Surgical rehabilitation of dysphagia after partial laryngectomy

Introduction

Surgical rehabilitation of dysphagia, after partial laryngectomy, is aimed at improving the sphincteric action of the larynx, the anatomy and physiology of which is completely deranged due to oncologic surgery. After surgical treatment of supraglottic horizontal laryngectomy, swallowing usually recovers spontaneously and completely, while after surgical treatment such as reconstructive laryngectomies with crico-hyoidoepiglottopexy, crico-hyoidoepiglottopexy or tracheo-hyoidoepiglottopexy “microinhalations” are unavoidable which decrease with time and particularly with logopaedic rehabilitation. But if, after several weeks, “macroinhalations” are present, which can cause bronchopneumonia ab ingestis, then surgical rehabilitation is indicated, in order to avoid gastric tube (percutaneous endoscopic gastrostomy - PEG) or total laryngectomy.

The most frequent anatomic situations which must be treated are:
- an excessively posterior position of the cricoid ring in pexy with hyoid bone;
- a reduced backwards pushing of the tongue base;
- stiffness, reduced motility or improper movements of the arytenoid/s, due to injury of the recurrent laryngeal nerve or to a block of the crico-arythenoid articulation;
- an excessively anterior position of the residual epiglottis;
- a small amount of mucosa covering the cricoid and/or the arytenoid/s cartilage;
- reduced pharyngeal sensitivity, due to injury of the superior laryngeal nerve;
- scarring stenosis of the pyriform sinuses or excess mucosa in the neolarynx which interfere with the bolus progression;
- in outcomes of supraglottic horizontal laryngectomy, surgical rehabilitation is rarely necessary, however, it can be advisable in the event of:
  a. hypotrophic vocal folds,
  b. reduced motility or paralysis of one or both vocal folds due to recurrent laryngeal nerve paralysis or crico-arythenoid articulation block,
  c. intervention enlarged to the tongue base.

These situations can cause bolus inhalation, which is mostly intra-deglutitive, on account of an alteration in the pharyn-
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Surgical procedures of injection laryngoplasty

Surgical approach through microendoscopy is performed under general anaesthesia with oro-tracheal intubation. For fat injection, we use a 1 mm calibre needle (Fig. 1). This allows integrity of adipocytes to be preserved, an essential means to avoid massive fat reabsorption.

Fat can be removed by means of lipo-aspiration from the sub-cutis of the peri-umbilical region, using a 10 cc disposable autostatic syringe, connected via luer-lock to a 14 Gauge needle for thoracenthesis. Prior to this step, a vasocostrictor solution is injected into the peri-umbilical region (to reduce blood in the fat sample and to prevent ruise). With “come and go” movements two syringes of 10 cc are filled. Then the needle is removed from the syringe and substituted by a luer-lock plug; the syringe is centrifuged at 3000 turns per minute, for 3 minutes, as described by Coleman 10. This procedure separates fat from blood; then blood is eliminated and the concentrated fat is placed in a 5 cc luer-lock syringe with a three-way joint. Contact of the fat with air, during the transfer from one syringe to another, must be avoided, in order not to cause oxidation of the fat. The 5 cc syringe can be directly linked to the endoscopic needle or inserted into a high pressure injection pistol (Fig. 2), offering better control of the injection procedure. It is always necessary to inject a double quantity of fat in order to correct glottic or neoglottic insufficiency, as

Fig. 1. Endoscopic needles by Storz® (Karl Storz GmbH & Co. KG, Tuttingen, Germany) for fat injection (below) and injection of collagen, hyaluronic acid, fluids (above) 5.
part of the injected fat (from 30% to 70%) is reabsorbed. For injection of collagen and hyaluronic acid, a thinner needle can be used (Fig. 1), which is linked to the high pressure syringe, in which the material is placed using a three-way circuit.

It is very important to make a slow and gradual injection, as the material must fill only the chosen point of injection, without lacerating the mucosa with consequent extrusion of the material into the airways.

