14 and 7.2 ± 1.5, respectively. The difference between groups in terms of duration of postoperative air leaks and hospital stay was statistically significant (P = 0.0001). Conclusions: The use of GIA staplers and pericardial sleeves to complete interlobar fissures for pulmonary lobectomy significantly reduces the duration of postoperative air leaks and hospital stay; no complications were associated with this technique. © 1998 Elsevier Science B.V. All rights reserved.

Keywords: Pulmonary lobectomy; Air leaks; Bovine pericardium

1. Introduction

Air leakage after major pulmonary resections is a well known problem; in fact, nearly all patients undergoing lobectomy or segmentectomy can be expected to present some degree of postoperative air leaks. This complication occurs more frequently when interlobar fissures are incomplete or absent and if the pulmonary resection is to be performed in older patients with emphysema [1]; the incidence is similar in open and thoracoscopic pulmonary resections [2,3]. Air leaks persisting for more than 7 days are considered a complication since they prolong hospital stay and may contribute to an increase in postoperative morbidity [4]. Ideally, treatment begins with prevention; if the fissures are incomplete, meticulous attention should be given to anatomical planes of interlobar dissection and staplers can be used [5] to reduce the incidence of air leakage. However, notwithstanding these measures, air leaks may still occur and compromise complete lung reexpansion. We evaluated the role of different techniques to complete interlobar fissures during pulmonary lobectomy to prevent postoperative air leaks and reduce hospital stay.

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2. Materials and methods

A total of 30 patients undergoing pulmonary lobectomy for lung cancer and presenting incomplete or absent interlobar fissures that needed to be opened both anteriorly and posteriorly formed the object of our study. Patients with anatomically well defined fissures were obviously excluded; we also did not include patients with lesions already treated with neoadjuvant chemotherapy or who previously underwent thoracic operations; T3 tumors with chest wall involvement and patients with extensive pleural adhesions were also excluded. Patients were randomized into three groups: In Group I (mean age 67.4 ± 6.7 years; seven males and three females; mean FEV1: 70.6% predicted) fissures were created with a GIA stapler and buttressed with bovine pericardial sleeves. In Group II (mean age 67.2 ± 6.8 years; six males and four females; mean FEV1: 77.1% predicted) we used TA 55 staplers alone. In Group III (mean age 66.5 ± 8.9 years; seven males and three females; mean FEV1: 75.5% predicted) we used the ‘old fashion’ cautery, clamps and silk ties. Technically, the identification of the interlobar planes was performed in the same way in all groups; fissures were completed after isolation of the lobar pulmonary vessels and at least an initial dissection of the bronchus. Working posteriorly, from a point just superior to the artery for the superior segment of the inferior lobe and utilizing finger dissection, a passage from the posterior pleural surface to the interlobar fissure was created; the same can be performed anteriorly, towards the middle lobe or the lingula. Fissures can than be completed with bovine pericardial sleeves. In Group II, we had air leaks persisting for more than 7 days and one for 8 days. In Group I we had two complications unrelated to the use of bovine pericardium (cardiac arrhitmia and superficial wound infection); a superficial wound infection was present also in Group III. An infection of the urinary tract was observed in Group II, but it did not increase the duration of postoperative hospitalization.

The difference between groups in terms of duration of postoperative air leaks and hospital stay was statistically significant ($P = 0.0001$). The duration of postoperative air leaks in Group I was significantly decreased (Group I vs. Group II: $P = 0.0001$; Group I vs. Group III: $P = 0.0001$). Also, postoperative hospital stay was significantly shorter in Group I (Group I vs. Group II: $P = 0.0001$; Group I vs. Group III: $P = 0.0007$). Age significantly influenced the duration of postoperative air leaks but Group I was significantly better for this subset of patients ($P = 0.0001$).

3. Results

The type of pulmonary resection performed in each group is reported in Table 1 and staging is reported in Table 2. Postoperative air leaks and hospital stay were compared with one-way variance analysis.

