Voice Reconstruction with Free Ileocolon Flap Transfer: Implications for the Lower Respiratory Tract

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Background: Free ileocolon flap surgery is an effective technique for voice reconstruction in hypopharyngolaryngectomy defects. A tracheoesophageal fistula is created using an intestinal conduit characterized by secretions and a resident microbial flora. The aim of this study was to investigate the respiratory complications and modifications of the regional flora following ileocolon flap transfer.

Methods: A retrospective study was conducted on 35 patients who underwent voice reconstruction with the free ileocolon flap. The prevalence of respiratory symptoms, aspiration, and respiratory tract infections was studied and the management of respiratory complications was recorded. Ten patients were included in a cross-sectional study to evaluate the bacterial flora of the voice tube and the tracheostomy site.

Results: Six patients experienced aspiration of food into the trachea caused by incompetence of the ileocecal valve ($n = 5$) or pathologic tracheoesophageal fistula ($n = 1$). Four patients presented with pneumonia. In one case, pneumonia was consequent to aspiration caused by incompetence of the ileocecal valve. Radiotherapy, chemotherapy, and age older than 55 years did not influence the continence of the ileocecal valve. Mean follow-up was 34.2 months. *Escherichia coli* was the organism cultured most frequently.

Conclusions: Reconstruction with the free ileocolon flap was shown to be a possible therapeutic option when considering the consequences on the lower respiratory tract. Aspiration was the main complication and was avoided by internal plication of the valve and by reduction of the ileocecal angle. Awareness of the nature of the bacterial flora colonizing the trachea and voice tube could be helpful in guiding the empirical antibiotic therapy in case of infection. (*Plast. Reconstr. Surg.* 127: 1916, 2011.)

Restoration of voice simultaneous with reconstruction of the digestive tract in patients undergoing hypopharyngolaryngectomy has an important impact on the quality of life of the patients. Among the numerous techniques reported to achieve this aim, the free ileocolon flap, described in 1992 by Kawahara et al.,[1] allows reconstruction of the alimentary segment with cecum and ascending colon, whereas a phonatory shunt is fashioned from the terminal ileum. The latter is anastomosed end to end, or end to side, to the tracheal stump and directs the air flow to the neopharynx. This technique offers several advantages: a strong air source (trachea), a biological air conduit (terminal ileum), a vibratory mechanism (ileocecal valve), and a mechanism for prevention of aspiration (ileocecal valve).

In recent years, several series have been published by different centers confirming the reliability of the procedure in obtaining an intelligible voice and reporting a low incidence of comp-

lications.[2–5] However, none of these addressed specifically the occurrence of lower respiratory tract symptoms and pulmonary complications associated with this technique. The purpose of the present study was to investigate the prevalence of lower respiratory tract morbidity in patients undergoing reconstruction of the hypopharynx with a free ileocolon flap and to study the modifications, if any, of the bacterial flora of the patients at the tracheostomy site following flap transfer.

PATIENTS AND METHODS

Retrospective Study

A retrospective study was conducted between March of 2004 and December of 2008 on 35 patients undergoing either voice or voice and swallowing reconstruction following laryngectomy or hypopharyngolaryngectomy with free ileocolon or free ileocecal patch flaps. Primary reconstructions were performed at the same time of laryngectomy or hypopharyngolaryngectomy. Secondary reconstructions were performed for restoration of voice in patients who had undergone earlier laryngectomy or for reconstruction of the digestive tract and voice following recurrence of cancer in previously laryngectomized patients. All of the operations were performed by the senior author (H.-C.C.). The study was approved by the institutional review board.

Relevant Surgical Details

The surgical procedure has been described elsewhere.[4] In this article, we summarize the technical details of relevance to the present study.

