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Main Article

Prevention of postlaryngectomy pharyngocutaneous fistula using a sternocleidomastoid muscle collar flap

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Abstract

Objectives: The purpose of this study was to evaluate the efficacy of a sternocleidomastoid muscle collar flap in the prevention of pharyngocutaneous fistula in patients who had undergone total laryngectomy.

Study design: Retrospective clinical study.

Setting: Otolaryngology department, Tanta University, Egypt.

Methods: Sixty-five consecutive total laryngectomy procedures performed between October 1999 and October 2005 were reviewed. The fistula rate in laryngectomy patients operated on prior to 2002, without sternocleidomastoid collar flap creation (group A) was compared with that of patients operated on after October 2002, at which time this flap was introduced for routine use during primary surgery (group B).

Results: In group A, the incidence of pharyngocutaneous fistula was 12 in 35 (34 per cent) while its incidence in group B was 1 in 30 (3.3 per cent). On analysis, the risk factors within both the groups were essentially similar.

Conclusion: The routine addition of a superiorly based sternal head of sternocleidomastoid muscle flap on one or both sides to cover the repaired pharynx during surgery reduced the incidence of postlaryngectomy pharyngocutaneous fistula, patient morbidity and mortality, and hospital stay; voice rehabilitation and swallowing were also improved.

Key words: Laryngectomy; Pharynx; Fistula; Surgical Flaps

Introduction

Total laryngectomy, with or without neck dissection, remains the treatment of choice for advanced laryngeal carcinoma. The procedure is also performed as salvage surgery for residual or recurrent carcinoma after radiotherapy.[1] However, many complications may occur during or after a total laryngectomy. Pharyngocutaneous salivary fistula is one of the more troublesome complications, since it is always associated with tissue necrosis, which may result in carotid artery rupture and massive bleeding.[1–3]

Pharyngocutaneous fistula may be seen low in the neck, just superior to the tracheostoma at the weakest point of the suture line of the pharyngeal mucosa, or else high in the neck, at the three-point junction of the bilateral pharyngeal mucosa and the tongue base. The frequency and factors thought to increase the likelihood of salivary fistula have been mentioned in several articles.[4–7]

Saliva from a minute fistula causes tissue infection and micro-venous thrombosis, which result in tissue loss due to partial sloughing of the mucosa. This micro-necrosis with infection usually occurs within five to seven post-operative days.[8–11] Watching and waiting for spontaneous closure takes time, prolongs the patient's hospital stay and, in the majority of cases, may result in swallowing difficulty due to fibrous stenosis.[12] Surgical repair of persistent fistula is often difficult and, to date, no ideal procedure has been reported.[13–17]

In the literature, little has been published about surgical techniques to prevent or decrease the incidence of pharyngocutaneous fistula.[18–20] In 2002, I began routine use of a superiorly based sternal head of the sternocleidomastoid muscle flap, inserted between the pharyngeal anastomotic line and the skin and wrapping the repaired pharynx like a collar, as part of a trial to assess the usefulness of this technique in decreasing or preventing salivary leaks.

Patients and methods

This study reviewed the charts of all patients who underwent total laryngectomy for laryngeal carcinoma (all performed by the same main surgeon) in

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the otolaryngology department, Tanta University Hospital, from October 1999 to October 2005. Patients who underwent a total pharyngolaryngectomy for pharyngeal and upper oesophageal carcinomas were excluded. The database yielded 65 laryngectomized patients, who were divided into two comparative groups, A and B. In group A, consecutive patients from October 1999 to October 2002 received standard primary closure of pharyngeal defects, without sternocleidomastoid muscle (SCMM) flap creation, and thus constituted a control group. In group B, consecutive patients from October 2002 to October 2005 received standard primary closure of pharyngeal defects plus SCMM flap creation. Pre-operative, operative, and post-operative risk factors were reviewed, including age, sex, tumour staging, peri-operative radiotherapy and post-operative care (including nasogastric tube removal).

Patients from both groups underwent cricopharyngeal myotomy and unilateral pharyngeal neurectomy followed by standard pharyngeal closure, using a running Connel technique with an absorbable suture reinforced by midline constrictor muscle interrupted suturing. Broad-spectrum antibiotic prophylaxis initiated at the beginning of surgery was continued for a week post-operatively. Both antibiotic prophylaxis and pharyngeal defect closure technique were the same for both groups. The only significant variable was the use of an SCMM flap following pharyngeal closure for patients operated on between October 2002 and October 2005 (group B).

