The Laryngoscope

HOW I DO IT

Epiglottis Stiffening Operation for Epiglottis Collapse in OSAS: Standardization, Tips and Tricks

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INTRODUCTION

Treatment of primary epiglottis collapse (EC) in patients with obstructive sleep apnea/hypopnea syndrome (OSAHS) still represents a challenge. Drug-induced sleep endoscopy (DISE)[1] has allowed assessment of the prevalence of EC in 10% to 40% of patients suffering from OSHAS. In order to treat this condition, we developed a minimally invasive technique called "Epiglottis Stiffening Operation" (ESO).[2] By the time, ESO has shown to be a safe and easy-to-perform procedure, with great efficacy and very short surgical training required. Herein, we propose standardization of this technique by describing the surgical procedure in detail, including some tips and tricks.

METHODS

This study was conducted at the Department of Otorhinolaryngology of Humanitas San Pio X, a referral center for the management of sleep-related breathing disorders. All patients signed an informed consent form, and the study was carried out in accordance with the principles of the Helsinki Declaration and approved by the local Ethics Committee.

All patients who underwent ESO between January 1, 2015 and December 31, 2020 were enrolled for the study.

During the preoperative diagnostic work-up, each patient underwent a complete physical and endoscopic evaluation, polysomnographic study (PSG), and DISE. DISE was always performed by an expert ENT and recorded and later collegially discussed among the ENT surgeon, neurologist, pneumologist, and odontologist. All treatment options, including custom surgery, were proposed to the patient. Epidemiological and clinical data, surgical reports, outcomes, complications, and follow-up information were reviewed.

Indications

The presence of a primary EC, both complete (OSAHS) and partial (snoring), is the main indication for this type of procedure.

Surgical Technique

Exposition of the epiglottis in direct micro-laryngoscopy is performed using a traditional laryngoscope (e.g. Störz or Wolf) after mouth-guard application. In this phase, the lingual side of the epiglottis totally (or almost totally) occupies the field of the laryngoscope and its free edge touches the lower edge of the laryngoscope itself. The working area is identified as a rectangular area extended 1/3 in the upper half and 2/3 in the lower half of the epiglottis, between the lateral glossoepiglottic folds (including the median glossoepiglottic fold) (Fig. 1A). Using a *Kleinsasser* suction cautery (outer diameter 3 mm and working length 26 cm) with an *Erbe system* set in the forced coagulation mode (50 Watt max.), the exuberant mucosa included in the working area is raised and so cauterized causing an immediate and visible retraction of the epiglottis. In this phase, it is important to reach the perichondrium in order to induce stiffening and scar retraction of the tissues as a result of healing. The cauterization stops when the epiglottis free edge is seen more or less in the middle of the surgical field (Fig. 1B). During this step, it is mandatory to preserve the free margin of the epiglottis. The procedure ends by removing the excess cauterized tissue using a cottonoid soaked in physiological water. The laryngoscope is retracted and the mouth-guard is removed.

Contraindications

Body mass index (BMI) > 35 and anatomical features (e.g. trismus, mandibular prognathism, etc.) making laryngeal exposure difficult[3] represent contraindications for this technique. Furthermore, this procedure is not indicated when a bulky tongue base pushes the epiglottis backward (secondary EC).

Postoperative Management

Verbal Numerical Rating Scale 11 (vNRS-11) and Eating Assessment Tool 10 Italian version (I-EAT-10) (Table I)

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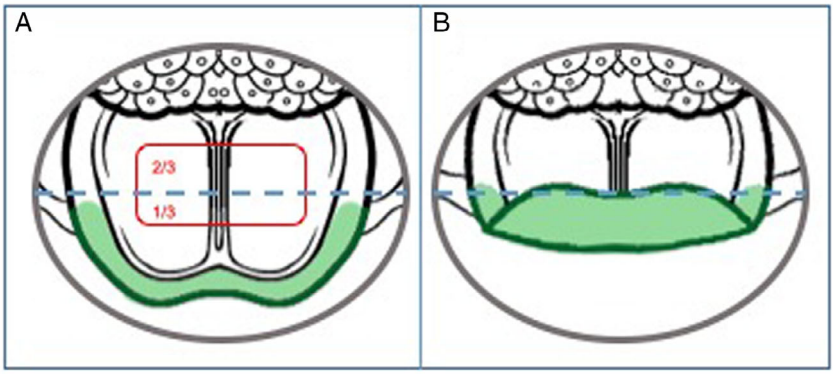


Fig. 1. (A) Exposing the epiglottis, the work area is identified as a rectangular area extended 1/3 in the upper half and 2/3 in the lower half of the epiglottis. (B) Visualization of the epiglottis in the middle of the surgical field at the end of procedure.