All patients received a mechanical bowel preparation on the night before surgery. A free ileocolic flap based on ileocolic vessels was harvested through a midline laparotomy incision. The flap was raised with two different resection lengths. For patients presenting with laryngeal and esophageal defects including more than 30 percent of the circumference, the mean lengths of ileum and colon were 17 ± 2 cm and 24 ± 4 cm, respectively. If only laryngectomy was performed, or when the esophageal defect was less than 30 percent of the circumference, a patch of colon was harvested (free ileocecal patch flap).[6] In this type of reconstruction, the mean lengths of ileum and colon were 13 ± 1 cm and 9 ± 3 cm, respectively. After division of the pedicle, the flap was irrigated abundantly with diluted povidone-iodine (Betadine 10%; Sinphar Pharmaceutical Co., I-Lan, Taiwan) and saline. Cotton-tipped applicators soaked in povidone-iodine were used to clean both bowel stumps and to remove any residual stool.

The flap was transferred to the neck and the microvascular anastomoses were performed. Subserosal sutures were placed between ileum and cecum to decrease the ileocecal angle to 30 degrees (external plication) (Fig. 1). The distal end of the cecum was opened and the ileocecal valve was plicated with interrupted 3-0 polydioxanone sutures, leaving 0.5 cm of the valve patent to allow air flow (internal plication) (Fig. 2). After plication of the ileocecal valve, the ascending colon was used to reconstruct the hypopharynx and cervical esophagus in an isoperistaltic direction, and the terminal ileum was anastomosed end to end or end to side to the tracheal stump, proximal to the tracheostomy site.

The technique described for reinforcing the continence of the ileocecal valve represents the current method used at our institution (the evolution of the procedure and its implications are reported in the Discussion section).

Patient Data and Statistical Analysis

Patients' charts were reviewed and information regarding patient demographics, diagnosis,
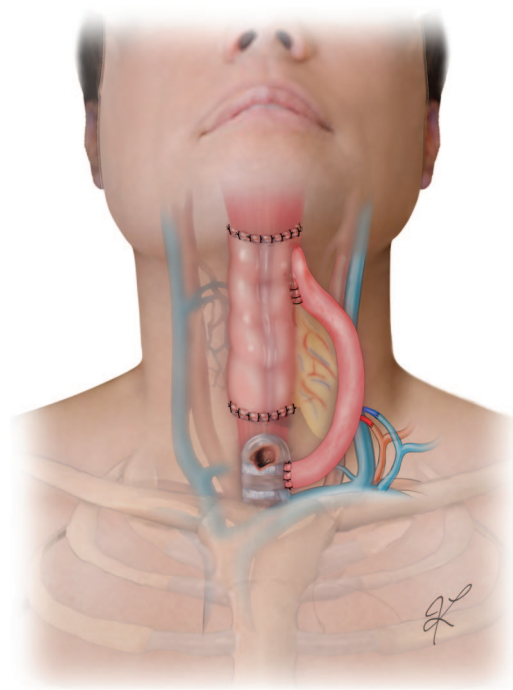

Fig. 1. Free ileocolon flap for voice reconstruction in hypopharyngolaryngectomy defects. The cecum and ascending colon form the neoesophagus and the terminal ileum creates a shunt between the trachea and the neoesophagus. Subserosal sutures between the ileum and the cecum close the ileocecal angle, reducing the chances for aspiration (external plication).
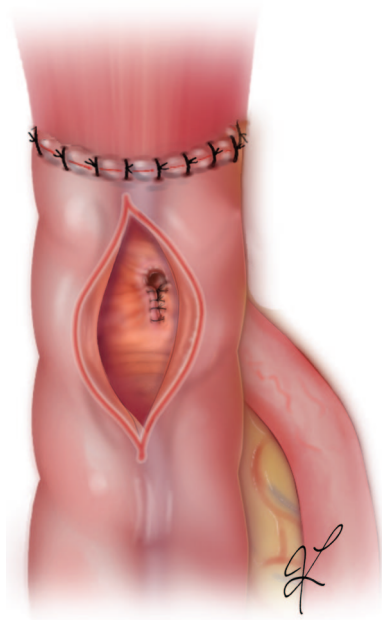
Fig. 2. The diameter of the ileocecal valve is reduced to 0.5 cm to increase the continence of the sphincter (internal plication).

associated diseases, type of reconstruction, and adjuvant or neoadjuvant radiotherapy or chemotherapy was recorded. Prevalence of chronic cough, sputum, fever, reflux of food into the voice tube, symptomatic aspiration, and respiratory infections was studied and medical and/or surgical treatment of respiratory complications and reasons of death were registered.