The creation of a prophylactic SCMM flap is not a well known technique amongst otolaryngological and head and neck surgeons. The sternal head of the SCMM is secured between the surgeon's forefingers and thumb just above the sternum and cut transversely using electrocautery or a radiofrequency probe (see Figure 1). The cut end is then manually drawn upward and medially while the cutting probe passes upward parallel to the muscle fibres, almost up to the midlevel of the muscle. The superiorly based sternal head of the muscle is then placed over the repaired pharynx, just below the tongue base. The other SCMM is subjected to the same procedure in order to meet its fellow below the tongue base, deep to the mandible (see Figure 2). The cut ends of the flaps are sutured in two layers vertically and their upper transverse border is sutured to the cut ends of the suprahyoid muscles (the myelohyoid and hyoglossus), giving the appearance of a neck collar, with a transverse part composed of the sternal heads and two vertical parts composed of the clavicular heads (hence the name 'collar flap') (see Figure 3). There is no need to suture the flaps to the constrictors or the covering skin, except in cases of unilateral radical neck dissection, in which the cut end of the remaining muscle is vertically sutured to the contralateral pharyngeal constrictor lateral to the pharyngeal suture line.

Post-operatively, all patients in both groups received nasogastric tube feeding for seven to 10 days, with oral feeding initiated following tube removal if there was no evidence of fistula. Fistulae were diagnosed clinically on the basis of a fluid collection under the skin flap with leakage through the skin suture line defect or around the tracheostoma. This was confirmed by having the patient swallow a diluted povidone–iodine solution, which passed through the fistula defect if present.

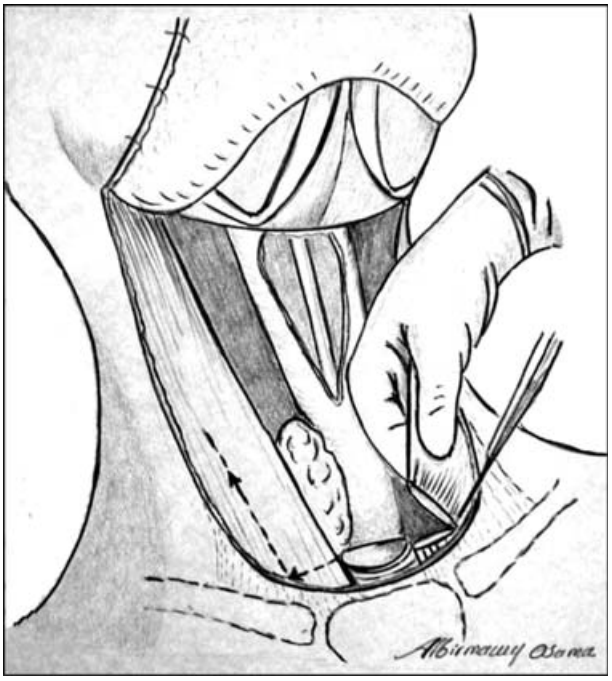

FIG. 1
The sternal head of the sternocleidomastoid muscle is secured and cut transversely and superiorly.

Results

In total, 65 patients were included in this study. In group A, 35 patients underwent total laryngectomy

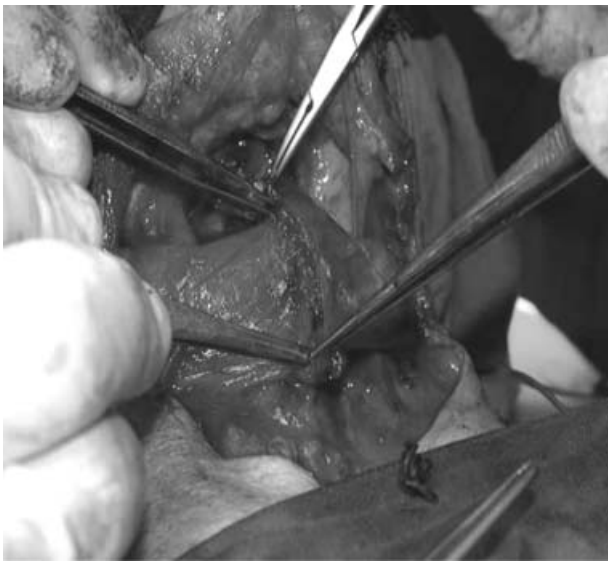

FIG. 2
The sternal heads are drawn over the repaired hypopharynx, to be sutured together in two layers.

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FIG. 3

The sternal heads are sutured as a collar over the repaired hypopharynx (thick arrows) and pulled up by the suprahyoid muscles (thin arrow).

without SCMM flap creation, from 1999 to 2002. In group B, 30 patients underwent total laryngectomy with SCMM flap creation, from 2002 to 2005.