TABLE I.
Eating Assessment Tool—10 (EAT-10).

#1	My swallowing problem has caused me to lose weight.	0	1	2	3	4
#2	My swallowing problems interferes with my ability to go out for meals	0	1	2	3	4
#3	Swallowing liquids takes extra effort	0	1	2	3	4
#4	Swallowing solids takes extra effort.	0	1	2	3	4
#5	Swallowing pills takes extra effort.	0	1	2	3	4
#6	Swallowing is painful	0	1	2	3	4
#7	The pleasure of eating is affected by my swallowing.	0	1	2	3	4
#8	When I swallow food sticks in my throat.	0	1	2	3	4
#9	I cough when I eat.	0	1	2	3	4
#10	Swallowing is stressful	0	1	2	3	4
	Total (max $4 \times 10 = 40$)					

This test allows us to document the degree of patient-reported swallowing-related disability. an EAT-10 ≥ 3 is abnormal. 0 = *no problem*; 1 = *mild problem*; 2 = *mild to moderate*; 3 = *moderate problem*; 4 = *severe problem*.

TABLE II.
Demographic Data of the Sample.

	M	F	Tot	
#	77 (88.5%)	10 (11.5%)	87	
OSAHS	65 (89%)	8 (11%)	73 (83.9%)	
Simple snoring	12 (85.7%)	2 (14.3%)	14 (16.1%)	
Mean age (yr)	52.2 ± 11.1	60.4 ± 9.1	53.1 ± 11.1	
Mean BMI (kg/m^2)	26.5 ± 2.9	26.6 ± 3.9	26.8 ± 3.1	
Preoperative features				
Mean AHI*	29.9 ± 20.7	30.6 ± 18.6	30 ± 20.3	
Mean snoring time (%)	25.7 ± 19.6	37.2 ± 25.9	26.7 ± 20.3	
Mean ESS	10.9 ± 4.1	9 ± 4.2	10.6 ± 4.1	
Postoperative features				
Mean AHI*	7.9 ± 9.6	3.52 ± 4.2	7.3 ± 9.2	$P < .01$
Mean snoring time (%)	14.1 ± 9.3	5.6 ± 5.4	11.2 ± 8.8	$P < .01$
Mean ESS	6.7 ± 2.3	3 ± 1.6	6.3 ± 2.2	$P < .01$
EAT-I 10	0.67 ± 0.7	0.63 ± 0.6	0.66 ± 0.7	
Mean FU (mo)	17.2 ± 13.5	23.5 ± 12.6	18 ± 13.4	

*Calculated on OSA patients.
P value < ,01: *t-Student* test comparing pre- and postoperative values of AHI, snoring time, ESS.
AHI = Apnoea Hypopnoea Index; BMI = Body Mass Index; EAT-110, eating attitude test (Italian version); ESS = Epworth Sleepiness Scale; F = female; FU, follow up; M, male; OSAHS, obstructive sleep apnoea-hypopnoea syndrome.

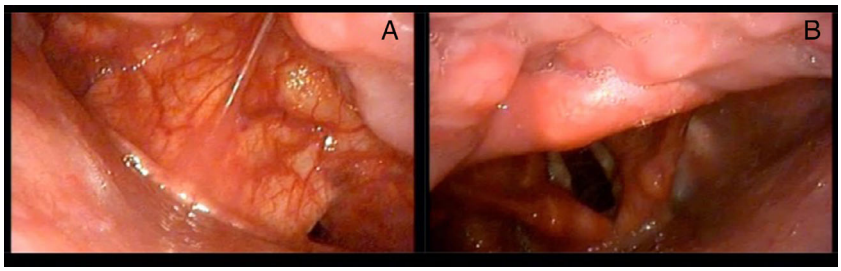


Fig. 2. (A) Preoperative evidence of total primary epiglottis collapse during DISE. (B) Stiffened epiglottis at 3 months postoperative DISE, the physiological shape of epiglottis is preserved without collapsing.

