The use of a chimaeric sero-muscular flap to prevent anastomotic leakage in head and neck reconstruction with free ileocolon flap

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Summary *Background:* In simultaneous reconstructions of cervical oesophagus and voice mechanism with free ileocolon flap, one of the most cumbersome complications is the anastomotic leakage at the junction between the colon and thoracic oesophagus.
Methods: Since 2007, a chimaeric sero-muscular flap has been islanded from the distal end of the voice tube to cover the anterior aspect of the colo-oesophageal junction. Fourteen patients undergoing reconstruction of the hypopharyngo-laryngectomy defects were consecutively treated with the sero-muscular flap. The leakage rate was compared with a group of 15 patients who were reconstructed with a free ileocolon flap prior to the adoption of the new procedure.
Results: All flaps survived completely. Swallowing function (scores 5—7), was restored in 69% of the patients. Speech function was restored (scores 4—5) in 59% of the patients. In the treatment group, only one patient suffered from anastomotic leakage compared to four patients in the control group.
Conclusions: The chimaeric sero-muscular flap can secure the colo-oesophageal junction, improving the healing process and preventing delays in the administration of adjuvant therapy.
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The free ileocolon flap is a reliable technique for restoration of swallowing function and speech in patients undergoing hypopharyngo-laryngectomy. The flap is composed by the caecum and part of the ascending colon, the ileocaecal valve and a segment of the terminal ileum. The ascending colon and caecum are employed to reconstruct the cervical

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portion of the oesophagus. The terminal ileum is used to create a biological tracheo-oesophageal fistula (voice tube), allowing the passage of air from the tracheal stump to the neoesophagus. The ileocaecal valve functions either as an antireflux system, preventing the passage of alimentary conduit content into the voice tube, or as a vibrating organ to generate voice.[1]

Although this flap has been associated with an overall low morbidity rate,[2,3] early postoperative salivary leakage from entero-oesophageal anastomosis could represent a cumbersome problem to resolve. The surrounding tissues are often poorly vascularised and fibrotic as a result of persistent infection, bilateral neck dissection or previous irradiation. Therefore, closure with local flaps warrants limited success, and a well-vascularised regional flap represents the main therapeutic option with the important drawback of reducing the number of reconstructive alternatives in case of recurrence in these difficult patients.

Since 2007, the authors have introduced a chimaeric sero-muscular flap harvested from the proximal end of the voice tube to reinforce the colo-oesophageal junction as a prophylactic measure to avoid anastomotic leakage. Here we report the results of the modified procedure as compared to a control group of patients.

Materials and methods

A prospective study was conducted enrolling 14 patients (group I) who underwent either voice or voice and swallowing reconstruction with free ileocolon and sero-muscular flap after laryngectomy or hypopharyngo-laryngectomy (primary reconstruction), between February 2007 and December2009. The study was approved by the Institutional Review Board of our hospital and informed written consent was obtained prior to surgery. For analysis of the outcomes, a group of 15 patients (group II) who underwent primary reconstruction with the traditional free ileocolon flap (January 2004 to December 2006) was used. Data regarding patient demographics, type of cancer, surgical procedure(s), perioperative and postoperative course, adjuvant therapies and complications were recorded.

The minimum follow-up duration was established at 18 months.

Presence of leakage was clinically defined by at least one of the following at any time after the reconstruction with an ileocolon free flap[4]: (1) any evidence of cervical wound infection requiring antibiotics or drainage; (2) radiologic evidence (by contrast pharyngo-oesophagogram) of free anastomotic leakage; or (3) radiographic evidence of contained anastomotic leakage significant enough to delay resumption of oral feedings.