Chronic cough was defined as persistence of the symptom for more than 3 weeks. Tracheobronchitis was diagnosed in the presence of fever (body temperature $>38.5°C$), leukocytosis (white blood cell count $>12,000 \times 10^6$ cells/liter), or leukopenia (white blood cell count $<4000 \times 10^6$ cells/liter) and the presence of purulent tracheal secretions. The diagnosis of pneumonia was made only when the previous criteria were combined with radiographic evidence of pulmonary infiltrates.

Differences in the prevalence of respiratory complications between patients who underwent reconstruction with an ileocecal patch or ileocolic flaps were analyzed by means of Fisher's exact test. The possible effect of radiotherapy, chemotherapy, and age (>55 years) on the continence of the ileocecal valve was evaluated with the Fisher's exact test. The Fisher's test was used to assess differences in occurrence of respiratory symptoms before and after reconstruction in patients who underwent a secondary reconstruction.

Cross-Sectional Study

Ten patients included in our retrospective study were regularly attending the outpatient clinic between September of 2007 and December of 2008, and were enrolled in a cross-sectional study to evaluate the bacterial flora of the voice tube and the tracheostomy site. The only exclusion criterion was systemic treatment with antibiotics at the time of sampling. The study was approved by the institutional review board, and the patients signed a written informed consent before enrollment.

Samples of the voice tube and tracheal secretions at the tracheostomy site were taken for aerobic and anaerobic microorganisms at three routine follow-up visits, with 30-day intervals. The specimens were sent to the microbiology laboratory and processed qualitatively and quantitatively to detect the level of carriage.

Bacterial growth was defined as light ($<10^6$ colony-forming units/ml), moderate ($\geq 10^6$ colony-forming units/ml), or heavy ($\geq 10^7$ colony-forming units/ml). Colonization was defined as light growth of bacteria in the trachea at the stomal site.[7]

RESULTS

There were 33 men and two women included in the retrospective cohort, with a mean age of 57 years (range, 38 to 80 years). Indications for surgery were hypopharyngeal cancer in 25 patients (71 percent), laryngeal cancer in nine patients (26 percent), and thyroid cancer in one patient (3 percent). Eleven patients (31 percent) underwent reconstruction with a free ileocecal patch flap, and 24 patients (69 percent) required a free ileocolon flap for reconstruction of the esophageal defect. Seventy-one percent of the reconstructions were performed secondarily, whereas in 29 percent the reconstruction was performed simultaneous with the resection of the cancer. Fifty-one percent of the patients suffered from associated conditions. All flaps survived completely. The mean follow-up was 34.2 months. Six patients received concomitant adjuvant radiochemotherapy, nine patients received adjuvant radiotherapy, and one patient received adjuvant chemotherapy.

During the follow-up, 16 patients (46 percent) presented with chronic cough and 17 patients (49 percent) suffered from episodic sputum. In laryngectomized patients who underwent secondary reconstruction, there was no difference in the prevalence of these symptoms before and after reconstruction ($p = 0.71$).

In this series, one patient underwent only external plication of the ileocecal junction (patient 9) (Table 1). Four patients received both external and internal plication of the ileocecal valve with the residual aperture of 1 cm (patients 7, 11, 12, and 17) (Table 1). All of these patients subsequently experienced aspiration. The remaining 30 patients underwent both external and internal plication of the ileocecal valve with the residual patency of 0.5 cm. Among these, there was only one case of aspiration caused by a tracheoesophageal fistula (patient 18) (Table 1).