The male to female ratio was 32 to 3 (10.6:1) in group A and 28 to 2 (14:1) in group B. This increasing male to female ratio was not significant.

The average age was not significantly different in either group, being 56.5 years in group A and 53.5 years in group B.

When tumour staging and nodal status were examined, both groups were essentially similar (Table I).

The number of patients who were treated with radiotherapy, either pre- or post-operatively, was similar in both groups (14.2 per cent in group A patients and 10 per cent in group B patients pre-operatively, and 20 per cent in both groups post-operatively). Analysis of the group A patients who received pre-operative radiotherapy indicated that their fistula rate was not significantly different compared with that in patients who received primary surgery with or without post-operative radiotherapy.

A review of the surgical methods used (Table II) demonstrated that the same regimen was used in both groups, with the exception of SCMM flap creation. All patients in both groups received broad-spectrum antibiotics for a week following surgery. Both groups received nasogastric tube feeding for seven to 10 days post-operatively, and the same closed drainage system was used in both groups and removed two to four days post-operatively.

Both groups underwent the same pharyngeal closure procedure, namely, a running Connel-type suture with a second layer of constrictor muscle coverage. The fistula rate was 12 of 35 patients (34 per cent) in group A and 1 of 30 patients (3.3 per cent) in group B. Interestingly, the one patient in group B who developed a fistula developed it on day 10, three days after removal of the nasogastric tube. This fistula resolved spontaneously after reinsertion of the nasogastric tube and an additional five days in hospital.

Tracheoesophageal puncture for prosthetic voice rehabilitation was performed in 20 patients out of the 35 in group A and in 26 patients out of the 30 in group B. The ratio between secondary and primary puncture in both groups was almost the same (3:1).

Twenty-six patients out of 30 developed satisfactory tracheoesophageal voice (19 secondary, seven primary), with straightforward maintenance of the puncture via smooth tracheostoma due to the cut sternal SCMM heads. Ten per cent of patients were satisfied with their oesophageal speech. Only one patient failed to develop oesophageal voice and refused puncture. Swallowing was fair in

TABLE I

PATIENT PROFILES

Patient factor	Group A*	Group B†
Tumour stage		
T_3 (%)	73	78
T_4 (%)	27	22
N_1–N_3 (%)	15	17
Radiotherapy		
None (*n* (%))	23/35 (65.8)	21/30 (70)
Pre-operative (*n* (%))	5/35 (14.2)	3/30 (10)
Post-operative (*n* (%))	7/35 (20)	6/30 (20)
Age		
Range (years)	38–75	35–72
Average (years)	56.5	53.5
Sex		
Male (*n*)	32/35	28/30
Female (*n*)	3/35	2/30

*$n = 35$; †$n = 30$. T = tumour; N = node

TABLE II

SURGICAL MANAGEMENT AND RESULTS

Procedure/outcome	Group A* (*n*)	Group B† (*n*)
Neck dissection		
None	27	23
Modified	3	3
Unilateral radical	5	4
Nasogastric tube	Yes	Yes
Hypopharyngeal management		
Myotomy & neurectomy	Yes	Yes
Sternomastoid flap		
Bilateral	No	26
Unilateral	No	4
Antibiotics	Yes	Yes
Fistula rate	12 (34%)	1 (3.3%)
Swallowing		
Fair	28	28
Relative dysphagia	5	2
Absolute dysphagia	2	–
Speech		
Oesophageal	10	3
TEP	20 (15 2°, 5 1°)	26 (19 2°, 7 1°)
None	5	1

*$n = 35$; †$n = 30$. TEP = tracheoesophageal puncture; 2° = secondary; 1° = primary

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93.3 per cent of patients; the remaining two cases showed relative dysphagia which improved with repeated dilatation.

In this study, no major complications were detected in group B. Only minor complications were noticed, in the form of seroma affecting two cases due to accidental early dislodgement of the closed draining system. The seroma was aspirated and resolved after two days of light compression of the neck, without any SCMM flap loss.

Discussion

Life is much improved without a postlaryngectomy fistula, not only for the patient but also for the surgeon, who may search in vain for the best time and optimum technique to deal with a fistula which is causing the patient more and more problems. Fistula prevention is an essential priority.

