SMJ- Sohag Medical Journal, Vol. 28 No(3) 2024

Print ISSN1687-8353 Online ISSN2682-4159

Original Article

Pectoralis Major Myocutaneous Flap in Reconstruction after Salvage Laryngectomy

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Abstract

Background:
Pharyngocutaneous fistula (PCF) is a major complication post salvage total laryngectomy (STL), mostly secondary to the effect of radiotherapy (RT) on tissue healing. It usually leads to other complications such as bleeding, wound infection, and wound dehiscence.

Aims/Objective:
This study aims to evaluate the outcomes of PMMF reconstruction post-STL in patients with recurrent tumours following primary treatment by CRT with a detailed analysis of all complications and causes of death.

Materials and methods:
A retrospective study involved 29 patients operated in the National Cancer Institute, Cairo, Egypt in the period between January 2015 and December 2021 by STL and reconstruction by PMMF for recurrent tumours post primary treatment by radio(chemo)therapy.

Results:
Our study included 29 patients; mean age was 54.8±10.24 years. All patients were males. All patients were operated by STL and reconstructed by PMMF, 16 (55.2%) patients complicated by pharyngocutaneous fistulae, mortality rate was high (62.1%).

Conclusion:
Recommendations for routine use of PMMF in salvage settings should be reevaluated and reconsidered. Regarding lowering the incidence of PCF, the PMMF has no objectively beneficial effect. However, it promotes faster healing of minor fistulas, and prevents larger fistula formation. Appropriate postoperative care and improvement of the

Key Words: Salvage Laryngectomy, Pectoralis Major Muscle Flap, Pharyngocutaneous Fistula, Laryngeal cancer
DOI : 10.21608/smj.2024.319541.1494 **Received:** September 09, 202 **Accepted:** September 10, 2024
Published: September 30, 2024
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Citation: Mahmoud Abdelghany. et al., Pectoralis Major Myocutaneous Flap in Reconstruction after Salvage Laryngectomy SMJ,2024 Vol. 28 No(3) 2024: 5- 12

Introduction:

Primary total laryngectomy with or without adjuvant therapy has been proven to be an effective strategy in the management of laryngeal cancer .(1) However, in the second half of the 20th century, the strategy had undergone significant changes with the development of larynx organ preservation (LOP) protocols using primary radio (chemo)therapy (aiming for cure) for the management of patients with locally advanced laryngeal cancer (stage I to IVa). This led to a high rate of organ preservation up to 64-80% and overall survival rates comparable to those seen in patients offered total laryngectomy. Nowadays, LOP protocols are considered the standard treatment for early cases of laryngeal cancer .(2,3)

Despite the effectiveness of chemoradiotherapy (CRT) in the eradication of the tumours and preservation of the laryngeal function, there is a considerable number of patients still require salvage total laryngectomy (STL) for recurrent tumours, residual tumours, laryngeal dysfunction, or radionecrosis .(2,4)

Radiotherapy (RT) not only kills tumour cells but also damages the surrounding normal tissues in the form of fibrosis, obliterative endarteritis, intimal thickening, proteoglycan deposition, and inflammatory cell infiltration in medium-sized arteries .(5) This impairs tissue's ability to heal which leads to a high incidence of complications after STL especially pharyngocutaneous fistulas (PCF) which is the most common complication (5-75%). (6,7,8,9,10, 11, 12) Other suspected causes for PCF were salvage surgery within the first-year post-RT, concurrent neck dissection, low hemoglobin level, low albumin level, advanced malignancies, supraglottic tumours, or positive surgical margins. (1,2,13,14,15)

Long hospital admissions, an increase in morbidity, and a delay in starting oral feeding are all consequences of pharyngocutaneous fistula.(2, 16) Non-irradiated tissues are used to reinforce the neopharynx to avoid these consequences. These healthy tissues have abundant vascularity which improves wound healing and prevents wound complications. (17, 18) These tissues range from loco-regional flaps such as pectoralis major muscle flap (PMMF) to free microvascular flaps. (11, 19)PMMF is preferred as it is accessible, easy to be harvested, takes less operative time, doesn't need special surgeon experience, the donor site is near to the neck, consistent anatomy, rich vascular supply, less need to intensive care unit admission, less need to flap monitoring, wide rotational capacity, and can be harvested at the same supine position of laryngectomy operation. (13, 20, 21, 22)