Overall, six patients (17 percent) experienced leakage of alimentary conduit content into the trachea. This was caused in five cases by the incompetence of the ileocecal valve and in one case by a pathologic tracheoesophageal fistula. Two patients (patients 11 and 12) (Table 1) either were asymptomatic or presented episodic cough and were treated conservatively. Surgical treatment for the remaining patients included closure of the pathologic tracheoesophageal fistula ($n = 1$), further internal plication of the ileocecal valve (patients 7 and 17) (Table 1), and internal plication of the valve in one patient who previously had received only external plication (patient 9) (Table 1).

Twenty-five patients underwent secondary reconstruction. In 14 patients, the reconstruction was performed with a free ileocolon flap, and in 11 cases, reconstruction was performed with a free ileocecal patch flap. Among these patients, aspiration, caused by incontinence of the valve, occurred in three patients who underwent reconstruction with a free ileocolon flap and in two patients who underwent reconstruction with a free ileocecal patch. These differences were not statistically significant ($p = 1.00$). The difference was not significant ($p = 0.64$) also when comparing the aspiration rate in reconstructions performed with a free ileocecal patch (secondary only, 11 patients) with all reconstructions performed with a free ileocolon flap (primary and secondary, 24 patients). Adjuvant radiotherapy, chemotherapy, and age of the patients were not associated with increased prevalence of aspiration ($p = 0.67$, $p = 1$, and $p = 0.67$, respectively).

Four patients (11 percent) presented with pneumonia. In only one case was pneumonia consequent to aspiration, and it was caused by incompetence of the ileocecal valve. The patient was admitted and received systemic antibiotic therapy. Two months later, internal plication of the ileocecal valve was performed to avoid recurrence (patient 9) (Table 1). One case was community-acquired pneumonia treated by means of an outpatient regimen. The tuberculotic pneumonia was treated with antitubercular therapy and the patient with metastatic disease was admitted and received systemic antibiotic treatment.

Four patients (11 percent) died during the follow-up period as a result of metastatic disease. There were no deaths related to respiratory problems.

Sixty specimens (trachea, $n = 30$; voice tube, $n = 30$) were collected from 10 patients (Table 2). Gram-negative aerobes represented 66 percent and 63 percent of all isolates from trachea and voice tube, respectively. Gram-positive aerobes were predominantly present in the tracheal samples (30 percent), whereas Gram-negative anaerobes were mainly present in the voice tube (20 percent). Overall, *Escherichia coli* was the organism cultured most frequently (Fig. 3).

DISCUSSION

Although reconstruction of the cervical esophagus and hypopharynx with intestinal flaps has been widely reported in the literature, the traditional techniques often fail to restore the voice, with an important impact on the quality of the life of the patients. Since its original description in 1992,[1] the popularity of the free ileocolon flap has increased, as it allows simultaneous reconstruction of the voice and swallowing functions with autologous tissues. Since 1995, we have performed 78 free ileocolic flaps for reconstruction of voice and swallowing in patients undergoing hypopharyngolaryngectomy. Our[4] and other groups'[5,8,9] clinical experience showed that the procedure is reliable in achieving an intelligible voice with low donor-site morbidity. However, the prevalence of the respiratory complications related to the tracheoesophageal shunt and risks associated with an intestinal conduit producing secretions with a high bacterial count at the inlet of the tracheostomy were not addressed in the previous reports.

