Objective: To evaluate the applicability and effectiveness of percutaneous corticosteroid injection in patients with vocal fold polyp and to describe its advantages and limitations in this group of patients.

Design: Prospective case series.

Setting: Tertiary care teaching hospital.

Patients: Twenty-four patients with vocal fold polyp treated between March 1 and December 31, 2007.

Interventions: Percutaneous corticosteroid injection performed with the patient under topical anesthesia. Stroboscopic examination was carried out to evaluate the postoperative response.

Main Outcome Measures: The Grade of the Severity of Dysphonia, Roughness, Breathiness, Asthenicity, and Strain (GRBAS) scale and the Voice Handicap Index were used for subjective assessments. Phonatory results including maximum phonation time, mean flow rate, jitter, shimmer, and noise to harmonic ratio were also collected for objective evaluations.

Results: The surgery was completed smoothly in 22 of the 24 patients, typically within 20 minutes. No complications were noted. The overall response rate by stroboscopy was 91% (20 of 22 patients) and complete remission rate was 59% (13 of 22). A significant improvement was noted between preoperative and postoperative results on the GRBAS scale ($P < .001$, $P < .001$, $P = .003$, $P = .001$, and $P = .002$, respectively, for the 5 measures). Mean Voice Handicap Index ($P = .001$), maximum phonation time ($P = .02$), jitter ($P = .006$), shimmer ($P = .001$), and noise to harmonic ratio ($P = .01$) also improved significantly after percutaneous corticosteroid injection.

Conclusions: Percutaneous corticosteroid injection can be used to manage vocal fold polyps with low invasiveness and minimal morbidity. It offers a simple and cost-effective alternative to traditional direct microlaryngoscopic procedures.

scribed classes of drugs. They have been used to treat benign lesions of the larynx, including granuloma, sarcoidosis, and some inflammatory diseases. Yanagihara et al reported that some patients with vocal fold nodules were spared surgical intervention after the injection of dexamethasone into the vocal fold by laryngal mirror. However, poor surgical view and technical difficulty are challenges for most surgeons. Tateya et al and Mortensen and Woo have improved the technique by transoral laryngeal injection using a specially designed curved injection needle under flexible or rigid laryngoscope guidance. Nonetheless, difficulty in precise injection caused by the length of the injection catheter and the gag reflex resulting from the transoral approach remains problematic.

With the intent of trying to find a practical and efficient method for corticosteroid treatment of vocal fold polyps, percutaneous corticosteroid injection (PCI) via the cricothyroid membrane has been performed at our institute since March 2007. The purpose of this report is to describe the technique and outcomes of PCI in patients with vocal fold polyp and also to describe its advantages and limitations to define its value in the treatment of these patients.

METHODS

From March 1, 2007, to December 31, 2007, PCI under topical anesthesia was performed prospectively on 24 patients with vocal fold polyp. There were 9 male and 15 female patients with a mean age of 49 years (range, 19-81 years). All of the patients had a history of hoarseness with symptoms for more than 6 months. The clinical diagnosis of vocal fold polyp was made by 2 otolaryngologists (Y.-B.H. and S.-Y.C.) and a voice pathologist through laryngovideostroboscopic analysis. Polyps were further classified as translucent, hemorrhagic, and fibrotic hyaline types on the basis of Cohen and Garrett’s stroboscopic classification of vocal fold polyps. There was no absolute contraindication for the procedure. Proper informed consent was obtained from all of the patients.

INJECTION TECHNIQUE

At the outpatient clinic, PCI was performed in each case with the patient seated on a conventional examination chair. Before the procedure, the nasal cavity, pharynx, and larynx of the patient were anesthetized with lidocaine topical spray, 4%. A flexible nasopharyngoscope (Olympus ENF type L3; Olympus Medical Systems Corp, Center Valley, Pennsylvania) was passed transnasally into the laryngeal introitus by an experienced assistant, maintaining a stable magnified image of the vocal folds on a video monitor. To reinforce the anesthesia, a few drops of lidocaine, 4%, were dripped onto the epiglottis and glottis with a curved cannula inserted transorally. Sedation was unnecessary.

