

## Original Article

## A New Technical Approach to Cancers of the Cervical Esophagus

Novin Nikbakhsh MD<sup>1</sup>, Farrokh Saidi MD, FACS, FRCS<sup>2</sup>, Hossein Fahimi MD<sup>3</sup>**Abstract**

**Background:** The aim of this study was to assess the possibility of a primary end-to-end pharyngoesophageal anastomosis after standard tumor resection of the cervical esophagus by acute flexion of the neck.

**Methods:** A total of 34 consecutive patients with primary cervical esophageal cancer, none having received prior radio- or chemotherapy, were treated by two methods based on intraoperative findings. In 18 patients, reconstruction after esophageal resection was carried out by the standard gastric pull-through technique (control group). In 16 patients, acute flexion of the neck after tumor resection allowed for reconstruction by primary end-to-end pharyngoesophagostomy (experimental group).

**Results:** There was no operative mortality in either group. The mean operative time for the experimental group was about 50 minutes less compared to the control group. Self-limited postoperative anastomotic leakage in the neck was twice as common in the experimental group. Postoperative dysphagia was about three times as common in the experimental group [5 patients (31%)] compared to the control group [2 patients (11%).]

**Conclusion:** In selected cases, segmental resection of primary cervical esophageal cancers reconstructed by end-to-end pharyngoesophagostomy is technically feasible by bending the neck acutely forward during anastomosis and maintaining it in the flexed position during a postoperative period of about 7 days. The advantages are reduced scope and duration of the operation. The downside is doubling of the frequency of postoperative cervical leakage.

**Keywords:** Cervical esophagus, esophageal cancer, squamous cell carcinoma

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**Introduction**

About 6% of esophageal cancers arise from the cervical segment lying between the cricopharyngeus and the thoracic inlet;<sup>1</sup> the vast majority are squamous cell carcinomas. At presentation, one-third of patients have extension of the tumor beyond the confines of the esophagus and in one-fifth, the trachea or vocal cords are involved.<sup>1,2</sup> The reported operative mortality ranges from 5% to 31%,<sup>3,4</sup> and 7% to 37% of patients have postoperative anastomotic leakage.<sup>3,4</sup> Neither mortality nor recurrence rates can be improved upon by removal of the entire length of the esophagus.<sup>5</sup> Old reconstructive techniques consisted of fashioning a full thickness skin tube in the neck (Wookey procedure) or interposition of free jejunal grafts. Both procedures were time consuming and cumbersome, and have been abandoned.<sup>3,6</sup>

Surgical management of cervical esophageal cancer differs from that of other portions of the esophagus in two major aspects. Removal of the larynx with permanent loss of phonation is unavoidable, and reconstruction by gastric pull-up greatly expands the scope of the surgery.

For these two reasons, chemo-radiotherapy has replaced surgery in many centers as the preferred treatment modality. Overall survival has not improved, however, nor has the rate of local recurrence diminished.

A recent study has shown locoregional relapse-free survival be-

tween 36% – 73% after curative chemoradiotherapy in a 2-year rate.<sup>7</sup> In these circumstances the management of local recurrence, furthermore, becomes hazardous and technically demanding because of prior radiotherapy.<sup>8–11</sup> Death occurs by suffocation or massive local bleeding and rarely because of distant metastases.

The purpose of this study was to evaluate the practicality of an end-to-end esophageal anastomosis in the neck after tumor resection, thereby lowering the extent of surgical trauma associated with formal laparotomy, mobilization, and transfer of the stomach to the neck. There has been, unintentionally, refutation of the axiom against primary end-to-end anastomosis anywhere along the esophageal length.

**Patients and Methods**

Between March 2001 and September 2008, a total of 34 consecutive patients with primary, biopsy proven squamous cell carcinoma of the cervical esophagus were admitted to the teaching hospitals of Beheshti University of Medical Sciences, Tehran and Babol University of Medical Sciences, Babol, Iran. None of the patients (15 males and 19 females; age range: 56 to 74 years) that enrolled in the study had any co-morbidities or received prior chemoradiotherapy. Permission for the study was granted by the Institutional Review Board of the respective universities, and informed consent was obtained from all patients after full explanation of the two technical approaches being considered. The need for permanent tracheostomy was explained, the psychological impact of permanent aphonia lessened by demonstrating one of the currently available hand-held mechanical speech devices.

