ORIGINAL ARTICLE

Reconstructive Surgery in the Treatment of Hypopharyngeal Cancer

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Abstract

We report our experiences with 283 reconstructions of pharyngoesophageal defects after adequate extirpation of hypopharyngeal cancer that have been accomplished in the past 17 years through 1970 to 1986 using various kinds of pedicled flaps such as Bakamjian's DP skin flap, slit technique of DP skin flap, pectoralis major and latissimus dorsi myocutaneous flaps, skin-grafted pectoralis major muscle flap and gastric or colic pull-ups. We conclude that each flap has its own merits and demerits and any one of these flaps cannot totally replace the others and that we must be familiar with characteristics of these flap techniques including free flap transfer to be able to indicate the best selection of reconstructive technique for every patient with different situations and, then, to obtain optimal result.

Key words: hypopharyngeal cancer, primary reconstruction, pedicled flap, salivary fistula, stenosis

Introduction

Treatment result of hypopharyngeal cancer is extremely poor, as has been reported in many literatures1-5 and as we have experienced in our department.6 Radiotherapy...
or chemotherapy alone may not be capable of curing hypopharyngeal cancer regardless of its stage or the site of origin in the hypopharyngeal cavity, and the surgical treatment must be considered.

In many patients with hypopharyngeal cancer, it often invades into the larynx and the cervical esophagus, and the radical surgery such as a total laryngopharyngectomy is the treatment of choice with a combined use of induction chemotherapy and postoperative radiotherapy. Only in certain carefully selected cases, where the tumor is localized within the pyriform sinus or in the posterior wall, the conservative surgery such as a partial hypopharyngectomy can be successful without sacrificing laryngeal functions as one of the authors has reported in a literature.7

Reconstructive surgery for the defect after radical or partial excisions of the hypopharyngeal cavity is, then, one of the most important factors in the treatment of hypopharyngeal cancer. There have been reported many kinds of techniques for primary reconstruction of the defect, and they can be classified into two major groups, pedicled flaps8–16 and free flaps17–18.

In the past 17 years, we have experienced more than 280 reconstructions of the hypopharyngeal defect utilizing pedicled flaps. They include a two-stage procedure with the deltopectoral (DP) skin flap, a one-stage reconstruction with the pectoralis major myocutaneous (PMMC) flap, the latissimus dorsi myocutaneous (LDMC) flap or the skin grafted pectoralis major (SG-PM) muscle flap, and a total replacement of the pharyngoesophagus with the stomach or a vascularized segment of colon.

Each technique has its own merit and demerit from both clinical and fundamental standpoints of view, and it is not always an easy task for us surgeons to determine an appropriate reconstructive technique considering many factors such as the versatility of the flap, technical ease, the incidence of mucocutaneous salivary fistula, a combination with adjuvant chemoradiotherapy, a total term of hospitalization, functional result, cosmetic aspect, and so on.

The purpose of this paper is to report our experiences with the use of these pedicled flaps for reconstructions of pharyngoesophageal cavity and to indicate the best selection in every patient with different situations.

Various flaps in reconstructions of pharyngoesophageal cavity

In the past 17 years through 1970 to 1986, a total of 283 patients with hypopharyngeal cancer were treated by the author(s) in the Keio University Hospital and its branch hospitals.

Two hundreds and twelve patients had T3 or T4 lesions, and a total laryngopharyngectomy in continuity with radical neck dissection was the operation of choice. In the other 28 patients with T1 or T2 lesions, a partial hypopharyngectomy was done without sacrificing the laryngeal functions. In 43 patients, the mucocutaneous salivary
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Table 1 Various Kinds of Flaps in Reconstruction of Hypopharyngeal Cancer, 1970–1986

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>212 Circumferential Reconstructions</td>
<td>68</td>
<td>Pectoralis Major Myocutaneous Flaps</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Latissimus Dorsi Myocutaneous Flaps</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Skin-grafted Pectoralis Major Muscle Flaps</td>
</tr>
<tr>
<td></td>
<td>105</td>
<td>Deltopectoral Skin Flaps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(21 Slit Techniques)</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Gastric Pull-ups</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Colic Pull-ups</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Free (jejunum) Flaps</td>
</tr>
<tr>
<td>71 Partial Reconstructions</td>
<td>28</td>
<td>Reconstructions after Partial Hypopharyngectomy</td>
</tr>
<tr>
<td></td>
<td>43</td>
<td>Revision Surgeries for Salivary Fistula</td>
</tr>
<tr>
<td>Total</td>
<td>283</td>
<td>Reconstructions</td>
</tr>
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fistula was observed in the neck, and the revision surgery with the use of a pedicled flap was accomplished.