A pharyngocutaneous fistula prolongs the patient's stay in hospital by an average of 18 days, and there is a significant risk of major complications, including carotid blowout.[7] The fistula delays the resumption of oral diet, adjunctive radiation therapy and speech therapy. The usual causes of pharyngocutaneous fistulae are infection, suture dehiscence, devascularized or irradiated tissues, closure under tension, and lack of wound support.[21]

Although a T-shaped closure is frequently used to decrease suture line stress, its mean weakness occurs at the junction of the crossbar at the tongue base. The continuous pull of the tongue against the trifurcation point enhances the likelihood of breakdown at this point. Straight line closure with a continuous submucosal suture has been advocated as particularly effective following radiation therapy in eliminating the weakness of the trifurcation.[22] Inverting or everting mucosal closure techniques and the use of absorbable, non-absorbable and synthetic sutures have been suggested, as well as delayed oral feeding. Many surgeons use a multiple-layer pharyngeal closure that supports the suture line with pharyngeal constrictor muscle and, occasionally, the thyroid gland. Despite such efforts, a spontaneous fistula rate of 22 to 50 per cent occurs in laryngectomized patients.[11] In this study, a running submucosal Connel-type suture with a second layer of constrictor coverage was used to repair the pharyngeal defect in both groups, performed by the same main surgeon. The thyroid gland was never used to support the suture line. The fistula rate in irradiated patients was not significant in comparison with that in non-irradiated patients in control group A.

Since Gluck first described a one-stage laryngectomy, involving firstly construction of the tracheostoma and then completion of the laryngectomy and primary closure of the pharynx, the mortality rate has markedly decreased. However, spontaneous pharyngocutaneous fistula is still an annoying and unresolved problem.[23] Many methods have been described to repair such fistulae: a pedicle flap,[24] a skin-lined deltopectoral flap,[25] a pectoralis myocutaneous flap[14] and a tubed bipedicle skin graft.[16] In 1974, Stell and Conney[25] successfully reduced the fistula rate to 13 per cent by adapting the following surgical techniques: a collar incision, closure of the pharyngeal defect in a straight line, a separate skin incision for the tracheostoma, and efficient suction drainage. In 2003, Smith *et al.*[26] dramatically decreased the incidence of fistula from 22.9 per cent to less than 1 per cent by the routine addition of a pectoralis major myogenic flap to cover the pharyngeal defect at surgery.

In this study, it was the author's intention from October 2002 to cover the pharyngeal suture line with a unilateral or bilateral, superiorly based sternal head of the sternocleidomastoid muscle flap. Unlike a pectoralis major myogenic flap, the technique used was not beyond the opened neck surgical field, the extra operation time ranged from only five to seven minutes, and no head and neck movement limitations were created. In addition, no muscle bulk problems were encountered following creation of a collar flap (i.e. compression of major blood vessels of the neck, overstretching of the covering skin, or even the need for partial thickness skin grafting).

The fistula rate decreased from 34 per cent in the control group to 3.3 per cent in the collar flap group. This may be explained as follows. The collar flap supports the hypopharyngeal suture line, rapidly mucosalizes any suture defect and avoids hypopharyngeal mucosal necrosis. The flap also prevents the shearing effect of neck skin movement over the suture line, as it interposes a smooth, vascular, myogenic barrier. On swallowing, the suprahyoid muscles pull the collar flap up, which in turn pulls the hypopharynx up to suck the food bolus, preventing its stagnation and also any pressure effect on the suture line. The flap protects the suture line against acid reflux, acting as a sphincter over the hypopharynx instead of the myotomized cricopharyngeal sphincter. The myogenic collar flap also protects against the postoperative ischaemic effect of radiotherapy.

- **This retrospective study reports the effect of using the sternocleidomastoid muscle as a collar flap to prevent pharyngocutaneous fistula, in 65 consecutive laryngectomy patients**
- **The patients were not randomized, but the study appears to show that the routine addition of a superiorly based flap based on the sternal head of the sternocleidomastoid muscle to cover the repaired pharynx reduces the rate of postlaryngectomy pharyngocutaneous fistula**
- **In addition, patient morbidity and hospital stay were reduced when using this flap and there was an apparent improvement in voice rehabilitation and swallowing, although no objective data are presented to substantiate these trends**

The technique delivered impressive functional results regarding speech and swallowing.

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Interestingly, the neck shape seemed unchanged, especially in patients without dissection, as the flap filled the upper neck space created after laryngectomy.

The procedure carries the unlikely risk of exposure of the lowermost part of the internal jugular vein, especially if this vein is more prominent on one side than the other; however, this did not represent a risk factor for any of the operated patients in the present series. The accumulative surgical experience of the operating surgeon may have influenced the significant difference in fistula rates between the collar flap and control groups.

Conclusion

The routine addition of a collar flap, composed of the sternal head of the sternocleidomastoid muscle wrapping the pharyngeal suture line during laryngectomy, is a new technique which dramatically reduces the incidence of pharyngocutaneous fistula, patient morbidity and mortality, and hospital stay, in addition to improving vocal rehabilitation and swallowing.

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