Pectoralis major muscle flap has some morbidities related to the donor site such as shoulder dysfunction, scar at the chest wall, bulkiness at the lower lateral neck, breast distortion in females, and flap contraction when denervation is not feasible. (11, 23, 24, 25).

The pectoralis major muscle flap can be classified as either myocutaneous or myofascial based on the existence or lack of a skin paddle. The myofascial flap is superior to the myocutaneous flap because it requires less time and prevents possible problems with blood supply at the myocutaneous flap. (8, 26)

Microvascular-free flaps are not preferred as they need special surgeon experience, special instruments, and special postoperative flap monitoring. Also, the operation is lengthy. (1,9)

Despite the use of PMMF in reconstruction, few cases present with complications such as PCF, bleeding, wound dehiscence, flap necrosis, and donor site morbidity. (2, 27)

This study aims to evaluate the outcomes of PMMF reconstruction post-STL in patients with recurrent tumours following primary treatment by CRT with a detailed analysis of all complications and causes of death.

Patients And Methods

This is a retrospective observational study for patients operated by STL and reconstructed by PMMF (myofascial or myocutaneous) for recurrent tumours post-radio(chemo)therapy at the surgical oncology department, National Cancer Institute (NCI), Cairo, Egypt, in a period of 7 years from January 2015 to December 2021. This work was performed after approval of the ethical committee of our institution.

The following data were extracted from each patient's medical record. age, sex, diabetes history, smoking history, and prior RT or CRT. Site, stage, pathological type, and grade of the recurrent tumours were recorded. All operative details were revised including type of neck dissection (if needed), type of thyroidectomy (if needed), and type of PMMF. The pathology results were recorded with special concern on the pathological tumour details (site, stage, pathological type, grade, and

margins of the tumour), thyroid gland infiltration, and lymph node metastasis. All postoperative routine laboratory investigations were revised. All early (like PCF, bleeding, wound infection, or wound dehiscence, etc.) and late (like recurrent tumour, swallowing problems, or speech problems) postoperative complications were analysed. Overall survival and mortality rate were also recorded.

Surgical Technique

A routine total laryngectomy was performed with only cold, sharp instruments (e.g. scalpel, Metzenbaum scissors) were used for pharyngeal incision (limited use of the diathermy). If tracheostomy was performed before the operation, the skin around the tracheostomy opening was excised with the tumour.

In patients with N0 cervical lymph nodes, a jugular type (II-IV) neck dissection was performed according to the intraoperative surgeon's decision. In patients with N+ lymph nodes, a modified radical (I-V) neck dissection was performed. The neck dissection was either unilateral or bilateral according to the tumour site.

If the thyroid gland was infiltrated by the tumour or in patients with subglottic tumour extension, total or hemithyroidectomy was performed according to the tumour site.

The PMMF was harvested from the side contralateral to the dominant hand. The choice of the type of the flap was based on the intraoperative circumstances. If there were sufficient mucosa to close the neopharynx primarily without suture tension, an onlay myofascial flap over the primarily closed neopharynx was used which was stitched to the tongue base superiorly and in both sides to the pre-vertebral fascia medial to the carotid sheath.

If the remaining mucosa was insufficient and the neopharynx couldn't be closed primarily, a myocutaneous flap was performed with the skin paddle of the flap was used as a patch to complete the circumference of the neopharynx.

Postoperative feeding by nasogastric (NG) tube was started on the first postoperative day. On the eighth postoperative day, if there were no signs of PCF, oral fluids were allowed, and on the following day, the NG tube and the neck drains were removed. If there were signs of PCF, the NG tube was left for feeding.