Triamcinolone acetonide (40 mg/mL) was used for injection and was delivered through a 25-gauge × 2.5-cm needle on a 1-mL disposable plastic syringe. The skin overlying the cricothyroid membrane was prepared with alcohol swabs. Contralateral to the lesion side, the needle was inserted just above the upper margin of cricoid cartilage, 2.5 mm off the midline with the needle tip directed toward the vocal fold polyp (Figure 1). After penetrating the mucosa of the subglottis, the needle was inserted to the base and body of the vocal fold polyp.

When the needle tip was confirmed to be properly positioned in the submucosal layer of the lesion under video monitoring (Figure 2B), approximately 0.1 mL (4 mg) of triamcinolone acetonide was slowly infused. Care was taken to avoid deep infusion into the vocalis muscle. On completion of the procedure, the patient was instructed to reduce voice use for 1 week. Voice therapy was not used before or after the PCI.

ASSESSMENTS

All of the patients were followed up at 1 and 3 months postoperatively and every 3 months thereafter. Stroboscopic evaluations were carried out and documented at each follow-up visit. The findings were analyzed and sorted into 4 categories (“disappeared,” “improved,” “unaltered,” and “deteriorated”) compared with the size of the vocal fold polyp before the procedure. The comprehensive voice evaluations were performed before and 1 month after the PCI. For perceptual assessments, the Grade of the Severity of Dysphonia, Roughness, Breathiness, Asthenicity, and Strain rating with a 4-point grading scale (0, normal; 1, slight deviance; 2, moderate deviance; and 3, severe deviance) was obtained. Patients also self-assessed their voice disorder by means of the Voice Handicap Index, which contains 30 items regarding the impact of the voice disorder on daily life. Scores on the index range from 0 to 120, with 120 being the most severely handicapped. In addition, the reports of maximum phonation time, mean flow rate, jitter, shimmer, and noise to harmonic ratio were reviewed for objective evaluations as well.
STATISTICAL ANALYSES

All computations and analyses were carried out with SPSS software version 15.0 (SPSS Inc, Chicago, Illinois). Voice Handicap Index scores and phonatory results (maximum phonation time, mean flow rate, jitter, shimmer, and noise to harmonic ratio) are presented as means with standard deviations. To compare the differences before and after the PCI, Wilcoxon test or paired t test was used where appropriate. P < .05 was considered to be statistically significant.

RESULTS

Percutaneous corticosteroid injection under topical anesthesia was performed successfully in 22 of the 24 patients (92%). The procedure was typically completed within 20 minutes, including the time for topical anesthesia and injection. Two patients failed to complete the procedure because of the thick, soft tissue in the anterior neck or hypersensitive gag reflex. The median follow-up time from the PCI was 15 months (range, 9-19 months).

Postoperative stroboscopic findings are given in Table 1. Figure 2 shows the preinjection and postinjection appearance of a vocal fold polyp. The polyps disappeared in 5 patients (23%) at 1 month after the PCI and in 13 (59%) after a 3-month follow-up period. No further improvement was noted at 6 months. When results were analyzed by polyp type, the response rates were 100% (1 of 1) for translucent polyp, 91% (10 of 11) for hemorrhagic polyps, and 90% (9 of 10) for fibrotic hyaline polyps. The overall response rate evaluated by stroboscopy was 91% (20 of 22).