One of the main advantages of the free ileocolic flap is the presence of an intrinsic mechanism to avert aspiration: the ileocecal valve. Although the intrinsic tone and the continence of the valve are not dependent on the integrity of the extrinsic nervous supply,[10] several techniques have been described to increase the competence of the valve following transfer as a free flap: wrapping the anterior and posterior walls of cecum around the terminal ileum,[1] application of Lembert sutures along the ileal tract,[9,11] and combined excision of a wedge of the ileocecal valve and application of sutures between the terminal ileum

Table 1. Summary of Patient Data

Patient	Age (yr)	Sex	Diagnosis	Associated Diseases	Flap	Type of Reconstruction	RT	CT	Cough	Sputum	Fever	Aspiration	Respiratory Tract Infection	Treatment	Follow-Up (mo)
1	75	M	Laryngeal cancer	—	Ileocecal patch	Secondary	—	—	—	Yes	—	—	—	—	28, alive
2	75	M	Hypopharyngeal cancer	—	Ileocecal patch	Secondary	—	—	—	—	—	—	—	—	35, alive
3	38	M	Hypopharyngeal cancer	—	Ileocolon	Primary	Yes	—	Yes	Yes	Yes	—	Community-acquired pneumonia	Antibiotic therapy	45, alive
4	53	M	Hypopharyngeal cancer	Tuberculosis	Ileocolon	Secondary	—	—	Yes	Yes	Yes	—	Pulmonary tuberculosis	Antitubercular therapy	46, alive
5	62	M	Hypopharyngeal cancer	Hypothyroidism, diabetes, hypertension	Ileocecal patch	Secondary	—	—	—	—	—	—	—	—	28, alive
6	56	M	Hypopharyngeal cancer	—	Ileocolon	Secondary	Yes	—	—	—	—	—	—	—	30, alive
7	60	M	Hypopharyngeal cancer	Chronic hepatitis	Ileocecal patch	Secondary	—	—	Yes	Yes	—	Yes	—	Further internal plication of ileocecal valve (0.5 cm left open for air flow)	31, alive
8	46	M	Hypopharyngeal cancer	—	Ileocolon	Secondary	—	—	—	—	—	—	—	—	56, alive
9	69	M	Hypopharyngeal cancer	Hypertension, cardiovascular disease	Ileocolon	Secondary	Yes	—	Yes	Yes	Yes	Yes	Aspiration pneumonia	Admission, antibiotic therapy, internal plication of ileocecal valve (previously not performed)	55, alive
10	80	M	Laryngeal cancer	—	Ileocecal patch	Secondary	—	—	—	—	—	—	—	—	29, alive
11	50	M	Hypopharyngeal cancer	—	Ileocolon	Secondary	—	—	—	—	—	Yes	—	Conservative treatment	34, alive
12	51	M	Hypopharyngeal cancer	Gout	Ileocolon	Secondary	Yes	—	Yes	Yes	—	Yes	—	Conservative treatment	21, died
13	60	M	Laryngeal cancer	Hypothyroidism	Ileocecal patch	Secondary	—	—	—	—	—	—	—	—	69, alive
14	58	M	Hypopharyngeal cancer	—	Ileocecal patch	Secondary	—	—	—	—	—	—	—	—	24, alive
15	75	M	Hypopharyngeal cancer	—	Ileocolon	Primary	—	—	Yes	Yes	—	—	—	—	56, alive
16	64	F	Laryngeal cancer	—	Ileocecal patch	Secondary	—	—	Yes	Yes	—	—	—	—	41, alive
17	72	M	Laryngeal cancer	Gout	Ileocecal patch	Secondary	—	—	—	—	—	Yes	—	Further internal plication of ileocecal valve (0.5 cm left open for air flow)	30, alive
18	47	M	Laryngeal cancer	Heroin abuser, chronic hepatitis	Ileocolon	Secondary	—	Yes	Yes	Yes	—	Yes	—	Closure of pathologic tracheoesophageal fistula	35, alive
19	57	M	Hypopharyngeal cancer	Hypothyroidism	Ileocolon	Primary	Yes	Yes	Yes	—	—	—	—	—	46, alive
20	46	M	Laryngeal cancer	—	Ileocolon	Secondary	—	—	—	—	—	—	—	—	33, alive
21	55	M	Laryngeal cancer	—	Ileocecal patch	Secondary	Yes	—	—	—	—	—	—	—	36, alive
22	59	M	Hypopharyngeal cancer	—	Ileocolon	Secondary	—	—	Yes	Yes	—	—	—	—	33, alive

