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MISCELLANEOUS

Swallowing outcome after TORS for sleep apnea: short- and long-term evaluation

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Abstract The aim of this study was to evaluate outcomes related to swallowing function in patients who underwent transoral robotic surgery (TORS) for sleep apnea on both short- and long-term scales. 78 patients who underwent TORS for sleep apnea between 2011 and 2014 were followed up for an average period of 20 ± 7.12 months (range 7–32 months), then swallowing outcomes determined by MD Anderson Dysphagia Inventory (MDADI) questionnaire, gastrografin fluoroscopy imaging results, nasogastric tube dependence and subjectively by recording the patients' complaints were analyzed and reported. Minimal insignificant short-term impact on swallowing function (4.58 ± 7.03 preoperative MDADI score versus 5.18 ± 8.32 post-operative) ($p = 0.56$) was registered. Mean time for start of oral feeding was 1.05 ± 0.25 days (average, 1–3). In no case nasogastric tube feeding was required. Only five patients (6 %) showed significant aspiration on gastrografin fluoroscopy examination after 1 week; there was no significant correlation between the volume of tissue removed from both tongue base and epiglottis to the incidence of aspiration as shown by gastrografin fluoroscopy examination ($p = 0.72$). No long-term swallowing complaint was registered. Patients who underwent TORS tongue base reduction and supraglottoplasty for sleep apnea proved to have a reasonable short-term swallowing outcomes with no long-term sequelae.

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Introduction

The first robotic procedure for obstructive sleep apnea/hypopnea syndrome (OSAHS) was performed in 2008, and the first series published in 2010 [1]. It was devised as a transoral robotic modification of Chabolle's open tongue base reduction and hyoid epiglottopexy [2]. TORS represents a minimally invasive approach. Bleeding as one of the greatest concerns with TORS and other reported adverse events were recently discussed in a multicenter setting publication [3]. Swallowing function is usually a questionable matter after performing TORS either for malignancy or sleep apnea. However, few previous studies were published to show outcomes including those related to swallowing function after TORS for oropharyngeal cancer treatment [4–15]. More recently, Glazer et al. [16] published a study dealing with post-operative complications following TORS for OSAHS including swallowing dysfunction but was short term and lacking objective documentation. In this study, we try to represent our data after TORS for sleep apnea with objective documentation of swallowing function in the short-term scale together with its evolution on the long-term follow-up.

Patients and methods

The Institutional Review Board at G.B. Morgagni L.Pierantoni, Forli granted approval for the retrospective review of a group of patients undergoing TORS for sleep apnea. Between December 2011 and February 2014, 78 patients

[57 (73 %) male and 21 (27 %) female] with age range from 12 to 72 years, mean 48 years, underwent TORS for sleep apnea. 23 of them underwent TORS tongue base reduction alone, while 55 underwent TORS in combination with other surgeries as a part of multilevel surgery. Epiglottoplasty was done in all cases (100 %). Tracheostomy was done for 64 (82 %) patients, while 13 (18 %) procedures were done without tracheostomy. Associated surgical procedures (nasal and/or palatal) were done in 70 % (55 of 78). Median anterior glossectomy was added in 19 % (15 of 78) patients to reduce oral tongue as well. (Table 1). Previously described operative technique was employed [17]. A minimal overall volume of 7 ml is recommended for alleviating obstruction. In our study, larger number of patients underwent TORS for sleep apnea during the same period but we included only patients with available follow-up gastrografin fluoroscopy results. In addition to gastrografin fluoroscopy test, chest X-ray was routinely done for patients during the first post-operative week. Additional methods were applied for evaluating the swallowing function post-operatively including MD Anderson Dysphagia Inventory (MDADI) questionnaire which the patient had to fill in a preoperative visit, during first week post-operatively and after 1 month post-surgery. Additional data about start of oral feeding (days), nasogastric tube dependence (days) were collected. Subjective complaints by the patients themselves were collected for the long-term evaluation. The patients were followed up for average period of 20 ± 7.12 months (range 7–32 months). Demographic and clinical data were recorded including patient age, sex, type of surgical procedures performed, TORS operative time and volume of tissue removed.

Statistical analysis

To test differences among groups, Fisher's exact test, Student *t* test and ANOVA were used as appropriate. Probability values lower than 0.05 were considered statistically significant. All analyses were performed with Stata 12.0 software (Stata corp., college station, TX, USA).

Table 1 Patient and treatment characteristics

Characteristic	No. (%) ($n = 78$)
Sex	
Male	57 (73)
Female	21 (17)
Associated procedures	
Tracheostomy	64 (82)
Nose and/or palate	55 (70)
Median anterior glossectomy	15 (19)
Epiglottoplasty	78 (100)

Results

The operative time calculated for TORS procedure alone ranged from 15 to 90 min with the mean of 39 ± 11 min. Calculation of the resected volume of tongue base and epiglottic tissue was routinely done and it ranged from 3 to 40 cc with the mean of 12.35 ± 5.77 cc. The mean time of hospital stay was 8.5 ± 2.63 days (range 5–19 days). The mean time for decannulation of tracheostomy tube was 3.5 days (range 3–4 days). The mean post-operative follow-up time was 20 ± 7.12 months (range 7–32 months).

