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Basic interrupted versus continuous suturing techniques in bronchial anastomosis following sleeve lobectomy in dogs☆

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Abstract

Objective: Sleeve resection with or without lung resection is a valid conservative operation for patients with benign or malignant tumors; it enables the preservation of lung parenchyma. The aim of this prospective randomized study was to compare complications, operating time, and bronchial healing between the techniques of interrupted and continuous suturing for bronchial anastomosis in dogs. **Methods:** Twenty adult mongrel dogs each weighing 18—22 kg (average: 20 kg) were divided into two groups according to the anastomosis technique performed: group A, interrupted suturing and group B, continuous suturing. Each group comprised of 10 dogs. Following right thoracotomy, sleeve resection of the right cranial lobe was performed in all dogs. Basic interrupted sutures using 4/0 Vicryl (Ethicon, USA) were used in group A, and continuous sutures were used in group B. **Results:** The median anastomosis time was 15.2 min (range: 13—21 min) in group A and 9.6 min (range: 8—13 min) in group B. In all dogs, the anastomosis line was resected via right pneumonectomy for histopathological investigation 1 month after sleeve resection. Histopathological examination revealed that the healing of the anastomosis was not affected by the suturing technique applied. One dog from each group died on the fourth postoperative day; Fisher's exact test, $p = 0.763$. **Conclusions:** Our research revealed that the healing of the anastomosis was not affected by the suturing technique performed.

Keywords: Sleeve resection; Continuous suturing technique; Interrupted suturing technique

1. Introduction

Sleeve resection with or without lung resection is a valid conservative operation for patients with benign or malignant tumors; it enables the preservation of lung parenchyma. The mortality and morbidity rates of sleeve resection ranged from 1.3% to 7.7% and from 2.5% to 11%, respectively [1]. Sleeve lobectomy has become a routine procedure in thoracic surgery, and achieves the same long-term results as pneumonectomy. Each major part of the lung should be considered vital for lung function; therefore, the thoracic surgeon should aim to preserve as much functioning lung tissue as possible and perform bronchoplastic and angioplastic procedures whenever possible regardless of the lung function [2]. The most popular method for the anastomosis of sleeve resection is the single interrupted suturing technique performed using different material such as Vicryl or polydioxanone (PDS) (Ethicon, USA). Although interrupted suturing for anastomosis is widely applied, continuous suturing has recently been reported [1]. In this report, we prospectively compared the results of the continuous and interrupted suturing techniques for anastomosis following sleeve resection in dogs.

2. Materials

Since the bronchial anatomy of dogs resembles that of humans, 20 mongrel dogs were included in this study after obtaining approval from the ethical committee (reference: 14.12.2004/3). The median weight of the dogs was 20 kg (range: 18—22 kg). The dogs were divided into two groups according to the anastomosis technique applied: group A, interrupted suturing and group B, continuous suturing. Ten dogs were operated in each group.

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3. Methods

General anesthesia (xylazine HCL, pentothal sodium, and 2% isoflurane) was induced and intratracheal intubation was performed in all dogs. Pulse oximetry and capnography were used to monitor O_2 saturation and CO_2 pressure, respectively.

A right thoracotomy via the fourth intercostal space was performed in all dogs. First, the artery, and second the vein of the right upper cranial lobe were ligated, and the lobe was resected with an approximately 1 cm sleeve segment of the right main bronchus (Fig. 1). Anastomosis in group A was achieved with the interrupted suturing technique using ten 4/0 Vicryl sutures commencing from the posterior part of the bronchus. The sutures were tied in an anterior to posterior fashion. Continuous suturing was achieved in group B using three 4/0 Vicryl sutures. The first suture was used to approximate the membranous portion of the bronchus that was tied to the second and third sutures on both sides of the bronchus where the cartilaginous portion began. The second and third sutures were continuous and tied at the anterior part of the anastomosis. The sutures were tightened using hooks. The chest cavity was filled with water, and the anastomosis was examined at 40 mmH_2O pressure.