Surgical approach through fiberoendoscopy is performed under local anaesthesia with vaporization of 10% lidocaine into the nose and the pharynx and with instillation of 4% and 10% lidocaine into the larynx. The local anaesthetic is also added to the solution used for subcutaneous infiltration into the site of fat withdrawal. Light sedation with 2-3 mg of Midazolam can be performed intravenously. This technique, called “fiberoendoscopic phonosurgery” (FEPS), has been proposed by the CELF group of Santander and developed in Italy with the setting up of specific instrumentation. We use a fiberoptic endoscope with a 2 mm working channel, where endoscopic instruments such as needles, forceps and scissors are inserted. Fiberoptic endoscopes are now substituted by high definition flexible digital endoscopes, with a distal chip camera, which offers high quality images, as in microlaryngoscopy; in these endoscopes, the optic fibers bring only the light to illuminate the visual field. For fat injection, we use a 19 Gauge endoscopic needle 80 cm in length, within a plastic catheter which prevents damage to the endoscope. For collagen or hyaluronic acid injection, a 23 Gauge needle can be used (Fig. 1), which is linked to a 19 Gauge BTC endoscopic needle 80 cm in length, within a flexible digital endoscopes, with a distal chip camera, which offers high quality images, as in microlaryngoscopy; in these endoscopes, the optic fibers bring only the light to illuminate the visual field. For fat injection, we use a 19 Gauge endoscopic needle 80 cm in length, within a plastic catheter which prevents damage to the endoscope.

The advantages of the fiberoendoscopic, compared to the microlaryngoscopic, procedure are:
- “functional” display of the operative field, with the possibility to check the effect of laryngoplasty on swallowing and phonation;
- chance to perform the intervention even when tracheostomy has already been closed.

On the other hand, disadvantages are:
- need of collaboration on the part of the patient as swallowing must not be affected during the injection;
- a less precise injection, as the needle cannot remain inserted for a long time, since slight movements of the patient, the needle or the endoscope can enlarge the breach or lacerate the mucosa, with consequent leakage of material into the airways.

Patients and methods

In the last 2 years, 7 patients with severe dysphagia, due to partial laryngectomy, have undergone surgical rehabilitation:
- 4 patients with cricohyoidoepiglotticpexy with maintenance of 1 arythenoid;
- 2 patients with cricohyoidoepiglotticpexy with maintenance of 2 arythenoids;
- 1 patient with cricohyoidoepiglotticpexy with maintenance of 1 arythenoid.

All patients were males, aged between 43 and 78 years. The surgical technique performed was:
- injection laryngoplasty with bovine collagen (Zyplast®, McGhan Medical Corporation, Fremont, CA, USA) through fiberoendoscopy under local anaesthesia in 4 cases;
- injection laryngoplasty with autologous fat through fiberoendoscopy under local anaesthesia in one case;
- injection laryngoplasty with PDMS (Vox Implants®, Uroplasty Inc, Minnetonka, MN, USA) through microlaryngoscopy in 2 cases.

Clinical evaluation of dysphagia was based on the anamnestic evaluation of the swallowing problem (Table I) and on endoscopic and radiological dynamic study of swallowing (Table II), which were performed the day before intervention and then one week, one month, 6 months and one year after intervention. In the patients with tracheostomy, fiberoendoscopy during swallowing and phonation was performed by the trans-nasal and trans-tracheostomyc approach. The most suitable injection points, the material to be used and the surgical procedure to apply were chosen after careful re-examination of the laryngeal endoscopy and of the radiological dynamic study.

Table I. Anamnestic evaluation of dysphagia

<table>
<thead>
<tr>
<th>Score</th>
<th>Symptoms</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Normal deglutition</td>
</tr>
<tr>
<td>2</td>
<td>Occasional cough during saliva deglutition, not related to food introduction</td>
</tr>
<tr>
<td>3</td>
<td>Occasional cough during food introduction</td>
</tr>
<tr>
<td>4</td>
<td>Frequent cough during food introduction</td>
</tr>
<tr>
<td>5</td>
<td>Frequent cough not related to food introduction</td>
</tr>
<tr>
<td>6</td>
<td>Ab-ingestis pneumonia</td>
</tr>
</tbody>
</table>