The decision regarding the manner of reconstruction was deferred until the resection was completed, in the following manner:

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**Table 1.** Patients' characteristics

|                | Patient's numbers | Sex       |            | Age (mean±SD) |
|----------------|-------------------|-----------|------------|---------------|
|                |                   | Male      | Female     |               |
| Gastric bypass | n=18              | n=8 (44%) | n=10 (56%) | 64.5±8        |
| Neck flexion   | n=16              | n=7 (44%) | n=9 (56%)  | 65.3±9        |

**Table 2.** Tumor characteristics in the two groups.

|                             | Gastric bypass group (n=18) | Neck flexion group (n=16) |
|-----------------------------|-----------------------------|---------------------------|
| <b>T status<sup>a</sup></b> |                             |                           |
| T1                          | ----                        | ----                      |
| T2                          | 1 (6%)                      | 2                         |
| T3                          | 10 (55%)                    | 8                         |
| T4                          | 7 (39%)                     | 6                         |
| <b>N status<sup>a</sup></b> |                             |                           |
| N0                          | 5                           | 4                         |
| N1                          | 13                          | 12                        |
| <b>M status<sup>a</sup></b> |                             |                           |
| M0                          | 18                          | 16                        |
| M1                          | ----                        | ----                      |
| <b>Stage<sup>a</sup></b>    |                             |                           |
| I                           | ----                        | ----                      |
| II                          | 6 (35%)                     | 4 (25%)                   |
| III                         | 11 (59%)                    | 12 (75%)                  |
| IV                          | 1 (6%)                      | ----                      |
| <b>Residual disease</b>     |                             |                           |
| R0                          | 16 (89%)                    | 15 (94%)                  |
| R1                          | 2 (11%)                     | 1 (6%)                    |

R0 = no residual tumor; R1 = microscopically residual tumor; <sup>a</sup>According to the TNM system (AJCC, 2002)

**Table 3.** Hospital morbidity and mortality.

| Complications                       | Gastric bypass | Neck flexion | P value |
|-------------------------------------|----------------|--------------|---------|
| Minor anastomotic leak <sup>a</sup> | 2 (11%)        | 4 (25%)      | 0.387   |
| Major anastomotic leak <sup>b</sup> | 1 (6%)         | 2 (13%)      | 0.591   |
| Cardiac arrhythmias                 | 5 (28%)        | 1 (6%)       | 0.180   |
| Respiratory failure                 | 0              | 0            | -----   |
| Blood transfusion required          | 2 (11%)        | 0            | 0.487   |
| Late stricture with dysphagia       | 2 (11%)        | 5 (31%)      | 0.214   |

<sup>a</sup>Anastomotic leaks apparent after the seventh postoperative day; <sup>b</sup>Anastomotic leaks apparent before the seventh postoperative day.

**Table 4.** Patterns of recurrence.

| Recurrence pattern | Gastric bypass (n=18) | Neck flexion group (n=16) | P value |
|--------------------|-----------------------|---------------------------|---------|
| Locoregional       | 2 (11%)               | 3 (19%)                   | 0.648   |
| Distant            | 4 (22%)               | 3 (19%)                   | 1.000   |
| Both               | 1 (6%)                | 2 (13%)                   | 0.591   |

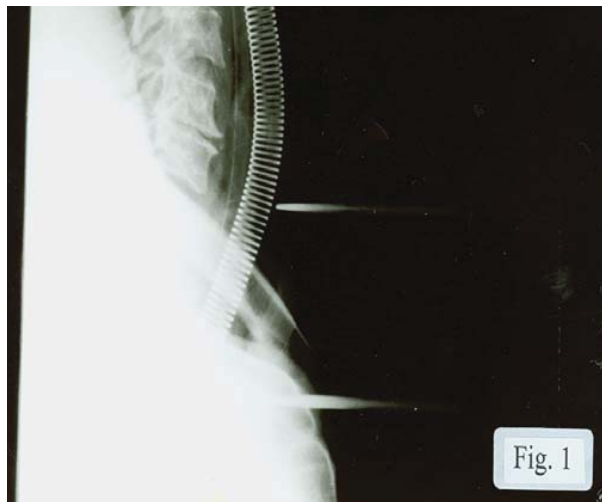
With the patient in the semi-sitting supine position, a mid-cervical collar incision allowed the lower skin flap to be opened enough to accommodate the permanent tracheostomy opening. The strap muscles were transected, and the exploratory finger inserted in the plane between the esophagus and anterior vertebral fascia. Obliteration of this space, which may not have been fully apparent on preoperative CT scans, meant unresectability of the lesion, as did gross involvement of the carotid vessels. The trachea was transected distal to the specimen in a beveled manner for tension-free accommodation to the skin aperture in the center of the lower skin flap. A prepared sterile endotracheal tube was inserted into the new tracheal opening (end- tracheostomy), which replaced the initial orally inserted endotracheal tube.