Statistical Analysis

Data were collected, recorded, revised, and entered into the Statistical Package for Social Science (IBM SPSS) version 20. The chi-square test was used in the comparison between two groups with qualitative data. An Independent t-test was used in the comparison between two groups with quantitative data. Disease-free survival and overall survival rates were calculated using survival analysis. Cox regression analysis was used to find factors affecting survival. The p-value < 0.05 was considered significant.

Results

This research included 29 patients. Mean age was 54.8±10.24 (range 30-71) years. All patients were men, 28 (96.6%) patients were smokers, 7 (24.1%) patients were diabetics. Eleven (37.9%) patients were treated by RT alone, 14 (48.3%) patients were treated with concomitant CRT, and 4 (13.8%) patients were treated by induction chemotherapy followed by concomitant CRT.

All patients presented with recurrent tumours; all details of the recurrent tumours were summarized in table 1.

Table 1: Details of the recurrent tumours.

	Number (%)
Site	
Glottis and supraglottis	11 (37.9)
Glottis	7 (24.1)
Glottis and subglottis	7 (24.1)
Supraglottis	4 (13.9)
TNM classification	
T 2	3 (10.3)
T 3	16 (55.2)
T 4	10 (34.5)
N 0	25 (86.2)
N 1	4 (13.8)
Pathological type	
Squamous cell carcinoma	28 (96.6)
Adenocarcinoma	1 (3.4)
Grade	
I	4 (13.8)
II	25 (86.2)
Total number of patients	29

All patients have undergone STL and the duration between the end of LOP protocol and surgery was less than 1 year in 18 (62.1%) patients. All patients were operated upon by STL which was associated with partial pharyngectomy in 17 (58.6%) patients. Neck dissection was performed in 23 (79.3%) patients, it was bilateral in 21 (72.4%) patients, and jugular type in 19 (65.5%) patients. Thyroidectomy was performed in 12 (41.4%) patients, 8 (27.6%) cases underwent hemithyroidectomy. Seventeen (58.6%) patients were reconstructed by myocutaneous flap while the remainning 12 (41.4%) were reconstructed by a myofascial flap. All patients tolerated the procedure well with no intraoperative morbidity or mortality. Postoperative albumin level was <3 g/L in 8 (27.6%) patients. Postoperative pathological details of the tumour are summarized in table 2.

Table 2: Postoperative pathology.

	Number (%)
Site	
Glottis and supraglottis	11 (37.9)
Trans glottis	8 (27.6)
Glottis and subglottis	5 (17.3)
Glottis	4 (13.8)
Supraglottis	1 (3.4)
Pathological TNM stage	
T 0	1 (3.4)
T 3	9 (31.1)
T 4	19 (65.5)
N 0	16 (55.2)
N 1	7 (24.1)
Pathological type	
Squamous cell carcinoma	28 (96.6)
Adenocarcinoma	1 (3.4)
Grade	
I	1 (3.4)
II	26 (89.7)
III	2 (6.9)
Margins	
R1	6 (21.6)
R0	23 (78.4)
Total number of patients	29

All early (PCF, bleeding, or wound dehiscence) and late (recurrent tumour, swallowing problems, or speech problems) postoperative complications were analysed (Table 3).

Table 3: Postoperative complications.

	Number (%)
Early postoperative complications	
PCF	16 (55.2)
Carotid blowout	5 (17.2)
Venous blowout	1 (3.4)
Wound dehiscence	3 (10.3)
Late postoperative complications	
Recurrent malignancy	7 (24.1)
Dysphagia required dilatation	5 (17.2)

Pharyngocutaneous fistula was the most common complication (Fig. 1). It occurred in 16 (55.2%) patients, in the early postoperative period (mean - 8.55±3.22 days). It was either small in size in 7 (24.1%) patients, medium in 5 (17.2%) patients, and large in 4 (13.8%) patients.

