



Continuous Submucosal Suture for the Pharyngeal Closure after Total Laryngectomy

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Abstract

Introduction: Pharyngocutaneous Fistula (PCF) is the most common and severe complication following Total Laryngectomy (TL). Since 2013, we have been adopting the continuous submucosal suturing method for pharyngeal closure after TL. This paper throws a light on the surgical techniques, which are employed for pharyngeal closure following TL, the risk factors associated with PCF, and the effectiveness of continuous submucosal suturing for pharyngeal closure after TL.

Materials and Methods: A retrospective review of the patients undergoing continuous submucosal sutures for the pharyngeal closure following TL was performed. The study included 40 patients who underwent TL at the Kindai University Hospital between January 2013 and July 2019.

Results: PCF developed in 3 (7.5%) patients. PCF was closed in 2 patients by using conservative treatment and by using a local flap in 1 patient. The oral intake was started at an average of about 12.8 days (range: 9 to 18 days) after surgery in patients without fistula and at an average of 111.3 days (range: 55 to 180 days) in patients with PCF.

Conclusion: Continuous submucosal suturing method is simple and easy to learn and facilitates the reduction of the possibility of occurrence of PCF when compared to other suturing methods. It is likely to become a preferred suturing method by surgeons for pharyngeal closure after TL.

Keywords: Total laryngectomy; Pharyngocutaneous Fistula (PCF); Continuous submucosal sutures

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Introduction

Pharyngocutaneous Fistula (PCF) is the most common and severe complication following Total Laryngectomy (TL). A PCF is associated with increased morbidity and other severe life-threatening complications. It has been reported that the occurrence of PCF ranges between 2 and 35% of all cases, and several risk factors are associated with it, including prior tracheostomy, lower hemoglobin level, concomitant disease, previous radiotherapy, and positive surgical margins, which lead to the development of PCF [1]. However, no clear evidence is available with respect to the relationship between the type of suture for pharyngeal closure and PCF. Since 2013, we have been adopting the continuous submucosal suturing method for pharyngeal closure after TL. Therefore, this paper throws a light on the surgical techniques, which are employed for pharyngeal closure following TL, the risk factors associated with PCF, and the effectiveness of continuous submucosal suturing for pharyngeal closure after TL.

Materials and Methods

This study was approved by the Institutional Review Board of Kinki University Hospital (No. 31-098). Keeping in mind, the aims of the study, a retrospective review of the patients undergoing continuous submucosal sutures for the pharyngeal closure following TL was performed. The study included 40 patients who underwent TL at the Kindai University Hospital between January 2013 and July 2019. They were diagnosed for laryngeal cancer, hypopharyngeal cancer, thyroid cancer, and severe dysphagia with aspiration pneumonia in 35, 3, 1, and 1 patient, respectively. In addition, 28/35 (80%) of the patients with laryngeal cancer received primary total laryngectomy as the initial treatment and 7/35 (20%) received salvage total laryngectomy after Radiotherapy alone (RT), Chemoradiotherapy (CRT), and Bioradiotherapy (BRT). All 3 patients diagnosed with hypopharyngeal cancer received TL and partial pharyngectomy as an initial treatment, while 2 of them had previously undergone RT for some other diseases. The medical records of patients

Table 1: Risk Factors of PCF.

| Factor | Fistula | | Total | P value |
|---------------------------|---------|-----|-------|---------|
| | no | yes | | |
| DM | | | | p=0.178 |
| no | 28 | 1 | 29 | |
| yes | 9 | 2 | 11 | |
| irradiation history | | | | P=0.332 |
| no | 25 | 3 | 28 | |
| yes | 12 | 0 | 12 | |
| preoperative tracheostomy | | | | P=0.462 |
| no | 20 | 1 | 21 | |
| yes | 17 | 2 | 19 | |
| neck dissection | | | | P=0.179 |
| no | 17 | 0 | 17 | |
| yes | 20 | 3 | 23 | |
| thyroidectomy | | | | P=0.370 |
| no | 11 | 0 | 11 | |
| yes | 26 | 3 | 29 | |