Staying in the midline, the thyroid lobes and attached parathyroids were displaced laterally to avoid injury. The larynx and proximal trachea attached to the cervical portion of the esophagus where the tumor was located and mobilized in preparation for transection, superiorly at the level of the hyoid bone and inferiorly at a distance above the thoracic inlet. Having superiorly entered the pharynx and sacrificing the epiglottis, the specimen could be lifted off its base to allow for transection of the esophagus inferiorly above the thoracic inlet with a grossly tumor-free margin. Multiple biopsies were taken from the two open ends of the phar-

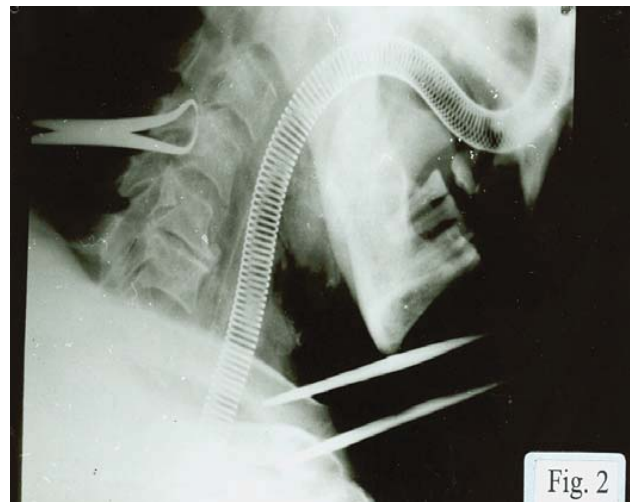
ynx (above) and the esophagus (below) to ensure microscopically tumor-free edges. No attempt was made to mobilize any portion of the remaining distal esophagus, either laterally from its bed or inferiorly into the thorax. The only tension-releasing maneuver used consisted of gentle finger dissection around the open stump of the pharynx, allowing for about 2 to 3 centimeters of downward displacement of the pharyngeal opening to be used for anastomosis. Visible and palpable lymph nodes were removed, but no formal neck dissection was performed.

With the specimen removed and the neck in the normal anatomic position, the resulting anatomic defect in the neck was measured with calipers. A gap of 8 centimeters or less suggested that a tension free, end-to-end anastomosis might succeed, but was verified by a somewhat more reliable maneuver, as follows:

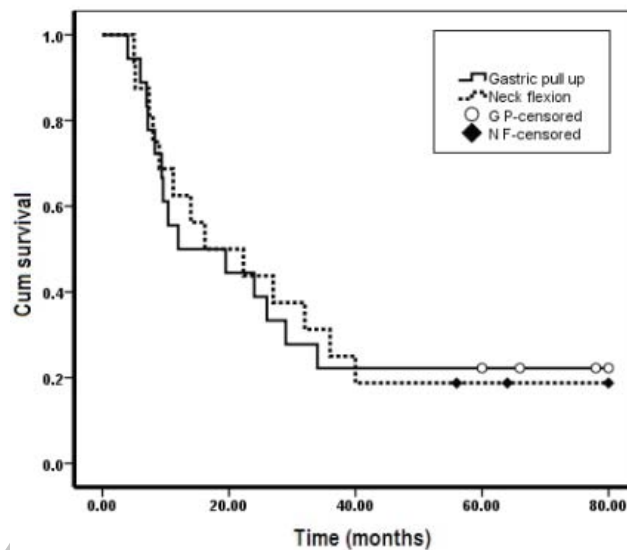
Pulling gently on two previously placed traction sutures on the sides of the pharyngeal opening (above) and the esophageal opening (inferior), an unscrubbed assistant would grasp the back of the patient's head and gently flex it forward to a maximal, but not forced degree (Figures 1, 2). The degree of final tension that would be transferred on the anastomosis could subjectively assessed by noting how readily the traction sutures would come together while flexing the neck. If the caliper measured defect was greater than 8 centimeters or the neck flexion maneuver indicated an intolerable



**Figure 1.** Operative X-ray with neck in the neutral position showing a hemostat on the lower rim of the proximal remnant of the esophageal segment, with another hemostat on the sternal angle.



**Figure 2.** Same patient. The neck has now been flexed about 45° forward, bringing the two hemostats much closer together.