Table II. Endoscopic and radiologic evaluation of swallowing

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Material does not enter airway</td>
</tr>
<tr>
<td>2</td>
<td>Material enters airway, contact with glottis, stimulates cough reflex and is ejected completely</td>
</tr>
<tr>
<td>3</td>
<td>Material enters airway, contacts glottis, stimulates cough reflex and is not completely ejected</td>
</tr>
<tr>
<td>4</td>
<td>Material enters airway, passes below glottis, stimulates cough reflex and is ejected completely</td>
</tr>
<tr>
<td>5</td>
<td>Material enters airway, passes below glottis, stimulates cough reflex and is not completely ejected</td>
</tr>
<tr>
<td>6</td>
<td>Material enters airway, passes below glottis and no effort is made to reject</td>
</tr>
</tbody>
</table>
Results
In the 7 patients treated, the following results were obtained (Table III):
– complete recovery of dysphagia for solids and liquids in 4 patients (57.1%, cases nos. 1, 2, 3, 4); two of them (cases nos. 1, 2) still had tracheostomy, which was closed one week after injection laryngoplasty. Phonation also improved, with better loudness of voice as well as longer duration of voice. The positive result was still maintained one year after intervention (Fig. 3);
– for 2 patients (28.5%, cases nos. 5, 6) only a partial positive result was achieved, as one month after an initial improvement, dysphagia for liquids was again observed; these 2 patients had very difficult anatomic situations, with a wide neogloctic insufficiency. Neither patient had tracheostomy. One patient (case no. 5) was operated of cricohyoidopexy with maintenance of 2 (small) arytenoids; an injection laryngoplasty with PDMS (Vox Implants®) through microlaryngoscopy, under general anaesthesia, was performed, after first re-opening of tracheostomy for the anaesthesiologic intubation.

Table III. Results 3 months after injection laryngoplasty.

<table>
<thead>
<tr>
<th>No.</th>
<th>Patient</th>
<th>Dysphagia score</th>
<th>P-A scale modified</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre-operative</td>
<td>Post-operative</td>
</tr>
<tr>
<td>1</td>
<td>J.M.</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>L.S.</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>V.C.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>L.C.</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>R.G.</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>E.R.</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>T.E.</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

* Result 1 week after intervention

Fig. 3. Laryngeal fiberendoscopy in case no. 1, operated for partial laryngectomy with crico-hyoidopexy with preservation of right arytenoid; a, b: pre-operative pictures during breathing (a) and phonation (b), c, d: laryngeal fiberendoscopy one year after injection laryngoplasty with bovine collagen (Zyplast®) into arytenoid and cricoid during breathing (a) and phonation (b).
In the other patient (case no. 6), operated upon for cri-
cothyoidectomy with preservation of one arytenoid, an
injection laryngoplasty with bovine collagen (Zyplast®)
through fiberendoscopy, under local anaesthesia, was
performed. For both patients, a new intervention of in-
jective laryngoplasty with collagen through fiberendos-
copy was performed:

− in one patient (14.4%, case no. 7), positive results were
not achieved despite collagen injection through fiberen-
doscopy, and followed by PDMS injection through mi-
croaryngoscopy. The patient, a 78-year-old male with
tracheostomy, operated for atypical sub-total larynge-
tomy with maintenance, but with stiffness, of both arytenoids, with a wide “slide” effect on the tongue
base and with a spasm of the crico-pharyngeal mus-
cle (revealed by video-fluoroscopy), which created a
post-deglutitive stagnation of food with inhalation that
caused several bronchopneumonias ab ingestis. The
patient could not undergo a botulin toxin injection into
the crico-pharyngeal muscle, because of a hiatal hernia
with severe gastro-oesophageal reflux, not brought un-
der control with proton pump inhibitors treatment. In
this patient, it was necessary to perform total laryngec-
tomy.

Conclusions

These first results, even if referring to a small number of
cases, show that injection laryngoplasty through fiberen-
doscopy can be considered a good solution for dysphagia
after partial laryngectomy. Also the voice can improve with
this procedure. Our experience with injection of Vox Im-
plants® through microaryngoscopy is still in the early stage
and it is too early to express judgement, but a recent report
by Bergamini et al. 10, on the use of this technique, in 8
patients submitted to partial laryngectomy, leads to encour-
aging results.

Finally, it is worthwhile stressing that logopaedic rehabili-
tation is fundamental in order to strengthen the results of
surgical treatment of dysphagia.

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