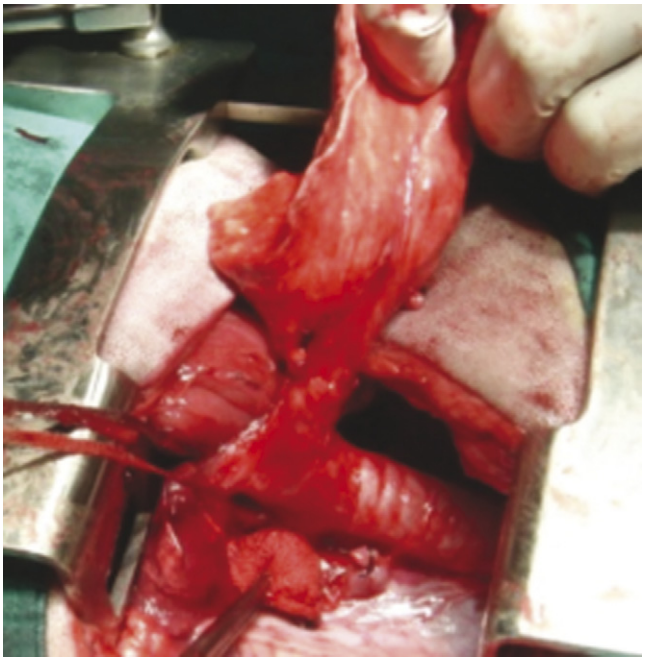

Fig. 1. Right upper cranial lobe.

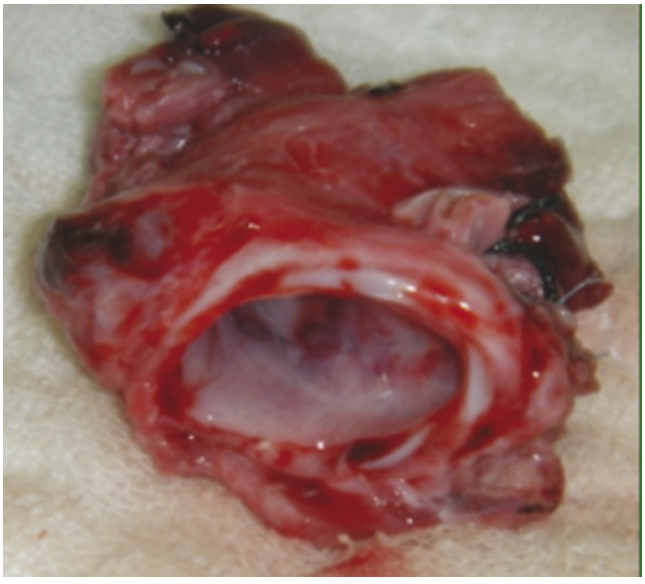

Fig. 2. Resected bronchus for histopathological examination.

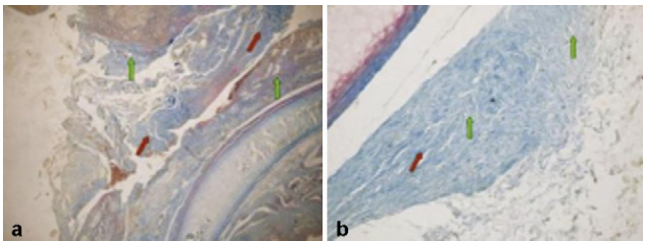

Fig. 3. (a) Histopathological image of the interrupted suture technique. (b) Histopathological image of the continuous suture technique (red arrow, connective tissue formation; green arrow, neovascularization at histopathological examination). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

The dogs were followed-up for 1 month in order to ensure complete healing. On the 30th day after recovery, the dogs were operated on again, and the anastomosis was resected via a right pneumonectomy (Fig. 2). The resected anastomosis was sent for histopathological examination. Connective tissue formation, neovascularization, and colonization of inflammatory cells were analyzed at the histopathological examination.

4. Results

On the fourth postoperative day, one dog from each group died due to respiratory failure. An autopsy was performed, and minimal dehiscence was observed in both dogs, which was accepted as a technical problem.