Swallowing was evaluated according to the type of ingested food (solid, semisolid or fluid), alteration of eating habits, weight status and necessity for dietary supplementation. The occurrence of postoperative dysphagia, dumping, reflux or aspiration was investigated. A seven-point Likert scale was used to evaluate the deglutition, where 1 indicated severe complaints and an inability to swallow and 7 indicated satisfactory swallowing without any complaints.[5] Speech function was recorded as the percentage of intelligible words when speaking, loudness of speech and fluency of the speech. A modified version of the five-point Likert scale was used for the evaluation, where 1 indicated the patient could not produce any voice and 5 indicated a very good outcome.[5]

Oesophagography with barium meal, video-fluoroscopic swallowing tests and a computed tomography scan of chest and neck were performed during the regular follow-up.

Fisher's exact test was used to assess the fistula formation rate between the two groups and considered significant if $p \leq 0.05$. Wilcoxon's test was used to assess the differences of speech and swallowing between the two groups and considered significant if $p \leq 0.05$.

Surgical procedure

The surgical procedure has been described elsewhere.[2] In this article, we summarise the technical details of relevance to the present study.

A free ileocolon flap based on ileocolic vessels was harvested through a midline laparotomy incision. A 3-cm segment of the ileal loop was isolated from the distal end of the ileal loop. The mesenteric vascular arcades connecting the ileal segment to the main flap were successively ligated until sufficient mobility was achieved. The ileal segment was opened along the antimesenteric border (Figure 1). The submucosa was inflated by an injection of 1% lidocaine and epinephrine 1:10,000, and the mucosa was removed with
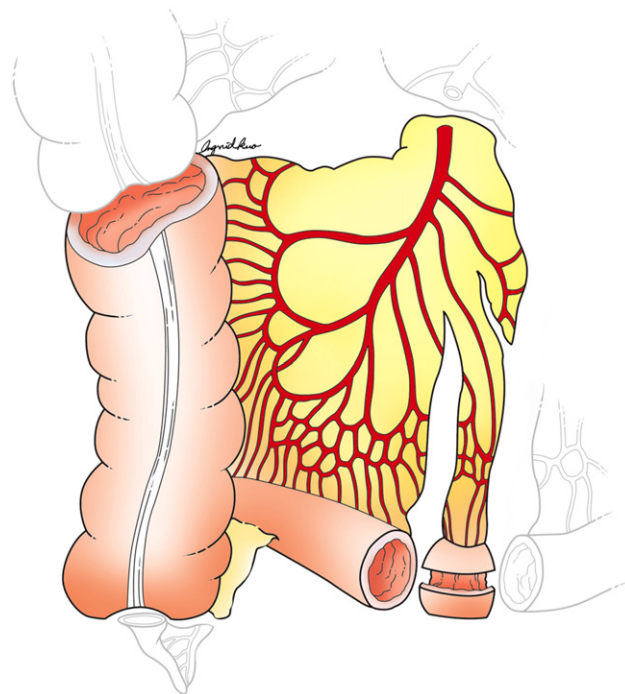

Figure 1 The ileocolon flap is harvested based on the ileocolon artery and vein. A 3-cm segment of the ileal loop is isolated from the proximal part of the ileum. The mesenteric vascular arcades connecting the sero-muscular flap to the main flap are successively ligated until sufficient mobility is achieved. The chimaeric flap is opened along the antimesenteric border.

scissors (Figure 2). The chimaeric flap was then transferred to the neck. Flap inset began after completion of the microvascular anastomoses. The ascending colon was used to reconstruct the hypopharynx and cervical oesophagus in an isoperistaltic direction. An appendectomy was performed and through the base of the appendix a transverse incision was made in the caecum to allow the inset of the flap into the hypopharyngeal stump. The proximal end of the caecum was sutured to the pharyngeal stump in a two-layered fashion. The back wall was repaired prior to the suture of the anterior aspect of the anastomosis. The second layer was then performed. During placement of the second layer of sutures, the critical area was the mesenteric side. This area was carefully closed by approximating colon to neck structures to imbricate the first layer. Distally, the flap was sutured to the oesophageal stump in a two-layered fashion.

The sero-muscular flap, 7 × 3 × 0.5 cm, was then sutured to the antero-lateral walls of the colo-oesophageal anastomosis, with interrupted 4/0 polydioxanon (PDS) with the mesenteric axis parallel to the anastomotic suture line (Figure 3).