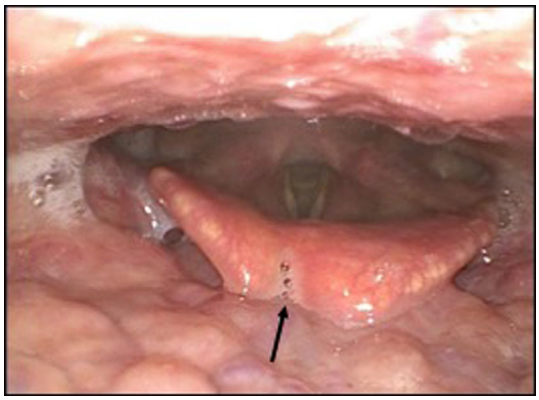


Fig. 3. Postoperative onset of a notch of loss of substance caused by a vigorous manipulation of the epiglottis during the procedure. Example of improper healing of the epiglottis after ESO.

questionnaire were administered postoperatively Patients were discharged in 1st postoperative day with oral antibiotics therapy consisting in a 3rd gen. Cephalosporins (e.g. cefixime) once daily for 7 days and a smooth and cold diet for 7 to 10 days. Corticosteroids administration is not necessary. Patients were followed for at least for 6 months postoperatively; endoscopic evaluation on 7th and 30th postoperative days and PSG at 3 months were always performed.

RESULTS

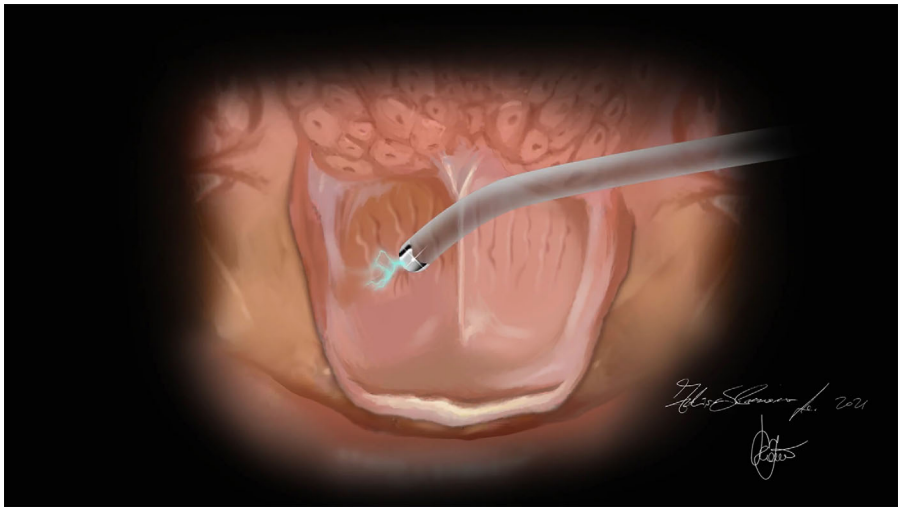
From January 2016 to December 2020 we performed 536 surgical procedures for OSAS, identifying a total of 109 patients with primary EC. 22 patients underwent ESO within a multilevel snore surgery and were therefore ruled out, while of 87 patients, who underwent ESO exclusively, fulfilled the inclusion criteria. Demographic data of the patients enrolled are summarized in Table II.