Reconstruction of the defect was carried out using various kinds of pedicled flap as shown in Table 1. A two-stage procedure with the DP skin flap was utilized mainly before 1978 in a total of 105 patients. The slit technique of the DP skin flap is versatile enough to repair the defect in heavily irradiated patient, and we utilized this particular technique mainly after 1979 in 21 among these 105 patients. A one-stage reconstruction using the PMMC flap was done in 68 patients after 1979. In female patients with buxom breasts or thick subcutaneous fat, the LDMC flap or a newly developed technique with the SG-PM muscle flap were utilized in a total of 17 patients. In 16 patients with tumor that extends down to the cervical esophagus, the total replacement of the pharyngoesophagus was accomplished by gastric or colic pull-ups in cooperation with surgeons in the Department of Surgery. The defect after partial hypopharyngectomy, on the other hand, was repaired using the DP skin flap or the PMMC flap in 19 and 9 patients respectively.

Techniques and Results

1. Deltopectoral Skin Flap

Bakamjian in 1965 popularized the DP skin flap as a pedicled anterior chest flap. The blood supply for the flap comes from the first three or four perforators of the internal mammary artery and is axial in distribution. The flap can be elevated in an undelayed fashion and rotated safely over the clavicle and into the neck, providing a
Table 2 Incidence of Salivary Fistula

<table>
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<tr>
<th></th>
<th>Without Radiation</th>
<th>Less Than 46 Gy</th>
<th>More Than 60 Gy</th>
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<tr>
<td>PM-MC flap</td>
<td>2/26 = 7.7%</td>
<td>3/35 = 8.6%</td>
<td>5/7 = 71.5%</td>
</tr>
<tr>
<td>Slit technique of DP skin flap</td>
<td>—</td>
<td>—</td>
<td>2/21 = 9.5%</td>
</tr>
<tr>
<td>DP skin flap</td>
<td>—</td>
<td>27/68 = 40%</td>
<td>14/16 = 87.5%</td>
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viable skin tube for pharyngoesophageal defect. The flap has an improved versatility and has frequently been utilized in major head and neck reconstructions, though it takes rather a long time because of its staged procedures.

We utilized the Bakamjian's technique in a total of 84 patients with hypopharyngeal cancer mainly before 1978 for a primary reconstruction of the entire cervical esophagus. The flap was versatile enough and we have never seen any major complication such as total necrosis, but experienced the mucocutaneous salivary fistula in not a few patients. As shown in Table 2, the salivary fistula was encountered after the second stage operation mostly at the three point junction to the esophageal stump in 27 (40%) among 68 patients with planned preoperative radiotherapy less than 46 Gy and 14 (as high as 87.5%) among 16 heavily irradiated patients with more than 60 Gy. Spontaneous closure of the salivary fistula was not observed in these heavily irradiated patients and the revision surgery forced the patients a long hospitalization. According to these results, we must conclude that the Bakamjian's technique is not a good candidate for irradiated patient.

A longitudinal slit for about 3.5 cm can be placed in the center and near to the base of the DP skin flap. This incision can be made without risk for disruption of the axial vessels, since they also run along the intercostal spaces parallel to the original design incisions. The incision provides an appropriate hole at the base of the flap with which the esophageal stump is to be anastomosed end to side without undesirable three point junction (Figs. 1-4). We introduced this slit technique of the DP skin flap in 1979 and realized that it is satisfactory even for heavily irradiated patient. We successfully utilized this technique in 21 consecutive cases and encountered the salivary fistula in only 2 (9.5%) among these 21 heavily irradiated patients. These results indicate that the slit technique seems most likely a viable alternative to original Bakamjian’s technique. Though it is imperative that adjuvant chemoradiotherapy not be delayed because of staged procedures, it probably does not represent a substantial drawback for the use of this technique in already and heavily irradiated patient.

2. Myocutaneous Flap

Both pectoralis major and latissimus dorsi myocutaneous flaps are now available for the reconstruction of pharyngoesophageal defect. The PMMC flap is much popular
Fig. 1 In this heavily irradiated patient, tissues around defect is extremely fibrotic and hypovascular. DP skin flap including second and third perforating vessels is designed on chest wall for primary reconstruction.