were reviewed for studying the development of PCF. Each PCF was examined using hypopharyngeal fluoroscopy and computed tomography after the fluoroscopy at about 2 weeks after the diagnosis of TL. Oral feeding was initiated after confirming no PCF. The process of continuous submucosal suture for pharyngeal closure after TL has been described. First, the lower portion of the defect was sutured with 4-0 Polydioxanone (PDS). The needle was made to enter the fascia at approximately 5 mm lateral to the margin of the mucosal membrane and on the outer side without perforating the mucosa. The needles entered the submucosal layer on the opposite side and outer to the fascia, about 5 mm lateral to the margin of the mucosal membrane. The width of the suture was about 10 mm. The suture is performed continuously in the vertical direction and it proceeds in the left direction of the horizontal line of the T-shaped suture. After reaching the end of the horizontal line of the T-shaped suture, it returns to the original line with a double layer. Further suture proceeds horizontal line on the opposite side continuously. After suturing with a double layer on the right side and reaching 3 points junctions of the T-shaped suture, the suture of the vertical line of the T-shaped suture is performed continuously. Finally, the continuous

Table 2: Rate of PCF in TL.

| Source | Year | Number of cases | Rate of PCF (%) | Pharyngeal Closure technique | Type of manual suture method |
|----------------------------|------|-----------------|-----------------|------------------------------|------------------------------|
| Akduman D, et al. [7] | 2008 | 53 | 35.9 (19) | Manual | Gambee |
| Gonçalves AJ, et al. [15] | 2009 | 30 | 36.7 (11) | Manual | N/A |
| Aires FT, et al. [11] | 2014 | 275 | 22.9 (63) | Manual | N/A |
| Haksever M [9] | 2015 | 31 | 3.2 (1) | Manual | Modified Connell |
| Öztürk K, et al. [13] | 2019 | 20 | 35 (7) | Manual | N/A |
| Sansa-Perna A, et al. [16] | 2020 | 80 | 16.3 (13) | Manual | N/A |
| Avci H, et al. [10] | 2020 | 31 | 16.1 (5) | Manual | Modified Connell |
| Avci H, et al [10] | 2020 | 38 | 39.5 (15) | Manual | Albert |
| Aires FT, et al. [11] | 2014 | 149 | 8.7 (13) | mechanical | |
| Allegra FT, et al. [12] | 2019 | 33 | 9.1 (3) | mechanical | |
| Öztürk K, et al. [13] | 2019 | 21 | 14.3 (3) | mechanical | |
| This study | 2020 | 40 | 7.5 (3) | Manual | Continuous submucosal suture |

suture goes back to the beginning point and the thread is ligated to finish. In other words, the pharyngeal defect was closed by double layers using a single thread. The following are some important points that were ensured during continuous stitching: (1) No suturing was performed on the mucosal surface, (2) local ischemia as a result of suturing was prevented, and (3) any dead space was eliminated. In addition, (1) caution was taken to move the needle carefully with appropriate tension, (2) a 10-mm distance was maintained between the stitches, and (3) the drainage was maintained with a negative pressure drain. The neck dissection was performed by taking care of the affected side, the extent of spread of the primary tumor, and the lymph node metastasis, while considering the general condition of the patients. Clinical data was collected from the patients' medical records, including the blood values (i.e., preoperative serum albumin and postoperative serum hemoglobin level), history of diabetes, previous radiotherapy of the neck, preoperative tracheostomy, and neck dissection and/or thyroidectomy accompanied with TL. TNM Classification (UICC; 8th edition) was followed for the correction of the preoperative staging. Data was analyzed by using the Statistical Package for Social Sciences (SPSS; version 25) software (IBM, NY, USA). Multivariate analysis was used to determine the association between the study groups. $P < 0.05$ was considered statistically significant.

Results

PCF developed in 3 (75%) patients. The history of diabetes, previous irradiation history of the neck, preoperative tracheostomy and neck dissection or thyroidectomy with TL were examined as risk factors for pharyngeal cutaneous fistula (Table 1). No significant differences were noted in the preoperative serum albumin level ($p=0.550$) and the preoperative serum hemoglobin level ($p=0.840$) between the patients with PCF and without PCF. No PCF was found in 10 patients with a previous history of radiotherapy. PCF was closed in 2 patients by using conservative treatment and by using a local flap in 1 patient. The oral intake was started at an average of about 12.8 days (range: 9 to 18 days) after surgery in patients without fistula and at an average of 111.3 days (range: 55 to 180 days) in patients with PCF.