A strong prevalence of males was found since only 10 patients were women (11.5%) while 77 were men (88.5%); the mean age was 53.1 year-old(DS $\pm$ 11.1). Mean BMI was 26.8 kg/m^2 (DS $\pm$ 3.1). 14 (16.1%) patients were affected by simple snoring with a mean snoring time 26.7% (DS $\pm$ 20.3) and 73 (83.9%) patients were affected by OSAHS with a mean AHI of 30 (DS $\pm$ 20.3). The postoperative course of all patients was regular substantially without pain (vNRS-11 range from 0 to 3), with discharge in the 1st post-op day. Moreover, no patient had dysphagia, aspiration (I-EAT 10 range from 0 to 2—Normal if <3) or dysphonia. two patients affected by diabetes mellitus had postoperative epiglottitis treated with oral antibiotics and solved within 6 days. Postoperative fiberoptic endoscopic evaluation on 7th and 30th postoperative day showed a consistent retraction of the epiglottis in all the patients (Fig. 2). In three cases loss of substance on the free edge of the epiglottis was found during the second postoperative examination (Fig. 3). Mean postoperative AHI was 7.3 (DS $\pm$ 9.2), mean postoperative snoring time was 11.2 (DS $\pm$ 8.8), and mean ESS was 6.3 (DS $\pm$ 2.2). Follow-up last 6 to 68 months (mean, 18 months; DS $\pm$ 13.4) (Video S1).

DISCUSSION

EC is an extremely important factor to evaluate in all those patients not-responders to conservative treatments for OSAHS, such as CPAP or MAD application. In fact, the positive pressure into the pharyngo-laryngeal space in patients with EC is responsible for a greater collapse of the free edge of the epiglottis into the glottic aditus, worsening the symptoms and the AHI. Moreover, in some patients it is also possible to appreciate the lack of stability of the epiglottis during the mandibular pull up at DISE, reducing the chance of complete resolution of the obstruction by means of an oral appliance.[2] As a consequence, surgical treatment could represent a good option when dealing with EC, even though up to now no standardized surgical procedures have been described. In order to approach EC, we got inspired by the C.A.P.S.O. (Cautery Assisted Palate Stiffening Operation) described by Pang et al.[4] It consists in the removal of an area of palatal mucosa with an electric scalpel inducing scar retraction without sutures so that stiffening of the soft palate is obtained, decreasing snoring and palatal prolapse. Similarly, we applied this principle at the lingual surface of the epiglottis, naming our procedure as "Epiglottis Stiffening Operation" (ESO).

Since epiglottis plays a role in preventing aspiration thanks to its sensitive receptors (distributed on the laryngeal surface, aryepiglottic folds, arytenoids, and posterior commissure) that stimulate the so-called "glottis closure reflex."[5] For this reason it is necessary to preserve a rim of healthy tissue along the free border of the epiglottis,



Video 1. Epiglottis stiffening operation:surgical technique. Video content can be viewed at https://doi.org/10.1002/lary.30089

saving sensitive receptors for the activation of these reflexes. In our experience, no patients with dysphagia were reported. It is also important to remember the particular slenderness of the epiglottis: we recommend gently handling it to avoid unexpected loss of substance (Fig. 3). The crucial step to maximize the efficacy of the procedure stands in reaching the perichondrium of the lingual side of the epiglottis with the suction cautery, especially on the midline, in order to induce an effective stiffening in the direction of the median thyroepiglottic ligament. Furthermore, in the case of the omega-shaped epiglottis, a horizontally extended cauterization leads to a simultaneous epiglottis opening and stiffening. It is necessary to consider that reaching the perichondrium, can predispose to cartilage exposure and consequent infections and necrosis: postoperative antibiotic administration is therefore strongly suggested. Other factors should be considered as tips and tricks when performing ESO: a) simultaneous scarification and suction reduce the excess of lax tissues at the same time; b) a small endotracheal tube allows good and complete visualization of the epiglottis; c) very low power cauterization avoids heat diffusion, reducing the chance of incorrect healing or even loss of substance of the epiglottis.

In conclusion, our technique showed good results comparing preoperative and postoperative AHI, snoring time, ESS with statistical significance ($P < .01$) and no major complications (e.g. dysphagia) occurred, proving to be a good surgical option in treating primary EC. On the basis of our experience, this procedure is safe and effective as a treatment for EC without altering epiglottis fundamental functions and devoid of major complications, easy to perform, modular, and with a very fast surgical training time. The short healing time and the lack of discomfort for the patients allow surgeons to perform ESO alone or in association with other techniques, in a multimodal multilevel surgical treatment.

AUTHOR CONTRIBUTIONS

All authors have read and approved the final version of the article.

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