Seven (24.1%) patients were managed conservatively by drainage of collections, small dressing bandage pressed over the fistula site, feeding by nasogastric tube, and antibiotics if there was associated infection according to culture and sensitivity tests. All fistulae healed within a period of follow up ranged from 15-60 (mean 42.7±7.1) days.

Five (17.2%) patients were complicated by carotid blowout and 1 (3.4%) case by venous blowout. Three (10.3%) patients were complicated by wound dehiscence which was managed by surgical repair, two of them were operated by debridement and primary closure, and one by reconstruction by contralateral PMMF.

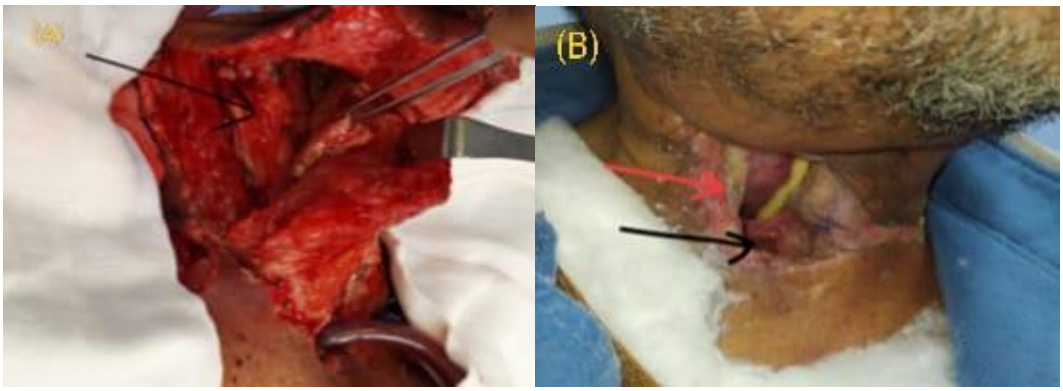

Figure 1: Pharyngocutaneous fistula with dehiscence of repair, (A) Intraoperative photo (arrowed), (B) Postoperative photo (red arrow directed to the site of fistula, black arrow directed to the tracheostomy opening).

Recurrent malignancy was recorded in seven (24.1%) patients which was local in 5 (17.2%) cases and distant in 2 (6.9%). All patients with recurrent malignancy were treated by palliative CRT.

Swallowing was evaluated in all patients, 14 (48.3%) had normal oral feeding, 10 (34.5%) were dependent on nasogastric feeding, and 5 (17.2%) were presented by dysphagia which required endoscopic dilatation.

Voice prostheses were inserted in 15 (51.7%) patients later on after STL, in a period not less than 6 months. They were functioning well in all patients.

The mortality rate was high in our series, 18 (62.1%) patients died. Seven (24.1%) cases died due to recurrent malignancy. Six (20.7%) cases died due to vessel blowout. Five (17.2%) patients died due to causes not related to primary disease or surgery (myocardial infarction (2 cases), stroke (2 cases), and Covid-19 (1 case)) (Table 4).

Table 4: Causes of death.

	Number (%)
Recurrent malignancy	7 (24.1)
Local malignancy	5 (17.2)
Distant malignancy	2 (6.9)
Related to surgery	6 (20.7)
Carotid blowout	5 (17.2)
Venous blowout	1 (3.4)
Other causes	5 (17.2)
Myocardial infarction	2 (6.9)
Stroke	2 (6.9)
Covid-19	1 (3.4)

Discussion

Although the management of early cases of laryngeal cancer by CRT has good results in organ preservation, many patients still require surgery for recurrent or persistent tumours with consequent wound-healing complications such as PCF .[6]

Reconstruction by PMMF post-STL has a very effective role in improving tissue healing and avoiding fistula. The majority of the published studies supporting flap use are retrospective, they provide encouraging results that support the usefulness of PMMF use in lowering the incidence of fistulas. [21, 24, 25, 26] However, many patients are still present by fistula despite using the flap .[8]