Discussion

PCF after TL is a serious complication that can lead to a long time period of tube feeding and hospital stay and lowers the patient's

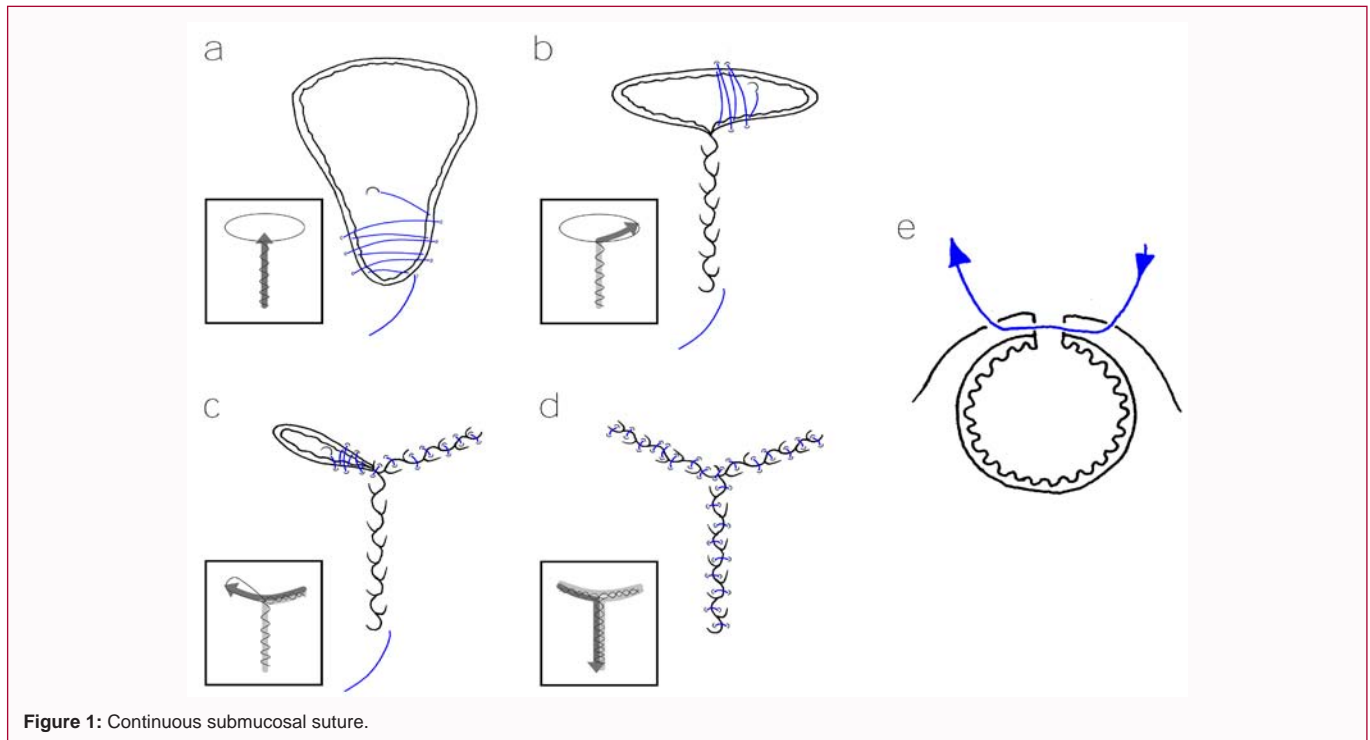


Figure 1: Continuous submucosal suture.

Table 3: Clinical features of 3 cases with PCF.

| Case | Age/Sex | Disease | Site | TNM | Previous RT | Preoperative tracheostomy | DM | Type of surgery |
|------|---------|---------------------|-----------------------|---------|-------------|---------------------------|-----|---------------------|
| 1 | 77/F | Thyroid carcinoma | Metastatic lymph node | rT01bM0 | no | no | yes | TL+bil. ND+Complete |
| 2 | 69/M | Laryngeal carcinoma | Glottis | T3N0M0 | no | yes | no | TL+bil. ND+Total TD |
| 3 | 72/M | Laryngeal carcinoma | Supraglottis | T4aN0M0 | no | yes | yes | TL+bil. ND+Total TD |