**Figure 3.** Overall survival curve.

tension at the anastomosis, a transhiatal gastric pull-up would be undertaken. Otherwise, primary end-to-end anastomosis was performed in the following manner:

With the head brought back to its normal anatomic position, a posterior followed by an anterior row of interrupted 2-0 Vicryl® sutures (0.5 centimeters apart) were placed and kept in sequential order, but not tied. The neck was fully flexed as described, essentially obscuring the site of anastomosis. Tying down the sutures, beginning with the posterior row, was carried out in a blind manner relying on the sense of touch in deciding the minimal degree of tension needed to bring the two open ends of the gullet together. If any doubt existed, the anastomosis was not completed, but reconstruction shifted to the gastric pull-up procedure. The anastomosis was not tested for leaks by either air or saline insufflations. At the end of the anastomosis, having maintained the head in the flexed position, the strap muscles were re-approximated and the

skin closed in two layers without drainage. A feeding jejunostomy was placed through a limited laparotomy incision, to be used on the first postoperative day. A stout chin suture further assured that the neck would be kept in the flexed position during the entire postoperative period of 7 days. The endotracheal tube, its balloon deflated, was kept in place for about 2 days to ensure access for the tracheobronchial toilet as needed. When signs of leakage such as cervical wound erythema or drainage were seen, we performed a dilute barium study to verify leakage. Its management was by cervical wound opening, dressing and nutrition via a jejunostomy tube. The mean duration of leakage in the neck flexion group was 5 days for minor anastomotic leak (anastomotic leaks became apparent after the seventh postoperative day) and 10 days for major anastomotic leak (anastomotic leaks became apparent before the seventh postoperative day). During the leakage period, mouth washing with normal saline and oral intake of metronidazole syrup

was prescribed. After 5 days, in all leakage cases, oral nutrition was started with liquids and metronidazole syrup. Swallowing was achieved in all of these patients.

#### Statistical analyses

Survival analyses were performed using the Kaplan–Meier method. Comparisons of survival between groups were assessed by the log-rank test. Differences in clinicopathologic variables among various groups were calculated using the  $\chi^2$  test, Fisher exact test, and student t-test when appropriate. Multivariate analysis with a stepwise Cox regression model was conducted to evaluate the independent prognostic factors. A *P* value of less than 0.05 was considered significant. All analyses were performed with SPSS software version 11.0 (SPSS, Inc., Chicago, IL).

### Results

A total number of 34 patients (55.9% female; mean age  $\pm$  SD:  $64.9 \pm 4.9$ ; range: 56 – 74 years) were enrolled in the study during a 90 month period. The mean total surgical time  $\pm$  SD was  $196.6 \pm 28.0$  minutes. Patients and tumor characteristics are shown in Tables 1 and 2.

There was no significant relationship between sex and the two surgery type groups (*P* = 0.9), nor was seen between the mean patients' age and two surgery type groups (*P* = 0.7). Analysis of patients' process data also indicated that the mean surgical time (min)  $\pm$  SD in the standard gastric pull-through technique group was  $220.3 \pm 14.0$  and in the primary end-to-end pharyngoesophagotomy group, it was  $170.0 \pm 8.9$ , which was significant (*P* < 0.001).

Overall, there was no significant relationship between sex and mean time (*P* = 0.9).

A noticeable issue in this study was the weak reverse-correlation between duration of surgery and age of patients (Pearson correlation: -0.072), however this relationship was not significant (*P* = 0.8).

Outcome details for both the 'gastric bypass' and the 'neck flexion' techniques of reconstruction are summarized in Table 3.

One patient in the gastric bypass group had a splenectomy because of inadvertent trauma to the spleen, and two patients required blood transfusions. The mean duration of hospital stay was similar for both groups, 15 days (10 – 30 days) in the neck flexion group and 12 days (10 – 20 days) in the standard method group.

There was no mortality in either group. There was no need for conversion once the neck flexion technique had been decided upon at completion of resection. This lent weight to the reliability of simple inspection and palpation in assessing anastomotic tension.

There was local tumor recurrence in 7 (39%) patients in the control group and 8 (51%) patients in the experimental group, with a mean delay of 16 months postoperatively (range: 3-80 months). Two patients in the control group developed tumor recurrence in the pulled-up stomach. Patterns of recurrence are depicted in Table 4. Overall actuarial survival in both groups is shown in Figure 3.

We could complete follow-up in all 34 patients. Of the 16 patients in the control group, 7 patients (40%) died of disease (locoregional and distant metastasis), 4 patients died from cardiovascular diseases, 1 patient died due to a car accident and 4 patients were alive and disease free. In the experimental group, 8 patients (50%) died because of disease (locoregional and distant metastasis), 2 patients died because of cerebrovascular accident, 3 patients died because

of cardiovascular disease, and 4 patients were alive without disease. The cause of death in the remaining patient was unknown.