In this study, PCF was diagnosed in 16 (55.2%) patients with 3 (10.3%) cases requiring re-surgery for fistula repair despite flap use, according to these results, the flap plays a minor role in reducing the risk of fistula, in agreement with a study published by Gil et al about 80 patient who underwent STL, 69 (86%) patients underwent primary pharyngeal closure alone and 11 (14%) underwent a PMMF reconstruction, the PCF rate was similar in the non-PMMF (24%) and the PMMF (27%) groups. [1] In comparison to a study published by Souse and his colleague about 31 patients, pharyngeal reconstruction using PMMF was performed in 61%, primary closure was performed in 39% of cases, PCF was developed in 16% of cases who were reconstructed by the flap, and in 58% of the patients with primary closure of the neopharynx (p-value < 0.02) .[24]

Low postoperative albumin level was the only statistically significant factor for fistula development (p-value-0,003). This highlights the importance of improvement of the nutritional state of the patient to minimize the fistula incidence [8, .[18]

Few variables were associated with high fistula incidence but weren't significant. The duration between the end of CRT and surgery was less than 1 year in 11 (68.8%) patients who developed fistula (p-value-0.411). Thirteen (81.2%) patients with PCF were operated by neck dissection concurrent with salvage surgery (p-value-0.233). Ten (62.5%) patients with fistula were treated by CRT (p-value-0.378), the above-mentioned factors were not statistically significant, although they were significant in other studies. [19, 20, 21]

Six cases (20.6%) of massive neck bleeding as a result of PCF were reported; this incidence is high in comparison to other studies .[2] The only significant factor associated with high bleeding rate was diabetes mellitus (p-value-0.008).

Pectoralis major muscle flap has no significant effects on swallowing, as evidenced by the five (17.2%) patients who complained of dysphagia necessitating dilatation, all patients presented with dysphagia were reconstructed by myocutaneous flap (p-value-0.04). This indicates that myofascial flaps are preferable than myocutaneous flaps in preventing dysphagia. [18]

Fifteen patients (51.7%) had voice prostheses that were functioning normally, indicating that the neopharynx continues to vibrate normally even with the flap present .[23]

The mortality rate was high, more than one-third of cases died due to tumour recurrence and all of them died in a period not more than 33 months post-STL. In comparison to a study by Li and his colleague about recurrent tumours post-salvage laryngectomy, a total of 100 patients were identified, with 72 patients in the early-stage group and 28 patients in the advanced-stage group. The post-salvage recurrence rate was 27.7% in the early-stage group and 36% in the advanced-stage group. [27] Due to deaths from caused not related to cancer or surgery, we cannot detect statistically significant factor for disease control.

Overall survival (OS) in 5 years was 28%, and the predictive factor affecting OS was diabetes (p-value-0.03), this indicates that improvement of the general condition of the patient and diabetes control is very important to improve survival .[8, 18]
The fact that this research was retrospective observational study with small patient group was one of its drawbacks. Additionally, there was bias in the choice of certain surgical steps, which varied based on the intraoperative surgeon decision. The lack of documentation is another limitation for this study as most of the preoperative laboratory investigations weren't found. Also, we don't have sufficient data about the time of the beginning of oral feeding, the degree of dysphagia, or the impact of PMMF harvesting on shoulder function.

Conclusion

Although most published papers recommend the routine use of PMMF in reconstruction post-STL. It should be remembered that most of the publicshed evidence comes from retrospective studies. Recommendations for its routine use in salvage settings should be reevaluated and reconsidered. A well-designed randomized-controlled trial to eliminate confounding factors is therefore required to establish its usefulness in salvage settings. The PMMF isn't very effective in reducing the PCF incidence post-STL. However, it promotes faster healing of minor fistulas, and prevents larger fistula formation. The myofascial flap is better than the myocutaneous flap to control the fistula rate. Improvement of the nutritional condition of the patient is very important to decrease fistula incidence. Control of diabetes is an important factor in improving overall survival.

Acknowledgement DECLARATION OF INTEREST STATEMENT

The authors have no funding, financial relationships, or conflicts of interest to disclose.

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