

## Posterior Glottic Stenosis in Adults

Michael Wolf MD, Adi Primov-Fever MD, Yoav P. Talmi MD FACS and Jona Kronenberg MD

Department of Otorhinolaryngology & Head Neck Surgery, Sheba Medical Center, Tel Hashomer, Israel  
 Affiliated to Sackler Faculty of Medicine, Tel Aviv University, Ramat Aviv, Israel

**Key words:** larynx, vocal cords, stenosis, fixation, laryngoplasty

### Abstract

**Background:** Posterior glottic stenosis is a complication of prolonged intubation, manifesting as airway stenosis that may mimic bilateral vocal cord paralysis. It presents a variety of features that mandate specific surgical interventions.

**Objectives:** To summarize our experience with PSG and its working diagnosis.

**Methods:** We conducted a retrospective review of a cohort of adult patients with PGS operated at the Sheba Medical Center between 1994 and 2006.

**Results:** Ten patients were diagnosed with PGS, 6 of whom also had stenosis at other sites of the larynx and trachea. Since 2000, all patients underwent laryngeal electromyographic studies and direct laryngoscopy prior to surgery. Surgical interventions included endoscopic laser procedures (in 2 patients), laryngofissure and scar incision (in 1), laryngofissure with buccal mucosa grafting (in 3) or with costal cartilage grafting (in 1) and laryngofissure with posterior cricoid split and stenting (in 1); one patient was not suitable for surgery. Postoperative follow-up included periodic fiberoptic endoscopies. Voice analysis was evaluated by the GRBAS grading. Seven patients were successfully decannulated within one to three procedures. Voice quality was defined as good in 7 patients, serviceable in 2 and aphonic in 1.

**Conclusions:** Posterior glottic stenosis may be isolated or part of complex laryngotracheal pathologies. Electromyographic studies and direct laryngoscopy must be included in the diagnostic workup. Costal cartilage or buccal mucosa grafts are reliable, safe and successful with respect to graft incorporation and subglottic remodeling.

*IMAJ 2007;9:597–599*

Posterior glottic stenosis is defined as a narrowing or fixation of the larynx. Laryngoscopy reveals bilateral impaired vocal cord mobility in a median or paramedian position with limited glottic patency [1]. PGS is a complication of prolonged intubation, occurring mainly among adults, caused by scarring of the mucosa of the interarytenoid area, arytenoids and cricoarytenoid joints. PGS was stratified by Bogdasarian and Olson [2] into four grades depending on unilaterality or bilaterality and by the involvement of the cricoarytenoid joints: grade 1 = interarytenoid scarring with normal posterior commissure, grade 2 = interarytenoid and posterior commissure scarring, grade 3 = posterior commissure scarring involving one cricoarytenoid joint, and grade 4 = posterior commissure scarring involving both cricoarytenoid joints.

In practice, one may notice impaired vocal cord mobility, mimicking nerve damage (i.e., paralysis). It has been assumed that the clinical history and physical examination enables differ-

entiation between vocal cord paralysis and fixation [3,4], although some patients survived complex central nervous system and peripheral organ injuries, long courses of mechanical ventilation, oral or nasal intubation, and nasogastric tubing. These may result in combined pathologies of both paralysis and fixation, or they may mask the alleged simplicity of making a diagnosis based solely on clinical grounds. The extent of scarring dictates the extent of surgical intervention. While endoscopic lysis of the scar is appropriate for grade 1, complex laryngoplasty procedures are mandated for grades 2 to 4 [3].

Surgical interventions are based on removal of the posterior segment of the glottis (i.e., arytenoidectomy and cordotomy) [5], separating the two arytenoids via scar incision and tissue interposition (i.e., mucosal flap advancement) [6], or costal cartilage graft – extensively described among children [7,8].

This report summarizes our experience with PGS in adults and emphasizes the establishment of a working diagnosis.

### Patients and Methods

We retrospectively reviewed a cohort of all adult patients undergoing surgical intervention for posterior glottic stenosis at our center. Preoperative evaluation included laryngeal electromyography performed in the neurological rehabilitation outpatient clinic (since 2000) and direct laryngoscopy (under general anesthesia) in all patients.