<table>
<thead>
<tr>
<th>Table 1. Postoperative Stroboscopic Findings</th>
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<tbody>
<tr>
<td>Finding</td>
</tr>
<tr>
<td>Disappeared</td>
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<td>Improved</td>
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<td>Unaltered</td>
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<td>Deteriorated</td>
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Figure 2. Right vocal fold polyp. A, Before injection. B, The needle tip (arrow) is positioned in the submucosal layer of the vocal fold polyp. C, After injection. D, Three months after the injection.
Table 2. Distribution of Preoperative and Postoperative Perceptual Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preoperative Score</th>
<th>Postoperative Score</th>
<th>P Value</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Grade</td>
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<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Strain</td>
<td>0</td>
<td>11</td>
<td>9</td>
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Table 3. Distribution of Preoperative and Postoperative Phonatory Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P Value</th>
</tr>
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<tbody>
<tr>
<td>Voice Handicap Index</td>
<td>54.32 (20.59)</td>
<td>38.19 (22.94)</td>
<td>.001</td>
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<tr>
<td>Maximum phonation time, s</td>
<td>10.67 (4.82)</td>
<td>13.55 (5.71)</td>
<td>.02</td>
</tr>
<tr>
<td>Mean flow rate, mL/s</td>
<td>177.31 (106.10)</td>
<td>168.72 (103.97)</td>
<td>.31</td>
</tr>
<tr>
<td>Jitter, %</td>
<td>3.77 (2.95)</td>
<td>2.09 (2.05)</td>
<td>.006</td>
</tr>
<tr>
<td>Shimmer, %</td>
<td>8.44 (5.69)</td>
<td>3.84 (1.86)</td>
<td>.001</td>
</tr>
<tr>
<td>Noise to harmonic ratio</td>
<td>0.24 (0.19)</td>
<td>0.14 (0.04)</td>
<td>.01</td>
</tr>
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</table>

Statistical analysis was performed for all 22 patients with complete evaluations before and after the procedure. According to the Grade of the Severity of Dysphonia, Roughness, Breathiness, Assthenicity, and Strain scale, there were significant differences between pretreatment and posttreatment results in each of the 5 measures tested \( P < .001, P < .001, P = .003, P = .001, \) and \( P = .002 \), respectively. The distribution of these measures before and after the PCI is shown in Table 2. The mean Voice Handicap Index score also showed significant improvement after the procedure \( P = .001 \). The results of preoperative and postoperative mean maximum phonation time \( P = .02 \), jitter \( P = .006 \), shimmer \( P = .001 \), and noise to harmonic ratio \( P = .01 \) improved significantly as well (Table 3).

The patients with complete remission according to stroboscopic examination results continued their follow-up for at least 6 months after the disappearance of the vocal fold polyp. All 7 patients with improved postoperative stroboscopic findings had sufficiently improved voice for daily life and avoided surgery. They continued to be followed up at our clinic.

Complications such as vocal fold atrophy, laryngeal infection, and lidocaine intoxication were not found in our study. Only minor bleeding occurred on occasion during the operation and usually stopped spontaneously. Recurrence of the vocal fold polyps was noted in 2 patients at 6 and 9 months after the injection.

Most vocal fold polyps are strongly associated with abusive or inefficient phonation. Continued irritation and excessive mechanical stress disrupt the lamina propria of the vocal fold. Injury induces inflammation to begin the healing process. Membrane and capillary permeability are increased, with an active aggregation of inflammatory exudates and cellular components. Attempts at wound healing also lead to remodeling of the epithelium and the superficial layer of the lamina propria, which results in excess collagen deposition. Interference of this process by repetitive injury and subsequent inflammation can lead to disorganization of the superficial layer of the lamina propria and cause the development of polyps. Microscopically, vocal fold polyps are characterized by the presence of stromal edema, fibroblast proliferation, dilated vasculature, hyaline degeneration, and fibrosis as a result of their chronicity. These findings may represent the histologic response to continued injury during various stages of wound healing.

Corticosteroids potently suppress inflammation and reduce edema and are staple medications with diverse uses in otolaryngologic practice. They have been shown to reduce the egress of inflammatory cells to sites of inflammation and decrease a variety of inflammatory mediators. Vascular permeability and the expression of adhesion molecules needed for extravascular extravasation are reduced as well. Corticosteroids also can inhibit fibroblast mitosis and interfere with the production of collagen by underhydroxylation of proline and lysine. Synthesis of collagen is therefore significantly decreased, whereas collagen degradation continues. Accordingly, corticosteroid treatment should be effective for vocal fold polyps.

