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Original Article

The effect of fibrin sealant spraying on prolonged air leak after pulmonary resections: a single center experience

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ABSTRACT

Background: The aim of this study is to evaluate the effects of fibrin sealant spraying on postoperative air leak in patients undergoing pulmonary resection for non-small cell lung cancer

Materials and Methods: Data of twenty-two patients who had undergone pulmonary resection (fibrin sealant group) were compared with a matched control cohort of nineteen patients (control group) retrospectively.

Results: Prolonged air leak was seen in fewer patients (n = 2; 10.5%) in fibrin sealant group compared to the control group (n = 4; 18.2%; p = 0.668). Apical chest tube removal time was also lower in fibrin sealant group (3 vs. 4 days; p= 0.01). Postoperative basal drain removal time, total chest tube drainage amount and intensive care unit stay time were similar between the groups (p = 0.945, p = 0.895 and p = 0.452, respectively).

Conclusions: Fibrin sealant application cannot replace an exact and precise surgical technique. However, they may be helpful particularly in small air leakages when the air leakage cannot be assured by routine surgical methods.

Key Words: air leak, lung resection, fibrin sealant

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Introduction

Postoperative air leakage is one of the most common pulmonary complication following pulmonary resections with a prevalence of greater than 15% [1, 2]. It may lead to longer chest tube duration, prolonged pain, increased risk of pneumonia and empyema, longer hospital stays and increased costs [3-5].

In recent years, a variety of surgical sealants such as fibrin sealants, collagen fleece-bound sealants, autologous blood patches and synthetic glues, have been introduced to shorten postoperative air leaks [2,4,6-9]. Fibrin sealants (Tisseel, Baxter Biosciences, Vienna, Austria) are biological sealants which can be safely used for hemostasis and tissue sealing [7,10]. In the present study, we aimed to evaluate the effects of fibrin sealant spraying on postoperative air leak in patients undergoing pulmonary resection for non-small cell lung cancer (NSCLC).

Materials and Methods

This retrospective study was carried out at the Department of Thoracic Surgery, Hacettepe University School of Medicine between May 2014 and December 2016. Data of twenty-two patients who had undergone elective pulmonary anatomic resection (fibrin sealant group) were compared with a matched control cohort of nineteen patients (control group). All patients were operated by the same surgeon. Only the patients who had undergone anatomic resections (lobectomy or segmentectomy) were included in the study. Patients' data were collected including the following variables: Sex, age, history of chronic obstructive pulmonary disease (COPD) and smoking, type of resection, histology, pathologic tumor stage, prolonged air leak, apical and basal chest tube removal time, amount of chest tube drainage, intensive care unit (ICU) and hospital stay. Prolonged air leak was defined as an air leak lasting beyond postoperative day 5. Baseline characteristics of the patients are shown in Table 1.

All resections were performed with open thoracotomy. Routine application of fibrin sealants in our clinic is as follows: (I) Following completion of the operation the thoracic cavity is installed with warm saline and the lung is insufflated with 25 cm water pressure to check the presence of air leak. (II) Fluid is evacuated from the chest cavity and the lung is collapsed. (III) Fibrin sealant, which is prepared according to the manufacturer's instructions, is sprayed over the entire areas of risk for air leaks. (IV) After three minutes the lung is ventilated, two drains are placed on underwater seal drainage without suction and the chest cavity is closed. In patients whom we do not use sealants, we routinely check air leaks with warm saline and control the leaks with polyprolene sutures. Following insertion of two drains, we close the chest cavity in the usual manner.

Table 1. Baseline characteristics.

Baseline variable	Fibrin sealant group	Control group	p
Age: years (SD)	53.7 (11.7)	59.9 (11.6)	0.195
Gender: n (%)			0.967
Male	15 (68%)	14 (73%)	
Female	7 (32%)	5 (27%)	
Smokers: n (%)	10 (45%)	8 (42%)	0.829
COPD: n (%)	8 (36%)	5 (26%)	0.724
Histology: n (%)			0.365
SCC	9 (40%)	9 (47%)	
Adeno Ca	11 (50%)	9 (47%)	
Large cell Ca	2 (10%)	1 (6%)	
Stage: n (%)			0.844
Stage I	12 (54%)	11 (57%)	
Stage II	10 (46%)	8 (43%)	

COPD: chronic obstructive pulmonary disease, SCC: squamous cell carcinoma

Statistical Analysis

Statistical analyses were carried out with IBM SPSS for Windows version 21.0 statistical software (IBM Co., Armonk, NY, USA). Categorical variables were compared using "chi-square test". Mann–Whitney U-test (non-normally distributed data) was used for evaluating the significance of differences between group means or medians, as appropriate. The significance of any proportional differences in attributes was evaluated using the Fisher's Exact Test. A p value < 0.05 was considered statistically significant.

