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Main Article

Vocal outcomes following subepithelial infiltration technique in microflap surgery: a review of 30 cases

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Abstract

Understanding of the anatomy and physiology of the vocal folds, availability of better diagnostic tools and precise instruments has spurred the development of newer techniques for the management of benign lesions arising in the vocal folds. As the propensity of the superficial lamina propria to regenerate is minimal, it is of paramount importance to maximally preserve it. Microflap surgery of the vocal folds is based on this principle.

There exists a dichotomy in opinion regarding the role of subepithelial infiltration in microflap surgery; the disadvantages cited being possible confusion of the surgical plane following infiltration and hydrodissection of the normal basement membrane from the superficial layer of the lamina propria. A prospective study was therefore carried out in 30 cases of benign glottic lesions and microflap surgery was performed with and without infiltration in similar pathologic lesions. The vocal outcomes i.e. fundamental frequency, jitter, shimmer and maximum phonation time were audited. The advantages of this technique with a review of the literature are discussed.

Key words: Voice Disorders; Vocal Cords; Otorhinolaryngologic Surgical Procedures

Introduction

Speech is the most important mode of human communication. It is this gift of nature to humans that separates them from other species.

Hirano's description of the layered microstructure of the vocal folds paved the way for the development of phonomicrosurgery which is the underlying principle of microflap surgery. This was further augmented by the advent of newer diagnostic modalities like stroboscopy and kymography. It was realised that for optimum post-operative voice there should be minimal damage to the superficial layer of the lamina propria.

We studied the results of microflap surgery performed for benign lesions of the vocal folds using cold instruments. The study was directed at comparing the results of surgery with and without the use of 1:10 000 saline adrenaline infiltration in similar pathological lesions i.e. cyst was compared to cyst. The study parameters were acoustic, aerodynamic and surgical.

Material and methods

A total of 30 cases of hoarseness of voice due to benign organic lesions of the vocal folds were studied from November 2003 to May 2005. These lesions included 20 cases of polyps, six subepithelial cysts, two nodules and two cases of respiratory papillomas. A one–one matching of similar pathological lesions was performed. For example, a polyp on the middle third of the vocal fold of one patient was compared to a similar sized polyp in another patient on the middle third of their vocal fold. At the same time, cases were also matched for age, sex, duration of symptoms and aetiological factors. The difference in duration of symptoms of two patients in a pair was not more than two months. Thus the treatment allocation was specific and not randomised.

A detailed clinical history was elicited including occupation, professional voice training, addictions, exposure to irritants, systemic illnesses and history of previous surgeries. All the patients underwent routine haematological investigations for anaesthesia fitness. A tele-laryngoscopy using a 70 degree rigid endoscope was performed on all patients for pre- and post-operative documentation.

Computerised voice analysis was performed pre-operatively and four to six weeks post-operatively so as to compare the acoustic and aerodynamic parameters. Stroboscopy was performed in all the patients. The acoustic parameters included in the study were fundamental frequency (F_0), jitter and shimmer. The aerodynamic parameter included was

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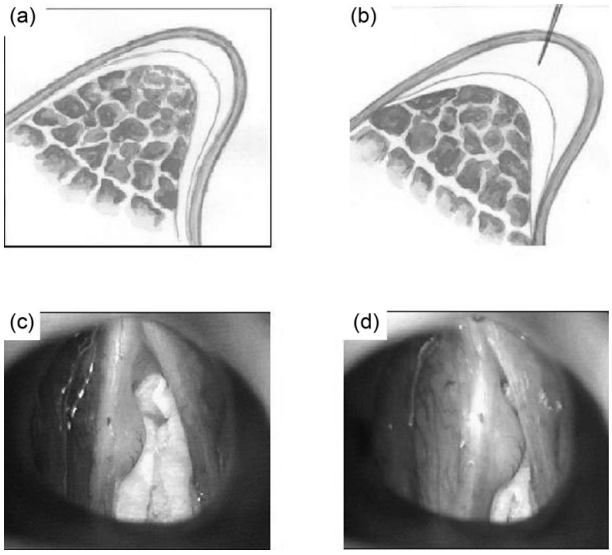

FIG. 1

(a) Schematic representation of the layered microstructure of the vocal fold, (b) schematic representation showing increase in the depth of the superficial lamina propria following subepithelial infiltration, (c) left vocal fold polyp, (d) left vocal fold polyp as seen following subepithelial infiltration of 1:10 000 saline adrenaline.