(*Continued*)

Table 1. (Continued)

Patient	Age (yr)	Sex	Diagnosis	Associated Diseases	Flap	Type of Reconstruction	RT	CT	Cough	Sputum	Fever	Aspiration	Respiratory Tract Infection	Treatment	Follow-Up (mo)
23	60	M	Hypopharyngeal cancer	None	Ileocecal patch	Secondary	—	—	—	—	—	—	—	—	40, alive
24	53	M	Laryngeal cancer	Diabetes, hypothyroidism	Ileocolon	Primary	Yes	—	Yes	Yes	—	—	—	—	22, alive
25	53	M	Hypopharyngeal cancer	Cardiovascular disease	Ileocolon	Primary	Yes	Yes	Yes	Yes	—	—	—	—	44, alive
26	55	M	Hypopharyngeal cancer	Hypertension, hypothyroidism	Ileocolon	Secondary	Yes	Yes	Yes	Yes	—	—	—	—	18, died
27	60	M	Hypopharyngeal cancer	—	Ileocolon	Primary	—	—	—	—	—	—	—	—	5, died
28	38	M	Hypopharyngeal cancer	Chronic renal insufficiency	Ileocolon	Secondary	Yes	Yes	—	—	—	—	—	—	18, died
29	63	M	Hypopharyngeal cancer	Heart disease	Ileocolon	Secondary	—	—	—	Yes	—	—	—	—	3, alive
30	53	M	Hypopharyngeal cancer	—	Ileocolon	Secondary	—	—	—	—	—	—	—	—	26, alive
31	50	M	Hypopharyngeal cancer	—	Ileocolon	Secondary	Yes	—	—	—	—	—	—	—	34, alive
32	47	M	Hypopharyngeal cancer	Hypertension, chronic hepatitis	Ileocolon	Primary	Yes	Yes	Yes	Yes	Yes	—	Pneumonia secondary to pulmonary metastasis	Admission, antibiotic therapy	30, alive
33	49	M	Hypopharyngeal cancer	—	Ileocolon	Primary	Yes	Yes	Yes	Yes	—	—	—	—	28, alive
34	70	F	Thyroid cancer	Diabetes	Ileocolon	Primary	Yes	—	—	—	—	—	—	—	27, alive
35	49	M	Hypopharyngeal cancer	Diabetes, hypertension	Ileocolon	Primary	Yes	—	Yes	Yes	—	—	—	—	21, alive

CT, chemotherapy; RT, radiotherapy; M, male; F, female.

Table 2. Bacterial Isolates from the Voice Tube and Tracheostomy Samples*

Bacterium Type	Trachea (%)	Voice tube (%)
Aerobes		
Gram-negative		
Escherichia coli	15 (50)	28 (93)
Morganella morganii	12 (40)	9 (30)
Pseudomonas aeruginosa	12 (40)	3 (10)
Klebsiella pneumoniae	9 (30)	4 (13)
Serratia marcescens	6 (20)	3 (10)
Proteus mirabilis/Proteus vulgaris	7 (23)	2 (6.6)
Providencia species	4 (13)	1 (3.3)
Haemophilus influenzae	4 (13)	3 (10)
Gram-positive		
Staphylococcus aureus	16 (53)	1 (3.3)
Staphylococcus epidermidis	5 (16.6)	0 (0)
Corynebacterium species	7 (23)	1 (3.3)
Streptococcus group B	3 (10)	0
Anaerobes		
Gram-positive		
Peptostreptococcus species	4 (13)	4 (13)
Lactobacillus	0	5 (16.6)
Gram-negative		
Bacteroides species	1 (3.3)	15 (50)
Prevotella	0	5 (16.6)