Fig. 2 In slit technique, esophageal stump is anastomosed end to side with slit that is made in center and near to base of DP skin flap.

Fig. 3 First stage operation is completed by closing neck wound and grafting split-thickness skin on chest wall.

Fig. 4 After completion of second stage operation, patient can swallow food in 3 weeks postoperatively. Incidence of salivary fistula was much lower in this technique than in Bakamjian’s technique.
than the LDMC flap because of its technical ease and also because it is unnecessary to change the position of the patient for flap elevation and transfer, though the LDMC flap has excellent capability for transferring large amounts of skin and has an arc of rotation that permits this transfer to relatively superior locations of the head. We utilized the LDMC flap in only a limited number of patients for whom the PMMC flap is not indicated for some reasons.

Ariyan in 1979 reported his successful use of the PMMC flap in head and neck reconstruction, and suggested the possibility of a one-stage circumferential reconstruction of the cervical esophagus using this flap. We also introduced this flap for this purpose in the same year, and the flap has become one of the most dependable options for cervical esophageal reconstruction in our department, mainly because this one-stage technique has significant advantages over the DP skin flap, facilitating an earlier onset of postoperative chemoradiotherapy and oral alimentation.

A skin island on the anterior chest wall is quadrangular, 11×11 cm. The distal end of the skin island that is to be anastomosed with the oropharyngeal stump must be designed as a wavy line to lengthen the suture line. By vertical skin incision to the skin island, bilateral chest skin flaps are elevated, revealing entire part of the pectoralis major muscle. This procedure is also necessary to close the donor defect in a single line. Being detached from ribs and sternum, the entire pectoralis major muscle including the skin island is elevated up to the clavicle. A part of muscle pedicle is separated from it so as to contain one of the ramified blood vessels. This muscle flap is particularly useful to fill up dead spaces around the esophageal stump after a complete extirpation of paratracheal nodes deep into the mediastinum. The skin island is made into a tube, then the flap is rotated over the clavicle and into the neck defect. Immediate reconstruction of the cervical esophagus is accomplished by end to end anastomosis of the skin island with the oropharyngeal and esophageal stumps. The wound in the neck and on the chest wall is closed primarily over suction catheters (Figs. 5–16). The patient can begin to swallow foods in 3 weeks postoperatively, and tolerates well postoperative chemoradiotherapy with a total dose of 55 Gy.

In heavily irradiated patients, however, the PMMC flap is not always dependable as has been shown in our series of 68 patients. Among 68 reconstructions using the PMMC flap, the incidence of mucocutaneous salivary fistula was less than 10% in

<table>
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<th>Lower Limit of Tumor</th>
<th>Skip Lesion</th>
<th>Second Primary</th>
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<tr>
<td>Within C7</td>
<td>2/143 = 1.4%</td>
<td>5/143 = 3.5%</td>
</tr>
<tr>
<td>Beyond C7</td>
<td>6/27 = 22.2%</td>
<td>1/27 = 3.7%</td>
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Fig. 5 Defect to be reconstructed after laryngopharyngectomy in association with bilateral neck dissection.

Fig. 6 Design of skin incision on chest wall for PMMC flap.

Fig. 7 Chest skin is elevated far laterally, revealing entire part of pectoralis major muscle.

Fig. 8 Entire part of pectoralis major muscle with skin island is elevated up to clavicle.

Fig. 9 Skin island is made into tube, but muscular layer is not tubed.

Fig. 10 Tubed skin island that is pedicled by pectoralis major muscle.
Fig. 11 Part of muscle pedicle is separated so as to contain ramifying blood vessels, that is useful to fill up dead spaces low in neck.

Fig. 12 One stage reconstruction is completed by end to end anastomosis of tubed skin with oropharyngeal and esophageal stumps.

Fig. 13 Chest and neck wounds are closed over suction catheters.

Fig. 14 Patient can begin to swallow food no later than 3 weeks postoperatively.

Fig. 15 Barium study shows well reconstructed cervical esophagus. Stenosis at junction to esophagus that is ascribable to salivary fistula was observed in not a few patients with previous heavy radiotherapy.