Results

Prolonged air leak was detected in two patients (10.5%) who received fibrin sealant compared to 4 patients (18.2%) in the control group ($p = 0.668$). The median duration of apical chest tube removal time for patients receiving fibrin sealant was 3 days (range 2 to 6 days) compared with 4 days (range 2 to 14 days) for the control group ($p = 0.01$). Air leak duration time was statistically lower in the fibrin sealant group (mean 0.6 ± 1.6 vs. 1.2 ± 2.2 days; $p = 0.05$). Postoperative basal drain removal time, total chest tube drainage amount and intensive care unit stay time were similar between the groups ($p = 0.945$, $p = 0.895$ and $p = 0.452$, respectively). Comparison of the two groups is shown in Table 2.

Table 2. Comparison of the groups.

	Fibrin sealant group	Control group	p
Prolonged air leak: n (%)	2 (10.5)	4 (18.2)	0.668
Apical tube removal time (day)	3 (2-6)	4 (2-14)	0.01
Basal tube removal time (day)	4 (2-12)	4 (2-16)	0.945
Air leak (day)	0.6 ± 1.6	1.2 ± 2.2	0.05
Chest tube drainage (ml)	200 (70-570)	200 (50-450)	0.895
ICU stay (day)	1 (1-2)	1 (1-3)	0.452

ICU: Intensive care unit

Discussion

Post-operative air leak is a major cause of morbidity after lung resections. Many research studies were conducted in order to find possible methods to avoid or reduce this complication [13-15]. This complication leads to an increased risk for development of pneumothorax, bronchopleural fistulae, infections and, consequently, a prolonged hospital stay and higher healthcare costs. Although advances in surgical techniques, including the use of stapling devices, have reduced the incidence of this complication, it is still threatening thoracic surgeons [8].

In order to overcome this complication various natural and synthetic materials have been utilized including fibrin sealants, collagen fleece, and synthetic glues, with conflicting results. Nearly all of these studies represent a heterogeneous group of trials with a variety of products [16-18]. An overall review of these trials concluded that systematic use of these products were not recommended, as only one trial demonstrated a reduction in the duration or incidence of prolonged air leak [13].

Fibrin sealants are readily available biological sealants which can be safely used for hemostasis, tissue sealing and engineering [10, 19]. Besides, it is a biodegradable product that may stimulate fibroblast growth, and thus decrease the number of adhesions [20]. Studies pointing up the use of fibrin sealant to control pulmonary air leakage are also controversial. Although most surgical groups have reported beneficial effects, some others have failed to demonstrate such concrete results [21-23]. To sum up, according to the literature fibrin sealants may be advantageous in reducing small pulmonary air leakages when properly applied with a spray system to a dry lung surface (with no bleeding or air leakage) [24,25]. The application method of fibrin sealant is also important. When fibrin sealant sprayed directly on to the lung surface, fibrinogen, which is found in the lung parenchyma, is converted to fibrin and enhances the sealing efficacy [25].

In this study, we aimed to examine the effects of fibrin sealant spraying on postoperative air leak in patients undergoing pulmonary resection for non-small cell lung cancer (NSCLC). Our results showed that fibrin sealant is not beneficial in terms of prolonged air leak, basal tube removal time, chest tube drainage and ICU stay time. However, in this study, apical tube removal time and air leak duration were lower in the sealant group. Although fibrin sealant application seems beneficial according to the lower air leak duration in that group, we were unable to support its efficacy with other parameters. We believe that this conflict may be due to the limited number of cases and the retrospective review of the data in a single institution.

In conclusion, we believe that fibrin sealant application cannot replace an exact and precise surgical technique. However, they may be helpful in small air leakages when the air leakage cannot be assured by routine surgical methods such as careful suturing, stapling, electrocautery and so forth.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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