*Numbers indicate the positive cultures per microorganism.

and the cecum.[5] We started to perform free ileocolon flap surgery for voice reconstruction in 1995. Initially, we applied only subserosal Lembert sutures along the ileal wall to increase the resistance of the conduit and the pressure at the ileocecal junction (as described by others[9,11]). This alone proved insufficient to avert aspiration. Therefore, we abandoned this technique and introduced the "external plication" of the ileocecal juncture with adjustment of the ileocecal angle. Aspiration persisted, but at a lower rate. Thus, we supplemented the technique with an internal plication of the valve. In this evolution, a residual aperture of the ileocecal valve set at 0.5 cm was sufficient to avert aspiration without compromising voice generation. Among the patients in the present series who experienced aspiration, one had received only external plication of the ileocecal junction (this patient required internal plication of the valve with a 0.5-cm aperture). Four patients had undergone external and internal plication with the residual aperture of the ileocecal valve greater than 1 cm after internal plication. In two patients, aspiration was episodic and was treated conservatively (patients 11 and 12) (Table 1). The other two patients required further plication of the valve to achieve resolution of the symptoms (patients 7 and 17) (Table 1).

The mechanisms adopted to augment the continence of the valve (adjustment of the ileocecal angle and the ileocecal valve aperture) were sufficient to protect patients who underwent reconstruction with a free ileocecal patch flap as well. It has been shown that the terminal 30 cm of ileum and the proximal 5 cm of colon constitute a specialized zone, the ileocolic junctional segment,
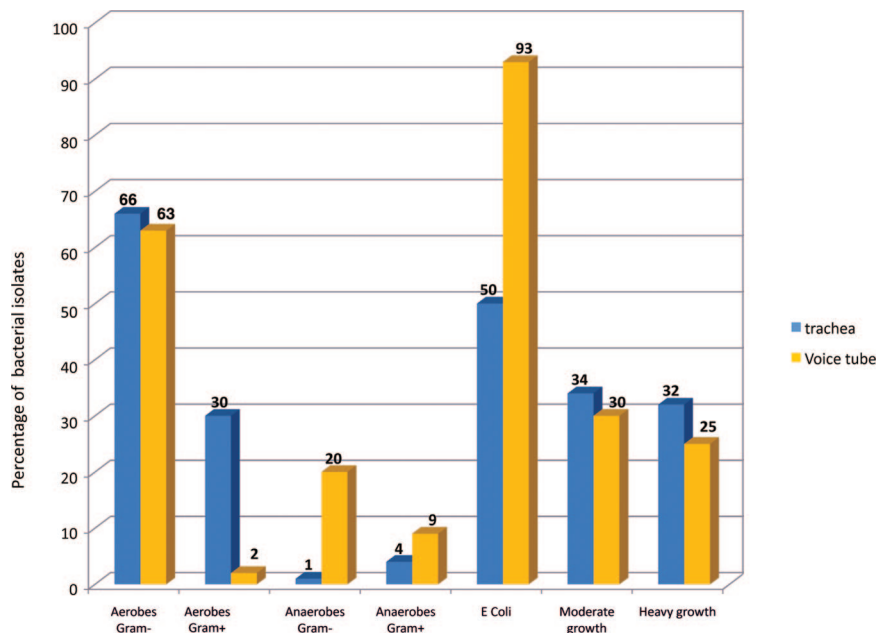

Fig. 3. Spectrum of the bacterial isolates from the voice tube and trachea. Gram-negative aerobes represented the majority of the isolates. *Escherichia coli* was the organism cultured most frequently.

which contributes to the sphincteric tone.[12] Harvest of a patch of cecum disrupts this mechanism and could potentially increase the aspiration rate. Patients undergoing reconstruction with the ileocecal patch flap did not show an increased incidence of aspiration compared with those undergoing free ileocolon flap surgery.