Fig. 16 Patient with competent gullet may be able to obtain speech function by pressing reconstructed esophagus against cervical spine.
patients without previous radiotherapy or with planned preoperative chemoradiotherapy less than 46 Gy. On the contrary, the salivary fistula was encountered in 5 (as high as 71.4%) among 7 heavily irradiated patients with more than 60 Gy, and spontaneous closure could not be observed (Table 2). The results indicate that the PMMC flap is also not the best selection for heavily irradiated patient.

3. Skin Grafted Pectoralis Major Muscle Flap

In female patients who are elder and with atrophic breasts, the PMMC flap is available, though a cosmetic deformity of the chest wall with a distortion of the nipple is problematic. While in female patients with buxom breasts, the PMMC flap can not be utilized because of its bulkiness. The LDMC flap is mandatory in some selected cases, but is not always available because the subcutaneous fat is thick also in the lateral chest wall and the flap becomes too bulky.

The SG-PM muscle flap that has been developed by the author may be the best choice in this situation.

In association with preoperative examinations, a reserve operation is completed to graft a piece of skin directly onto the pectoralis major muscle. A skin incision is made around the breast and entire part of the pectoralis major muscle is revealed. An about 11 x 11 cm quadrangular piece of skin obtained from the thigh is sutured directly to the muscle, and the wound is closed primarily. Three to four weeks later at the definitive surgery for hypopharyngeal cancer, the same wound is reopened and the grafted skin is utilized as a skin island on the pectoralis major muscle being trimmed into an appropriate size and shape. The cosmetic deformity of the chest wall remains minimal, since the anterior chest skin is not utilized and the normal shape of the breast can be preserved without distortion of the nipple (Figs. 17-28).

The SG-PM muscle flap was utilized in 6 female patients. In four patients, no major complication was observed. Wound healing was uniformly uneventful, and they were able to swallow food without difficulty no later than three weeks postoperatively. Barium studies disclosed an adequate lumen with no evidence of leaks or strictures at the mucocutaneous junctions. Two patients among these 4 underwent postoperative radiotherapy and tolerated it without any problem. The scar of the neck and anterior chest wall seemed cosmetically acceptable. In the other 2 (33%) patients, however, strictures at the junction to the esophagus were observed that required repeated dilations using a dilator once or twice every month or two. One of these 2 patients died of recurrence in the neck, and another one finally needed a revision surgery using a slit technique with the DP skin flap. We consider that the SG-PM muscle flap may not be advisable in patients with poor recipient conditions such as hypovascular fibrosis due to heavy radiotherapy.
Fig. 17 Design of skin incision in anterior chest wall for reserve operation of SG-PM muscle flap technique, that is performed 3 to 4 weeks prior to definitive surgery.

Fig. 18 Entire chest skin including breast is elevated, and entire pectoralis major muscle is revealed.

Fig. 19 Split-thickness piece of skin is grafted onto pectoralis major muscle.

Fig. 20 Wound is closed primarily leaving small window, through which wound is irrigated daily.

Fig. 21 Three to four weeks later at definitive surgery, take of grafted skin is confirmed through window.

Fig. 22 At definitive surgery, wound is reopened and grafted skin is trimmed into appropriate size and shape for skin island.
Fig. 23 Entire pectoralis major muscle containing skin island is elevated.

Fig. 24 Both skin and muscular layers are tubed. Distal and proximal ends are to be anastomosed with oropharyngeal and esophageal stumps respectively.

Fig. 25 Being rotated into neck, tubed muscle-skin compound is anastomosed end to end with oropharyngeal and esophageal stumps.

Fig. 26 Chest and neck wounds are closed over suction catheters. Cosmetic deformity of breast and nipple remains minimal.

Fig. 27 Patient can swallow food no later than 3 weeks post-operatively.

Fig. 28 Barium study disclosed competent gullet reconstructed in 4 among 6 female patients, but the other 2 showed stenosis at junction to esophagus.
4. Gastric or Colic Pull-ups

It is well known that hypopharyngeal cancer may be accompanied by skip lesions or second primary in the lower esophagus. Fiberscopic examination for 170 patients with hypopharyngeal cancer revealed them in not a few cases as demonstrated in Table 3. In case that the tumor localizes within the level of C7, the skip lesion was encountered in only 1.4%. On the contrary, when the tumor invades downward beyond the level of C7, the incidence of the skip lesion was as high as 22.2%. These results indicate that a total esophagectomy is advisable for the patients with tumor extending beyond the level of C7, and the reconstruction using gastric or colic pull-ups is absolutely indicated.