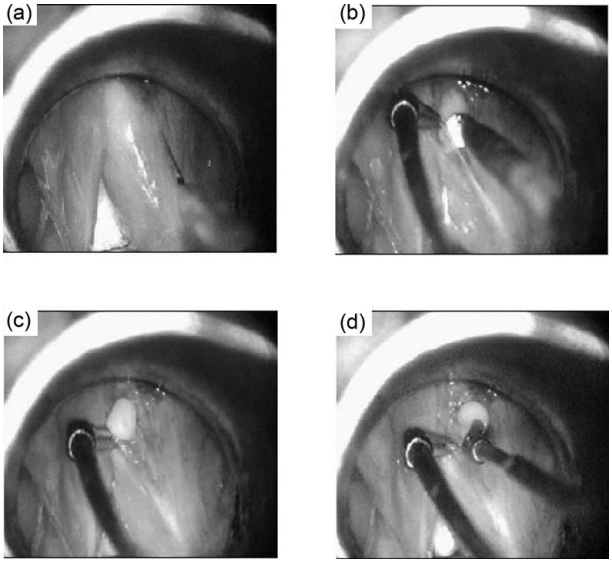

FIG. 2

(a) Right vocal fold polyp as seen after infiltrating 1:10 000 saline adrenaline, (b) dissection of the cyst with a microflap elevator to elevate the epithelial layer over the cyst, (c) epithelial layer of the vocal fold completely separated from the lesion and the epithelial flap held with alligator forceps, (d) completely separated lesion held with cup forceps.

maximum phonation time. The surgical parameters included were time required for surgery, bleeding, flap tear and whether or not *in toto* excision of the lesion had been possible.

In the procedure the vocal folds are exposed by a laryngoscope and are visualised under the highest magnification of the operating microscope during surgery. The lesion is visualised and 1 cc of 1:10 000 saline adrenaline solution is injected in the superficial lamina propria with a No. 27 microlaryngoscopy needle (Figure 1). After waiting for 10 minutes an incision is made with a sickle knife over the superior surface of the vocal fold lateral to the lesion. With careful dissection, using a microflap elevator, the epithelial cover is freed from the lesion holding the medial lip of the incision with curved alligator forceps. The lesion is then held with cup forceps or heart shaped forceps and dissected from the underlying superficial lamina propria, removed and sent for histopathological examination (Figure 2). Redundant epithelium is trimmed and the flap is then reposited back. At all times during handling, care is taken to prevent a tear in the flap. Ten per cent lignocaine is sprayed to prevent laryngospasm and for post-operative analgesia. The patient is advised on strict voice rest for 7 days following the surgery after which a speech therapy programme is instituted.

Observations and results

Similar pathological lesions of similar size were compared with and without infiltration on the basis of subjective appearance and site of the lesion as seen on rigid laryngoscopy and stroboscopy. Infiltration was performed in 15 cases while the remaining 15 cases were operated without infiltration.

The sample size was 30 patients in our study and cases which had no matching counterparts were excluded. The choice of a total of 30 cases was because for a total sample size of $n \geq 30$ the assumption about normal distribution is not necessary.

The surgical parameters were evaluated (Table I) and it was seen that complete surgical excision of the lesion was obtained in 14 cases of the ones in which infiltration was used. One patient in whom *in toto* excision could not be achieved was a revision case in which the epithelium was very fragile and adherent to the underlying vocal ligament in places.

In cases in which infiltration was not used, *in toto* excision was possible in 12 cases. In the three cases where *in toto* removal was not achieved, one was a very large polyp with a thin pedicle which needed to be debulked before removal. There were two cases of subepithelial cysts that ruptured during surgery.

Flap tear, however, was observed in four cases, of which only one was with infiltration. This was a case of a polyp which was incompletely removed in a private hospital previously and the overlying epithelium was adherent to the vocal ligament in places due to loss of the underlying superficial lamina propria. Of the remaining three cases done

TABLE I

SURGICAL PARAMETERS

Group	With infiltration	Without infiltration
In toto excision	14	12
Flap tear	1	3
Bleeding (interfering with surgery)	0	1

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TABLE II

CHANGES IN THE ACOUSTIC AND AERODYNAMIC PARAMETERS WITH AND WITHOUT INFILTRATION

Group	With infiltration	Without infiltration
Mean improvement in MPT	5.5 seconds	3.2 seconds
SD	3.59	2.48
Mean decrease in Jitter	0.55%	0.10%
SD	0.68	0.23
Mean decrease in Shimmer	0.87%	0.02%
SD	1.25	1.07

MPT = maximum phonation time; SD = Standard deviation

without infiltration and which had a flap tear, two were cases of subepithelial cysts and one was a polyp.

Troublesome bleeding did not occur in any of the cases. In one case of a large haemorrhagic polyp, bleeding did occur, but was readily controlled with adrenaline soaked cottonoids. It was observed that infiltration made the surgery technically less difficult due to the increased depth of the superficial lamina propria.

The acoustic and aerodynamic parameters were analysed in the patients before the surgery and four to six weeks following the surgery (Table II). *t*-test (independent samples) was applied for a statistical evaluation of three parameters i.e. maximum phonation time, jitter and shimmer. A 95 per cent confidence interval was used to determine statistical significance.