Local corticosteroid injections appear to have an effect on vocal fold polyps that is more substantial than that of systemic corticosteroid treatment, likely owing to the high concentration directly administered at the lesion site. The effect after a single injection seems to last for several weeks, largely because of the depot nature of the suspension. Moreover, only about 4 mg of triamcinolone acetonide is used for PCI. The systemic morbidity of corticosteroids is avoided, and side effects are very limited. Several special requirements should be noted in PCI. To spare patients the general anesthesia and inhibit the gag reflex throughout the surgery, topical anesthesia should be given adequately by endolaryngeal lidocaine spray and dripping before the procedure is initiated. In addition, the cooperation of 2 specialists is necessary, with an experienced assistant to keep a clear and stable view on the video monitor and a well-trained surgeon to op-
erate the needle precisely. After PCI, we advocate 1 week of reducing voice use to minimize the risk of corticosteroid leakage and, theoretically, to increase absorption in the vocal fold polyp.

Knowledge of laryngeal anatomy based on external landmarks is also an essential component in this technique to properly direct the needle. The site of insertion and the direction of the needle should be accurately preset. The ability to manipulate the needle direction after it penetrates the subglottic lumen is very limited. This technique requires 3-dimensional concepts of tissue anatomy and experienced skills, which can be obtained through training with cadaver or laryngectomy specimens.

Minimal invasiveness and convenience are the most unique advantages of PCI. This technique can be carried out within 20 minutes in the outpatient clinic with the patient under topical anesthesia. Percutaneous corticosteroid injection is also successful at first attempt in most patients, and difficulty in completing the procedure is encountered in only a small number of patients. The procedure is performed with a 25-gauge needle on a 1-mL disposable plastic syringe. No specially designed instrument is needed and the trauma is trivial. Surgical risk and medical costs are reduced from those of traditional surgery as well. In addition, PCI can be performed on patients with cervical spine disease who are not suitable for suspension laryngomicrosurgery. Patients with trismus may have poor exposure due to direct laryngoscope, and PCI also offers a good treatment choice.

In contrast to traditional microlaryngoscopic surgery, PCI avoids possible scar formation, and a second injection can be considered if necessary. In addition, this technique avoids the need for direct microlaryngoscopic instruments and the expense and risk of general anesthesia. Compared with transoral techniques, the percutaneous approach also provides several distinct advantages. It is less likely to evoke a gag reflex. Patient tolerance is better and more manipulation time is available. Furthermore, the insertion level of the needle tip can be clearly visualized and properly positioned. Corticosteroid can be infused into the submucosal layer more precisely.

In our experience, there is no absolute contraindication to this technique, and age is not a major concern if patient performance is acceptable. For patients with poor medical status and poor general anesthesia. Compared with transoral techniques, the percutaneous approach also provides several distinct advantages. It is less likely to evoke a gag reflex. Patient tolerance is better and more manipulation time is available. Furthermore, the insertion level of the needle tip can be clearly visualized and properly positioned. Corticosteroid can be infused into the submucosal layer more precisely.

In our experience, there is no absolute contraindication to this technique, and age is not a major concern if patient performance is acceptable. For patients with poor medical status and a higher surgical risk, this technique is a better alternative to direct microlaryngoscopy. It is less likely to evoke a gag reflex. Patient tolerance is better and more manipulation time is available. Furthermore, the insertion level of the needle tip can be clearly visualized and properly positioned. Corticosteroid can be infused into the submucosal layer more precisely.

In conclusion, PCI is a practical procedure with low invasiveness and minimal morbidity. This technique saves valuable time and is cost-effective. It offers a simple and applicable alternative to standard direct microlaryngoscopic surgery.

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Author Contributions: Drs Hsu and Chang had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Hsu and Chang. Acquisition of data: Hsu, Lan, and Chang. Analysis and interpretation of data: Hsu and Lan. Drafting of the manuscript: Hsu, Lan, and Chang. Critical revision of the manuscript for important intellectual content: Chang. Statistical analysis: Hsu and Lan. Administrative, technical, and material support: Hsu, Lan, and Chang. Study supervision: Chang.

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REFERENCES