An oesophagography with barium meal was performed 2 weeks postoperatively, and if leakage from the anastomosis was absent, the patient started the swallowing training. At the same time, a speech therapist started the rehabilitation of the voice.

Results

In group I, there were 12 males and two females with a mean age of 53 years (range 41−72 years). The indications for reconstruction with the free ileocolon flap were hypopharyngeal cancer (10), thyroid cancer (2), oesophageal cancer (1) and laryngeal cancer (1). All of the patients received reconstruction with a free ileocolon flap and sero-muscular flap. Ten patients received radiotherapy as part of the treatment. The average follow-up was 31 months.

In group II, there were 14 males and one female with a mean age of 58 years (range 41−79 years). The indications for surgery were hypopharyngeal cancer (11) and laryngeal

Figure 2 Intraoperative image of the sero-muscular flap isolated from the distal part of the ileal loop after removal of the mucosa.
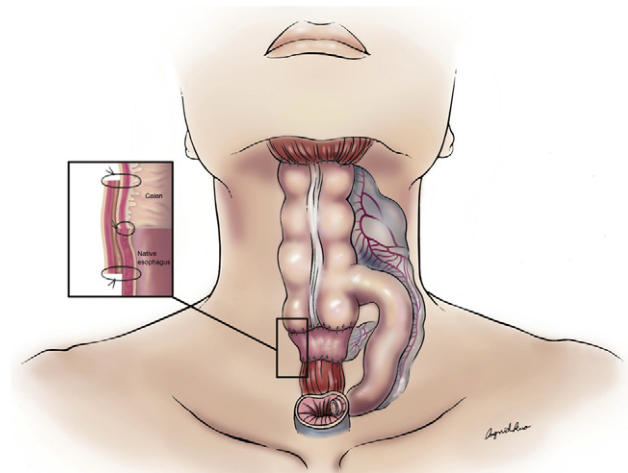

Figure 3 Schematic representation of the chimaeric sero-muscular flap used to seal the colo-esophageal junction. The flap has been opened along the antimesenteric border and draped over the anterior wall of the distal colo-esophageal anastomosis.

cancer (4). All patients received reconstruction with a free ileocolon flap and radiotherapy as part of the treatment. The average follow-up was 71 months.

Anastomotic leakage

Overall, five patients suffered from anastomotic leakage presenting with recurrent cough, choking and leakage of saliva from the tracheostome or discharge from the skin. All of the fistulas stemmed from the anterior wall of the colo-oesophageal junction as evidenced by oesophagography and computed tomography (CT) scan.

In group I, only one patient developed leakage, 1 month after reconstruction (group I leakage rate 7%). Conservative treatment achieved complete closure of the fistula.

In group II, four patients experienced leakage from 1 month to 17 months after reconstruction (group II fistula rate 27%). Three patients presented with fistula between the neoesophagus and cervical skin (entero-cutaneous fistula) and were treated with a delto-pectoral flap or with a pectoral major flap; one patient presented with a fistula between the neoesophagus and tracheostome (tracheo-oesophageal fistula) and was treated with a sero-muscular flap. No recurrence was experienced.

Differences between the two groups were not statistically significant ($p = 0.33$).

Swallowing and speech

In both groups, the median swallowing score was 5. Half of the patients presented only minimal complaints and were totally able to swallow without a bolus (dry swallowing) at the last follow-up. The median speech score was 4 in either group. Half of the patients spoke long sentences with an intelligible voice and moderate loudness. There were no statistically significant differences between the two groups (swallowing, $p = 0.2$: speech, $p = 0.8$).