In patients in whom infiltration was performed, the mean improvement in the maximum phonation time was 5.5 seconds compared to 3.2 seconds mean improvement in the no infiltration group. In this case, calculations from the data suggest $p = 0.042$ and therefore, this difference is statistically significant. Mean decrease in jitter was 0.55 per cent in the group in which infiltration was performed. In the control group this value was 0.10 per cent. In this case calculations from the data suggest $p = 0.021$, which is statistically significant.

The infiltration group had a 0.87 per cent mean decrease in shimmer while in the no infiltration group the mean decrease was 0.02 per cent. In this case calculations from the data suggest $p = 0.05$, which is statistically significant. In all patients of both groups, the fundamental frequency returned to normal values for their respective age and sex.

Discussion

A bad voice has an impact on the emotional as well as the social interactions of a person. It is important to recognise that many of these cases are due to organic lesions of the vocal folds which are treatable. The most common presenting symptom of benign glottic lesions was hoarseness. Breathlessness as a presenting symptom was observed in only two cases of very large polyps which were completely filling the glottis. The aetiology of the lesions could not be ascertained in all cases. However, most of the patients had a history of some form of phonotrauma.[1] Although many patients did not have overt symptoms of laryngopharyngeal reflux, most of them did benefit by taking anti-reflux agents, thus establishing reflux as among the major contributing factors of these lesions.[2]

Laryngoscopy using a 70 degree rigid laryngoscope was performed in all patients as an office procedure. Polyps and nodules had a typical origin at the junction of the anterior and middle third of the vibrating vocal folds. This is the point of maximum contact (striking zone) during a phonatory cycle and therefore sustains the maximum trauma.[3]

Basic parameters like fundamental frequency, maximum phonation time, jitter and shimmer were evaluated in all patients. The factor most affected is the maximum phonation time, which generally is severely decreased but reverts back to normal following successful surgery. The submucosal infiltration technique was first described in the 1890s by Hajek and Reinke, although for some other indications. Pressman *et al.*[4,5] and Welsh *et al.*[6] repeated the investigations in a similar fashion, but again for a different purpose. This technique was popularised for benign vocal fold lesions in the last two decades mainly through the work of Hirano[7] and Zeitels.[8]

Following surgery, all patients were advised on strict voice rest for at least 7 days after which a speech therapy programme was instituted. Postoperative evaluation of both groups showed that the vocal outcomes were better in the patients in whom the infiltration technique was carried out. These included subjective improvement of voice, improvement of maximum phonation time and decrease in frequency and amplitude variations i.e. jitter and shimmer, respectively.

- **Understanding of the anatomy and physiology of the vocal folds, availability of better diagnostic tools and precise instrumentation has led to the development of new techniques in the management of benign lesions arising in the vocal folds**
- **As the propensity of the superficial lamina propria to regenerate is minimal it is of paramount importance to maximally preserve it**
- **There exists a dichotomy in opinion regarding the role of subepithelial infiltration in microflap surgery**
- **This study supports the view that the subepithelial infiltration technique should be used in microflap surgery to enhance vocal outcomes**

Subepithelial infiltration of 1:10 000 saline adrenaline solution is proposed to offer various advantages over the conventional microflap technique.[8] These are:

(1) By placing the pliable epithelium under greater tension and improving the exposure for

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perimeter incisions around the lesions, precision is enhanced.
(2) The adrenaline solution causes vasoconstriction of the microvasculature which aids in haemostasis and visualisation.
(3) Infiltration causes hydrodissection of the superficial lamina propria.
(4) Due to the increased depth of the superficial lamina propria, minimal damage is caused to the deeper layers of the superficial lamina propria.
(5) Since there is minimal loss of epithelium, healing is by primary intention with minimal post-operative scar formation over the vocal folds. Post-operative voice is therefore restored to near normal.
(6) Subepithelial infiltration helps in differentiating whether the lesion is arising only from the epithelium and superficial lamina propria or if there is underlying invasion of the vocal ligament by producing the 'doughnut effect'.

Conclusions

Hoarseness of voice is the most common presenting feature of benign pathological lesions of the vocal folds. In our study it was found that vocal fold polyps, constituting 66.7 per cent of the cases, are the commonest lesions followed by cysts (20 per cent). Vocal nodules requiring surgery (6.7 per cent) and papillomas (6.7 per cent) are comparatively rare.

The aetiology of most cases of polyps, cysts and nodules was phonotrauma and laryngopharyngeal reflux. In the two groups of 15 patients each from our study there was a statistically significant improvement in the acoustic and aerodynamic parameters i.e. jitter ($p = 0.021$), shimmer ($p = 0.05$) and maximum phonation time ($p = 0.042$) in the group in which subepithelial infiltration was performed. Therefore, we recommend that the subepithelial infiltration technique be used in microflap surgery to enhance vocal outcomes.

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