Although concurrent chemoradiotherapy has been reported to negatively affect the voice and swallowing following reconstruction with the free ileocolon flap,[5] chemotherapy and radiotherapy did not significantly increase the inhalation rate in our patients. Overall, the most frequent complaints were represented by chronic cough and daily production of sputum, affecting 46 percent and 49 percent of the patients, respectively. We believe that the prevalence of chronic cough and sputum in these patients was attributable mainly to the chronic tracheostomy rather than to the flap. We evaluated the prevalence of respiratory symptoms in the group of patients undergoing secondary reconstruction. These patients carried a chronic tracheostomy following primary laryngectomy and underwent subsequently reconstruction with a free ileocolon patch or a free ileocolon flap. We observed that the prevalence of chronic cough and sputum did not increase after reconstruction and was consistent with the data reported in the literature for patients with chronic tracheostomies (64 percent and 98 percent, respectively).[13]

Currently, the voice prosthesis inserted through a tracheoesophageal puncture represents the standard technique for voice rehabilitation following total laryngectomy. However, the applicability of this procedure in hypopharyngolaryngectomy is narrowed to the cases where an adequate esophageal stump is present, although a limited experience has been reported in autologous esophageal reconstruction with free jejunum or fasciocutaneous flaps. Among the complications associated with the procedure,[14] leakage through or around the prosthesis represents the most common, affecting between 2[15] and 26 percent[16] of patients and represents the main cause for replacement of the implant. The average device life has been reported to be between 5 and 12 months,[17] with definitive closure being necessary in 5 percent of the patients.[18] Insertion of the voice prosthesis through an intestinal or fasciocutaneous flap used for esophageal reconstruction is correlated with increased risks of stricture formation and enlargement of the puncture track, especially when the device is inserted primarily,[19,20] which is currently not advisable. Use of a double segment of free jejunum flap for simultaneous reconstruction of the esophagus and restoration of the voice is another option; however, it is associated with aspiration and a high rate of fistula formation (13 percent and 21 percent, respectively).[21] The latter accompanied by a more indigenous procedure led us to abandon this procedure that we were previously performing in favor of the ileocolon flap.

In the second part of this study, we investigated the bacterial flora of the voice tube. In contrast to the proximal parts of the enteric tube, the terminal ileum and colon are characterized by a resident microflora, with 10^{10} to 10^{12} bacteria per gram of intestinal content, consisting mainly (99.9 percent) of obligatory anaerobic microorganisms.[22] Therefore, use of these segments of the alimentary conduit, as opposed to jejunum, transfers a high bacterial load at the inlet of the trachea. Mechanical bowel preparation alone does not alter the luminal or mucosal associated bacterial counts significantly.[23] During the early period following surgery, moderate amounts of ileal secretions are produced from the voice tube. Although these secretions gradually decrease during follow-up, because of atrophy of the ileal mucosa (unpublished data), their bacterial content could contribute to the colonization of the tracheostomy site. The bacterial flora that characterized the trachea at the tracheostomy site in our patients was composed of Gram-positive and Gram-negative aerobic microorganisms, similar to previous studies.[24–26] Interestingly, differing from these reports, *Escherichia coli* represented the predominant species, probably derived from the voice tube flora. Our overall pneumonia rate was similar to that reported in the literature[24] for carriers of chronic tracheostomies, and none of the patients included in the screening study had suffered respiratory infections.

CONCLUSIONS

Rehabilitation of the voice and swallowing with the free ileocolon flap was shown to be a possible therapeutic option. Aspiration with or without overt infection could represent a problem if the continence of the ileocecal valve is not supplemented surgically. Furthermore, in the presence of a rich bacterial flora at the junction of the voice tube and tracheostomy, administration of broad-spectrum antibiotic therapy is wise while awaiting the results of specific cultures in the treatment of pulmonary infections in this group of patients.

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