Discussion

A free ileocolon flap was described in 1992 by Kawahara et al.[1] for simultaneous restoration of voice and swallowing functions in extensive hypopharyngo-laryngectomy defects. Since its original description, several series have been published evaluating the functional outcomes as well as the safety and reliability of this novel technique.[2,3,5,6]

Between January 1995 and December 2010, simultaneous reconstruction of the digestive tract and voice mechanism was performed in 78 patients with a free ileocolon flap. Early postoperative salivary leakage from the cervical anastomosis represented a problem difficult to resolve in these patients. This complication when it occurred contributed to significant postoperative morbidity through extended hospital stay, delay in adjuvant therapy and nutritional setbacks.[7] Although small fistulas and proximally occurring fistulas have a higher spontaneous closure rate and could therefore respond to the conservative management,[7,8] larger fistulas, distal fistulas and fistulas occurring after radiotherapy often require surgical closure.[7] However, local flaps are usually unusable and harbour a great risk of failure in the setting of fibrosis consequent to bilateral radical neck dissection, irradiation or persistent infection. Even with regional flaps, the operative treatment of persistent or recurrent fistulas could prove unsatisfactory[9] decreasing, moreover, the reconstructive options in the case of recurrence of cancer.

In designing an effective preventive measure for anastomotic leakage, it is of utmost importance to consider the different anatomical distribution of this complication in the different reconstructive methods. When the cervical oesophagus is reconstructed with free fascio-cutaneous flaps, the fistulas occur both proximally and distally with similar incidence. The reason has been imputed to the vulnerability of the T junction to intermittent rises of the intraluminal pressure and reduced vascularity.[10] In reconstructions performed with free jejunum flaps, the fistulas tend to occur more often at the proximal pharyngo-jejunal anastomoses,[7,11,12] mainly because of greater circumference discrepancy between the jejunum and pharyngeal remnant. On the contrary, the leakage in our patients originated at the distal colo-oesophageal anastomosis. The greater calibre of the caecum, as compared to the jejunum, allows for a more facile anastomosis proximally. However, distally it creates a mismatch with the oesophageal remnant with an increased risk of leakage. Other factors that contribute to fistula formation in this location are anastomotic strains during coughing and lack of serosa of the thoracic oesophagus. In our experience, the distal colo-oesophageal fistulas have a constant anterior location. Interestingly, this has been the case also for the jejuno-oesophageal fistulas, as reported by Reece[13] and Chang.[7]

This consistent anterior and distal location of the fistulas occurring in oesophageal reconstructions performed with the free ileocolon flap convinced us to use a chimaeric sero-muscular flap harvested from the distal end of ileum, as a prophylactic measure, to decrease the occurrence of anastomotic leakage.

The clinical use of a pedicled sero-muscular flap from the jejunum has been successfully described in a few case reports for the treatment of vescico-vaginal,[14] recto-vaginal[14] and broncho-cutaneous fistulas[15] and for protection of high-risk intestinal anastomoses.[16] We modified the concept of the sero-muscular flap for the treatment of the distal colo-oesophageal fistulas, harvesting the flap from the distal end of the ileal stump. The preventive use of the sero-muscular flap decreased the leakage rate from the high 27% (four patients) in the control group to 7% (one patient) in the treatment group. However, this difference was not statistically significant possibly because of the small sample size ($p = 0.33$). Moradi et al.[12] described the use of a pedicled pectoralis major flap for prevention of pharyngo-cutaneous fistulas in patients undergoing reconstruction with free jejunal transfers. They reported a decrease in fistula rated from 7% to 0% (difference not significant, $p = 0.54$).

The use of the sero-muscular flap did not affect negatively the voice production and the swallowing function. There were no statistical differences for the functional outcomes of swallowing and speech between the two groups.

In conclusion, the chimaeric sero-muscular flap method offers multiple intrinsic advantages: the flap is easily isolated from the distal end of the ileum; it has a rich vascular supply; it is thin and pliable and does not compress the anastomosis; given the close proximity of the distal ileum and the colo-oesophageal anastomosis after the inset of the ileocolon flap, the sero-muscular flap does not require further mobilisation to cover the suture line; it has no additional donor-site morbidity and most importantly spares the regional flaps for the treatment of the recurrences.

Funding

Conflict of interest statement

None.

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