RT: Radiotherapy; DM: Diabetes; TD: thyroidectomy

postoperative quality of life. It has been reported that the occurrence of PCF ranges from 2 to 35% in all cases [1]. Our study recorded the occurrence of PCF in 7.5% of all cases, which conform to the reports of previously conducted studies (Table 2). Several studies have investigated the risk factors associated with PCF. Some of the risk factors that have been reported are a decrease in the postoperative hemoglobin level to <12.5 g/dL, preoperative tracheostomy, previous radiotherapy, and concurrent neck dissection [2,3]. None of the patients with PCF had previously undergone radiotherapy, and no other risk factors associated with PCF were identified in the study (Table 1). An essential surgical technique employed by the head and neck surgeons is the pharyngeal suture after TL. Some types of suture methods have been reported in the past such as Connell stitch, Lembert stitch, Albert stitch, and Gambee stitch [4-7]. The technique of continuous submucosal suture has been passed down since 2013 at our institution. A few reports have suggested continuous submucosal suture for the pharyngeal closure after TL. In 1887, Halsted pointed out the importance of the submucosal layer for gastrointestinal anastomosis and introduced a single-layer inverted suture, including the submucosal layer [8]. Therefore, continuous submucosal suture is a preferred suture at the point of anastomosis in the submucosal layer. There were a few reports available on studies dealing with the association between the type of manual suture and the incidence of occurrence of PCF. Haksever et al. reported that the rate of PCF with modified continuous Connell suture was 3.2%, while that with the Gambee-type stitch was 35.9% [7,9]. Moreover, in the report comparing modified continuous Connell suture with interrupted

submucosal suture, PCF was 16% and 39%, respectively [10]. Surgical technique has emerged as one of the more important factors that have led to the development of PCF, despite the lack of clarity on the optimal method that can be used for pharyngeal closure in order to prevent the occurrence of PCF. However, some reports on mechanical suture have been available recently. Aires reported that the incidence of PCF in stapler-assisted pharyngeal suture was 8.7%, whereas that in manual pharyngeal suture was 22.9% [11]. Other investigators also reported the occurrence of PCF in stapler-assisted pharyngeal suture to be 9.1% to 14.3% (Table 2) [12,13]. These results suggested that the occurrence of PCF can vary depending upon the suturing method. In other words, the stitching technique by surgeons should receive greater consideration, as compared to the medical background and condition of the patients. It has been reported that the surgeon's ability plays an important role in the formation of PCF [9,10,14]. PCF was found in 3 patients (Table 3). If the broader areas of the pharyngeal mucosa are to be resected, which may increase the risk of insufficient suturing due to excessive tension and poor blood supply in the residual mucosa. In fact, additional resection of the pharyngeal mucosa results in defects in wider areas of the pharyngeal mucosa, as reported for case 1 and 3. In case 1, the excision range was from the outside of the pyriform sinus partly to the lateral and anterior oropharyngeal walls because of the invasion of the metastatic lymph nodes in the submucosa of the lateral wall of the pharynx. In case 3, the lesion spread from supraglottis to the left hypopharynx, and, as a result, the excision became wide, extending from the medial wall of the pyriform sinus partly up to the posterior wall. When the pharyngeal

defect becomes too large, it is better to close the pharyngeal mucosa without tension, followed by reconstruction by free vascularized flap or a pedicled flap. Interestingly, all 3 patients with PCF underwent total thyroidectomy. During total thyroidectomy, the superior and inferior thyroid arteries on both the sides were resected. As blood in the cervical esophagus and hypopharyngeal mucosa were supplied by inferior thyroid arteries, and insufficient blood supply to the pharyngeal mucosa may cause PCF. The study has the following limitations: It is retrospective in nature and includes a small number of cases and a heterogeneous cohort, albeit it is likely to lead to important conclusions with regard to the relative significance of risk factors associated with PCF and the optimal surgical techniques for the closure of pharyngeal mucosa.

Conclusion

Continuous submucosal suturing method is simple and easy to learn and facilitates the reduction of the possibility of occurrence of PCF when compared to other suturing methods. It is likely to become a preferred suturing method by surgeons for pharyngeal closure after TL.

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