Comment

Local recurrence, mainly due to incomplete removal of undetectable invasion deep in submucosal layer, plays a part in the poor prognosis of hypopharyngeal cancer. Therefore, a radical surgery such as a laryngopharyngectomy is the procedure of choice in advanced cases, and the circumferential reconstruction of the competent gullet offers another difficult task for the surgeon.

Bakamjian's staged technique using the DP skin flap had been adopted by many surgeons. However, it requires two stages and takes weeks to months to complete. Moreover, a previously irradiated bed apparently enhances the possibility of minor flap necrosis and troublesome mucocutaneous salivary fistula, which is often seen at the junction to the esophageal stump and requires additional months for completion of closure. These factors preclude meaningful postoperative chemoradiotherapy and offer serious problems in the total planning of hypopharyngeal cancer treatment.

A one-stage procedure using the PMMC or LDMC flaps has, then, apparently advantages over the Bakamjian's technique, and it has become one of the most dependable options for male patients. By several technical improvements described in this paper, reconstructions using it were successfully accomplished in patients who had not been irradiated or been irradiated with less than 46 Gy as a planned preoperative chemoradiotherapy. However, a relatively high incidence of salivary fistula limits the use of this technique in patients who have received radiotherapy with more than 60 Gy, since the functional results depend highly on the presence of salivary fistula and subsequent strictures. A small salivary fistula may close spontaneously without need for revision surgery, but it takes additional weeks to complete this process and it is highly likely to leave a fibrotic stenosis. It is noteworthy that most of salivary fistulas observed in heavily irradiated patients in our series did not close spontaneously and finally needed a revision surgery using the other technique such as, for example, a slit technique of the DP skin flap.

Another limitation for the use of these myocutaneous flaps is the thickness of the
tissue that is being transferred. Even a thin patient who has had a substantial weight-loss can have a relatively thick subcutaneous fat layer overlying the pectoralis major or latissimus dorsi muscles, and it is important to realize that this subcutaneous fat can not be manipulated in any way to try to thin the flap itself at the time of flap elevation. For the same reason, these myocutaneous flaps can not be utilized in female patients with buxom breasts.

In an attempt to overcome this problem, we have developed a new technique for immediate reconstruction that uses the SG-PM muscle flap. The development of this SG-PM muscle flap is based on our experience that female patients with buxom breasts and thick subcutaneous fat carry rather a thin pectoralis major muscle and the muscle-skin compound can never be thick even when it is made into a tube. Precisely speaking, this technique involves two operations: a new skin island should be prepared by grafting a split-thickness piece of skin onto the pectoralis major muscle before the definitive operation. But this reserve operation can be finished during the term of induction chemotherapy and examinations, and the reconstruction itself can be accomplished in a single stage. We consider this an important advantage over the Bakamjian’s technique. Another advantage of this flap over the other pedicled flaps is an improvement in cosmetic problems. The breast is left unaffected with the nipple in its normal position. To the best of our experience with the use of this flap, however, there is also a relatively high incidence of salivary fistula when it is used in heavily irradiated patients and the functional results are not always satisfactory.

A slit technique of the DP skin flap, on the contrary, may be the best selection for a primary reconstruction in heavily irradiated patients, showing an acceptable functional result that is ascribable to very low incidence of salivary fistula. Though this technique is a staged procedure and takes several weeks to complete, it can not be a substantial drawback for its use, because an early onset of postoperative radiotherapy is unnecessary for these already irradiated patients.

There is not much question that these pedicled flaps represent innovative and positive contributions to the field of pharyngoesophageal reconstructive surgery. But it is important to realize that each flap has its own limitations and should not totally replace the other flaps and that free flap transfer such as a segment of jejunum or forearm free flap will continue to make it an important reconstructive technique in certain types of situations, though a certain level of technical expertise is required. We would be well advised to become conversant with all these pedicled and free flaps to provide each patient with an optimal care.

Conclusion

We reported our experiences with the use of several kinds of pedicled flaps in primary reconstruction of pharyngoesophageal defect resulted from curative extirpation
of hypopharyngeal cancer.

We should realize that each flap has its own merits and demerits and that any flap can not totally replace the others. We emphasized that every surgeon should be well acquainted with all flap techniques including free flap transfer to be capable of providing an optimal care for every patient with different situations.

References