Swallowing outcomes

On short-term basis; various parameters were used to evaluate swallowing outcomes in our patients; first using (MDADI) questionnaire which the patient had to fill in a preoperative visit, after first week post-operatively and after 1 month post-surgery. By comparing the preoperative score with the average of the two scores obtained post-operatively, there was minimal insignificant short-term impact on the swallowing function (4.58 ± 7.03 preoperative versus 5.18 ± 8.32 post-operative) (p=0.56) (Fig. 1).

Another parameter by evaluating the results of gastrografin fluoroscopy test performed to the patients in the first post-operative week after removal of tracheostomy tube; 59 (76 %) of patients showed normal test results, 14 (18 %) of patients showed minimal aspiration, while 5 (6 %) patients showed significant aspiration (Fig. 2).

By correlating the volume of tissue removed from both tongue base and epiglottis to the results of gastrografin fluoroscopy regarding aspiration, no significant correlation was observed ($P = 0.72$) (Fig. 3).

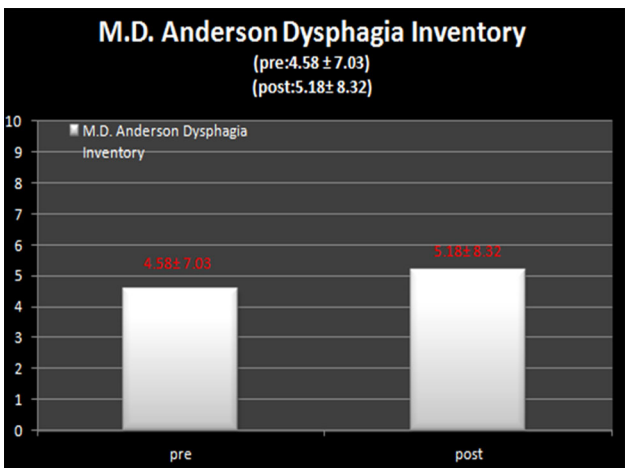

Fig. 1 Pre- and post-operative MD Anderson Dysphagia Inventory questionnaire score

Also, any significant correlation between results of gastrografin fluoroscopy regarding aspiration and the different procedures added to TORS, such as midline anterior glossectomy or palatal surgeries was not found ($P = 0.51$, $P = 0.09$, respectively).

Additional parameters used are: (1) the timing for start of oral feeding: the mean time was 1.05 ± 0.25 days (average, 1–3); (2) also the need for nasogastric tube feeding was considered: none of our patients needed nasogastric tube feeding either on short- or long-term follow-up. (3) Finally, by evaluating chest X-ray findings as an indicator for chest problems related to aspiration: 72 (92 %) patients showed normal free chest X-ray; one (1.2 %) patient showed irritation bronchitis and one (1.2 %) patient showed lung parenchymal density, possibly related to aspiration.

On long-term basis, there were no patients who complained of impaired swallowing as assessed by the long-term consultations scheduled in the post-operative follow-up. Moreover, by strictly following the 19 patients with initial abnormal findings on gastrografin fluoroscopy, we could demonstrate that their swallowing complaints disappeared completely within 3 months post-operatively and they also showed no remarkable weight loss related to their swallowing problems.

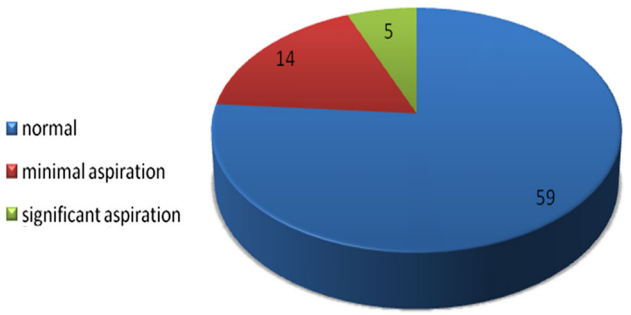

Fig. 2 Post-operative gastrografin fluoroscopy test results

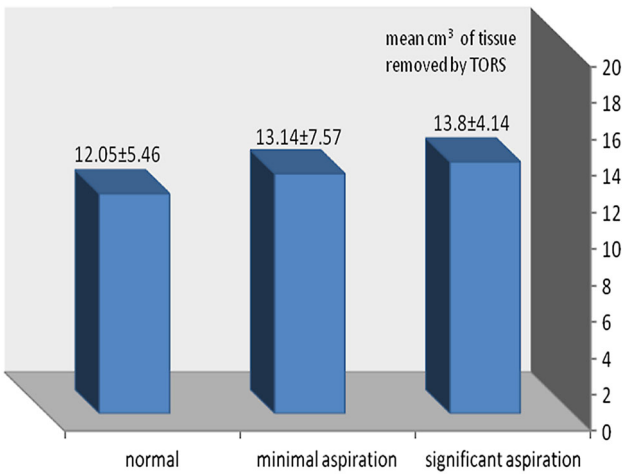

Fig. 3 Correlation between volumes of removed tissue from tongue base and epiglottis with incidence of aspiration

Discussion

The aim of the present study was to describe the common problems related to swallowing that we usually encounter during our practice and to explain the evolution of these problems on long-term follow-up together with its impact on the patient quality of life.