Histopathological examination of the anastomosis line in all samples revealed migrated inflammatory cells and the formation of connective tissue as well as neovascularization (Fig. 3a and b). In all dogs, satisfactory healing of the anastomosis was observed regardless of the technique applied. No difference was observed between the two groups with regard to the histopathological examination.

5. Discussion

Bronchial sleeve resection was originally designed for patients with compromised lung function who were unable to tolerate pneumonectomy. In the treatment of lung cancer, sleeve resection has now emerged as a routine procedure since the results obtained with this technique have equaled those of pneumonectomy. The preservation of functioning lung tissue improves postoperative life quality, reduces serious postoperative complications, and even allows a

second surgical intervention in the case of local recurrence of lung cancer in selected cases [2].

In April 1933, Graham and Singer reported the first successful one-stage pneumonectomy for lung cancer. After this successful operation, pneumonectomy became the standard treatment for lung cancer for the next two decades [3]. The first reported bronchial sleeve resection was performed in 1947 at the Brompton Hospital in London, England, by Sir Clement Price Thomas [3—7]. This technique involving the resection of a circumferential portion of the main bronchus was designed to conserve as much pulmonary tissue as possible, provided that the patient's expectation of prolonged survival was not altered [3]. In 1954, Allison performed the first sleeve lobectomy for bronchogenic carcinoma [7].

Recent reports have suggested that compared with pneumonectomy, sleeve lobectomy improves the quality of life and long-term survival, regardless of the underlying pulmonary function. Right upper sleeve lobectomy is the most frequently performed bronchoplastic procedure (average frequency: 70%), and right pneumonectomy is the most high-risk procedure [4,8,9]. In a study conducted by Okada et al., surgery-related mortality was significantly lower after sleeve lobectomy (1.6%) than after pneumonectomy (5.3%), indicating that bronchoplasty is a safer procedure than pneumonectomy [10].

Bronchoplastic procedures have been determined to be appropriate for 5—8% of patients with non-small cell lung cancer (NSCLC); in some series, they constitute as high as 19% of the procedures performed, although sleeve lobectomy constitutes approximately 4% of the lung resections performed for NSCLC [7,8]. In a collective review of 1915 bronchoplastic procedures performed in patients with NSCLC, it was found that sleeve lobectomy was accompanied by morbidity and mortality rates similar to those observed in pneumonectomy, but it was associated with better preservation of lung function [11].

In sleeve resection, the complication and mortality rates range between 2.5% and 11% and between 1.3% and 7.7%, respectively [1,10]. The most serious complication is the dehiscence of anastomosis in the early postoperative period; in addition, bronchovascular fistula (1.7—2.5%), bronchial stenosis (1.7—6%), suture granuloma, respiratory failure, atelectasis, pneumonia, and pneumothorax can also be observed [10,12,13].

Although single interrupted suturing, the most popular technique for anastomosis, is widely employed, running sutures have also been reported recently [1]. The other technique involves closing the cartilaginous portion of the bronchus with a running suture, and the closure of the membranous portion with interrupted sutures. Interrupted sutures of the membranous portion are preferred because they allow the adaptation of bronchial ends with different diameters by adjusting the stitches [2]. The safety of the continuous suturing technique has been demonstrated by Kutlu and Goldstraw in 100 cases using 3/0 propylene sutures with 2% anastomosis insufficiency and 5% late stenosis [1]. Hsieh et al. performed interrupted and continuous suturing with absorbable and non-absorbable sutures, and found that the best results were obtained using absorbable suture material regardless of the technique used [14]. We used 4/0 absorbable multifilament material (Vicryl, Ethicon, USA) in dogs; however, monofilament material that can be both pulled and stretched can also be used. The hook is an important instrument for pulling and stretching both types of materials.

In conclusion, our research suggests that the results of the continuous suture technique are comparable with those of a series that used the interrupted suturing technique for bronchial sleeve resections. Although the histopathological examination revealed similar results for both suturing techniques, continuous suturing is simpler, faster, and more economical compared to interrupted suturing.

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