Table 1
Type of pulmonary resection performed in each group

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<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
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<tbody>
<tr>
<td>RIL</td>
<td>4</td>
<td>3</td>
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<tr>
<td>RSL</td>
<td>2</td>
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<td>ML</td>
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<tr>
<td>LIL</td>
<td>1</td>
<td>2</td>
<td>2</td>
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<tr>
<td>LSL</td>
<td>2</td>
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</tbody>
</table>

RIL, right inferior lobectomy; RSL, right superior lobectomy; ML, middle lobectomy; LIL, left inferior lobectomy; LSL, left superior lobectomy.

Table 2
Staging of the lesions resected in each group

<table>
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<th></th>
<th>Group I</th>
<th>Group II</th>
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<tbody>
<tr>
<td>Stage I</td>
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<tr>
<td>Stage II</td>
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<td>3</td>
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<td>Stage IIIA</td>
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4. Discussion

Successful closure of the airway is mandatory when performing a major pulmonary resection; when bronchioles and/or alveolar spaces remain open, a bronchioloalveolar-fistula develops and an air leak results. Nearly all air leaks originating from the periphery of the lung stop within 24–48 h of surgery when the remaining parenchima completely fills the pleural cavity. A prolonged air leak is considered as one that persists beyond the normal hospital stay (usually 7 days); it usually leads to prolonged hospitalization and increased costs but it does not directly imply a higher morbidity and mortality. Rice [1] reported 30 (15.2%) patients with an air leak for more than 7 days out of 197 patients undergoing major pulmonary resections, however, it persisted for more than 14 days only in three (1.5%) patients. In a series of 674 lobectomies or
lesser resections performed at two Canadian hospitals [2], the incidence of peripheral air leaks was 4%. Nagasaki [6] reported a prolonged air leak (7–20 days) occurring in 10 of 961 pulmonary resections for malignancy (<1%) and all air leaks stopped spontaneously. In a review of 369 lobectomies, Keagy [7] reported 16 prolonged air leaks (4.3%). Also in our experience, 3–4% of patients undergoing lobectomy present air leaks persisting for more than 1 week. Significant risk factors are considered male gender and larger FVC (related to larger lungs with greater raw surfaces after lung resection), age and COPD or other underlying lung diseases (lower percent predicted FEV1 and FEV1/FVC) [1].

Prevention of air leaks begins in the operating room and requires meticulous surgical technique, complete expansion of the residual lung and, if necessary, reduction of the pleural space. Dissection of incomplete fissures should be performed sealing the remaining lung surface; staplers can be employed [5] but up to now no real advantage has been reported in the literature [1]. The application of fibrin glue to the cut surface of the lung has not predictably prevented prolonged air leaks [10], even if theoretically and individually it may be useful [8,9]. Laser has also been proposed to control air leaks from raw surfaces of the lung [11], but in clinical practice it is not more effective than standard techniques [12]. Electrocautery has been reported to be as effective as laser in controlling the pulmonary parenchyma and it is easier to use and less expensive [1,12,13]. Ultrasonic dissection does not improve the control of distal airways or reduce the incidence of prolonged air leaks [14]. Some authors have suggested reinforcement of pulmonary closure with different materials when working with severely emphysematous lungs [15–17] and this technique has progressively gained acceptance with lung volume reduction surgery [17–19]. The use of bovine pericardial sleeves initially proposed by Cooper [17] and subsequently adopted by other authors has significantly contributed to reduce air leaks in this type of surgery; for this reason we postulated that it could also play a role during standard lobectomy, especially in older patients with emphysema and incomplete fissures. This technique has proved to be effective if compared to other ways of completing interlobar fissures, in particular in older patients (<70 years). Bovine pericardium is still expensive and costs should be addressed more carefully in the future, when they will be similar in all countries and a more liberal use of this material could contribute to a cost decrease; however, the costs are actually covered with the reduction of the postoperative hospitalization. On the basis of the positive initial experience with this technique of controlling peripheral air leaks during lobectomy, we consider the use of bovine pericardium useful when performing pulmonary resections in older patients with underlying diffuse lung disease and absence of interlobar fissures. It could also be helpful for segmentectomies and wedge resections. However, other inexpensive techniques, as the creation of a pleural tent, alone or associated with buttressing of the cut surface, should be investigated.

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References