The results of this study demonstrate no significant short-term impacts on swallowing in patients who underwent TORS for sleep apnea proved by non-significant increase in MDADI score after surgery. Also, by evaluating the results of gastrografin fluoroscopy that usually performed in the first post-operative week, the percentage of significant aspiration was very low (6 %). Chest problems detected on chest X-ray and related to aspiration [irritation bronchitis (1.2 %) and lung parenchymal density (1.2 %)] are very low compared to the overall patient number. During fiberoptic nasoendoscopy after 2 weeks, we noticed in most of our patients rapid healing with complete re-epitelization without significant pooling of saliva (Fig. 4). There was also rapid start of oral feeding within average of 1–3 days with no need at all for nasogastric tube feeding placement that consequently had a clear impact on shortening the hospital stay and hastening the patient discharge.

These results are not consistent with Richmon et al [18] who stated that patients undergoing TORS for OSA are at

Fig. 4 Fiber-optic nasoendoscopy after 2 weeks for a patient who underwent TORS tongue base reduction and epiglottoplasty showing good healing with complete coverage of the removed part by mucosa

greater risk of delay in initiation of oral diet and increased post-operative length of stay.

Also, they are better when compared to Chabolle's open tongue base reduction and hyoid epiglottopexy in which the start of oral feeding ranged from 9 to 21 days with mean of 15 days with decannulation range of 4–14 days and mean of 7 days [2].

Fujita et al [19] reported on case of prolonged odynophagia after laser midline glossectomy and one case of minor change in taste otherwise, no persistent difficulties in swallowing.

Mickelson et al [20] reported no patients with prolonged or persistent dysphagia, odynophagia, loss of taste sensation or aspiration after laser midline glossectomy.

Powell et al [21] stated that swallowing evaluations were unchanged from pre-treatment and remained normal after radiofrequency tongue base reduction.

De Vito et al [22] did not report any significant complications with multilevel radiofrequency ablation including tongue base.

Unfortunately, most of these studies did not provide real objective figures about swallowing problems after tongue base management.

We noticed that most of our patients experienced transient post-operative tongue numbness, and dysgeusia that is often described by the patients as altered sense of taste or a bitter, metallic taste. Fortunately, this complaint disappeared within 6 months in most of our patients (99 %) with only one patient (1 %) having persistent dysgeusia.

We could notice also that irrespective of other associated procedures on the palate and even with performing tracheostomy, the final outcome is reasonable and the incidence of real and persistent dysphagia is very low. As we did not observe any significant and objective dysphagia after 6 months post-operatively especially by strictly following up the 19 patients with initial abnormal findings on gastrografin fluoroscopy in 5 patients, where a subjective paresthesia in the pharyngeal area and in tongue base was registered, a completely normal physical examination, negative endoscopy and a totally normal functional profile at swallowing protocol in our institution (fluoroscopy, functional endoscopic evaluation of swallowing) were evident. It means that a subjective subtle complaint must be put into account without any need of special therapy.

One more additional observation in this study was the absence of any significant correlation between the incidence of aspiration problems as shown on gastrografin fluoroscopy and the volume of tissue removed from both tongue base and epiglottis (Fig. 3). In our opinion, this will give more confidence during resection of tongue base but of course, with respect to the neural and vascular anatomy of that region.

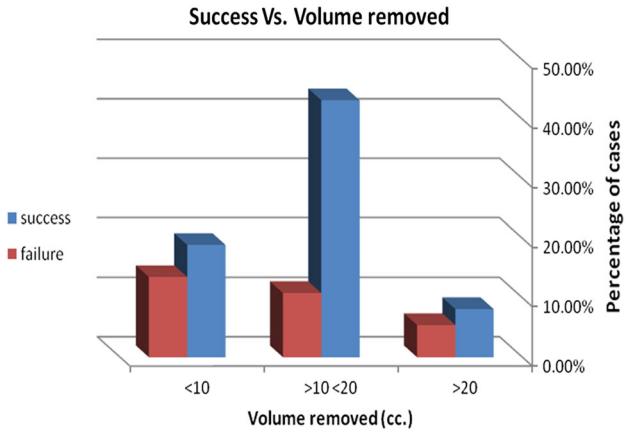

Fig. 5 Success vs volumes of removed tissue from tongue base and epiglottis

In previous unpublished data, we noticed that success is volume sensitive, and that was evident when we divided our patients into three groups (Fig. 5) according to the volume of tissue removed from both tongue base and epiglottis and calculated the percentage of successful and failed cases in each group, the group where between 10 and 20 cc of tissues were removed showed greater success to failure ratio, and accordingly we considered removal of 10–20 cc as ideal for our resection to get better outcome after surgery.

Conclusions

Transoral robotic surgery can be safely performed in patients with OSA with acceptable outcomes. The return to normal oral feeding is rapid and complete with no negative impacts on quality of life. Minor complications such as tongue numbness and dysgeusia remain for some time but final resolution is the rule.

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