### Discussion

This study showed the feasibility of primary pharyngoesophagostomy by neck flexion with overall lower morbidity than the standard method. As shown in Table 3, a doubling of postoperative anastomosis leakage and late stricture in our study was offset by significant saving of operative time and avoidance of complications with the gastric pull-up procedure.

Most studies<sup>12–16</sup> prefer gastric transposition as the best surgical technique for restoring alimentary continuity after laryngopharyngectomy. Ayshford et al. have reported that 58% of British surgeons elected gastric pull-up as their favorite method<sup>17</sup> of restoring alimentary continuity after cervical esophageal reconstruction. The mortality rate ranged from 5% to 31% and anastomotic leakage rate ranged from 7% to 37%. Sullivan and associates have reported results of 32 consecutive pharyngogastric reconstructions with a 12% mortality rate and anastomotic leakage rate of 31%.<sup>18</sup>

An unavoidable loss of the larynx has, understandably, swayed many surgeons towards chemoradiotherapy in managing primary cancers of the cervical esophagus. The benefits of chemoradiotherapy for lower-end esophageal cancers are being assessed,<sup>19–21</sup> but the results are not necessarily applicable to upper-end esophageal cancers. Any attempt, therefore, at ameliorating the plight of patients afflicted with cervical esophageal cancer would seem justified. Reverting to a completely surgical approach initially has the benefit of facilitating reoperations for local recurrence, something which would be technically difficult and hazardous after radiotherapy to the neck. Results of chemoradiation for cervical esophageal cancer by Burmeister et al.<sup>22</sup> among 34 patients has shown a failure rate of 12% for local control. Three patients (9%) died from persistent local disease and 2 (6%) patients died as a result of treatment [5 (15%)]. With well functioning, relatively inexpensive, hand-held laryngeal voice devices now available, it is possible that there will be a reversal to surgical management of cervical esophageal cancers in the future.

The neck-flexion maneuver, which allows for primary end-to-end pharyngoesophagostomy, rightfully raises the question as to whether there might be some compromise with extent of cancer resection needed for a possible cure. The only way to avert this possibility would be to postpone the final decision regarding reconstruction until resection has been accomplished, according to oncological principles. The next problem is the maximal length of the final esophageal defect after resection that would allow for a successful primary end-to-end. One-half of the tracheal length is considered the maximum that can be removed and tracheal continuity restored by primary anastomosis.<sup>23</sup> No comparable measure exists for the esophagus, and the final decision rests on correct judgment. The length of the cervical portion of the esophagus varies according to body build of patients, which varies as does the degree of neck flexion tolerated by different individuals. Assigning a numerical value to the length of the esophageal defect that can be bridged by neck flexion would, therefore, be much less valuable than a visual and palpatory assessment of permissible tension, as described. The final results confirmed the reliability of this type of subjective assessment of the safety of performing an end-to-end anastomosis in the neck. The only tension releasing maneuvers permitted are limited to digitally freeing the pharynx in the neck.



Any attempt at mobilizing the esophagus out of the thorax inferiorly should be resisted, the normal contractive pull of the freed-up esophagus making this maneuver counter-productive. End-to-end pharyngoesophagostomy runs counter to accepted surgical principles. Its execution in the neck, however, is made possible by the exceptional laxity brought about by neck flexion. This maneuver has also been used by Pirmoazen<sup>24</sup> in the management of long segment cervical esophageal strictures relieved by the Heineke-Mikulicz procedure, readily bringing together the two ends of the longitudinal incision. Maintaining the neck in the flexed position for a minimum of 7 days proved not to be a problem. A few patients voluntarily kept their head bent forward for an additional day or 2.

Postoperative cervical anastomotic leakage was not as frequent or serious as expected, nor delayed strictures as severe as feared. The bent-neck posture was tolerated quite well by patients after tracheal resection for 7 or more days, and the same was observed for the neck flexion group in this study. The total number of cases in this study was not large enough to show whether, in the long run, the overall risk-benefit balance of the neck flexion maneuver manner of reconstruction after cervical esophageal resection surpasses that of the standard gastric pull-through procedure.

## Conclusion

Resection of cervical esophageal cancer, based on oncological principles, with reconstruction carried out by primary end-to-end pharyngoesophagostomy is technically feasible, with no unacceptably high postoperative cervical leakage rates or local stricture formation.

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