The planned surgical intervention was endoscopic CO<sub>2</sub> laser incision of the interarytenoid scar for grade 1, buccal mucosa grafting for grade 2, and cricoid split with costal cartilage grafting for grades 3-4. All grafting procedures were performed via laryngofissure (open anterior laryngeal approach). Laryngeal stents or silicone T-tubes were used in all patients undergoing posterior cricoid grafting. The stents were fixed by two trans-laryngeal or trans-tracheal sutures. An uncuffed tracheotomy tube was left in place for 2–3 weeks for mucosal grafts and 4–6 months for costal cartilage grafts. Antibiotics were given for 2 weeks after surgery. Reflux precautions, including proton pump inhibitors, were utilized until removal of the stent. This was performed under general anesthesia via direct laryngoscopy.

Periodic endoscopies were performed to follow granulation tissue formation, mucosal coverage and scar retraction. Decannulation was attempted 2 to 3 months after stent removal assuming that scar contracture can take 6 to 12 weeks to complete. Voice quality was evaluated according to the GRBAS system (Grade, Roughness, Breathiness, Asthenia, Strain) [9].

PSG = posterior glottic stenosis

## Results

Ten adult patients, age 25–82 years, were diagnosed with PGS and scheduled for surgery. PGS grading was defined as follows: three patients at grade 1, three at grade 2, two at grade 3, and two at grade 4. Four patients had isolated PGS and six patients had other pathologies including anterior glottic stenosis, subglottic stenosis, supraglottic stenosis, tracheal stenosis, and complete glottic obstruction [Table 1]. All patients had a tracheostomy. Four patients with grades 2, 3 and 4 failed previous endoscopic CO<sub>2</sub> laser surgery.

Electromyographic studies confirmed the diagnosis of PGS, rather than vocal cord paralysis, in three patients. Direct laryngoscopy revealed grade 1 scarring in two of three patients who were considered grades 2 and 3; these two patients had CO<sub>2</sub> laser vaporization. The third patient, mistakenly diagnosed with posterior commissure scarring, was found to have grade 1 stenosis only after laryngofissure was performed. Four patients underwent laryngofissure: three with buccal mucosa and one with costal cartilage grafting. Laryngeal stents were inserted in two patients and a silicone tube in three other patients.

Two patients developed postoperative granulations that necessitated a single CO<sub>2</sub> laser intervention in each patient. No complications occurred in the buccal mucosa or costal cartilage graft sites. Three patients are still stoma-dependent

[Table 1]: one was operated before and developed an ossified cicatrix to an extent not suitable for further intervention; a second patient with complete subglottic obstruction underwent thyrotracheal anastomosis with posterior mucosal graft in a single stage. Although the subglottis is patent and enables vocalization, PGS was still present. A third patient, 82 years old, underwent segmental tracheal resection and tracheo-esophageal fistula correction in the first stage and bilateral posterior cordectomy in a second stage; this patient is still cannulated.

Patients with grade 1 stenosis had near normal voice quality (G0-1, R0-1, B0-1, A-0, S-0). The patient with costal cartilage graft developed false cord voice and the three patients with buccal mucosa grafts had a clear voice with mild breathiness (G1, R1, B1, A1, S1).

## Discussion

The extent and features of posterior glottic stenosis dictate its method of reconstruction [3]. Consequently, it is of paramount importance to define precisely the characteristics of the laryngeal pathology.

Langman et al. [10] observed that in normal larynges the posterior commissure is posterior to the anterior aspect of the body of the arytenoids while the posterior glottic chink was described

**Table 1.** Characteristics of 10 patients with posterior glottic stenosis

No. age/ gender	Primary evaluation	Pre-op diagnosis (post-EMG and DL)	Operative findings	Operation	Results
1 18 / F	VC paralysis, G2?	Normal EMG, G1	G1, interarytenoid scar	Endoscopy, CO <sub>2</sub> laser	Decannulated
2 41 / M	PGS, G2	Normal EMG, G1	G1, interarytenoid scar	Endoscopy, CO <sub>2</sub> laser	Decannulated
3 60 / M	PGS, G3	Normal EMG, G2	G1, interarytenoid ossified scar	Laryngofissure, scar incision	Decannulated
4 70/F	PGS, G2, Bilat VC paralysis, Post-Lt cordectomy	Normal EMG on Rt, PGS, G2	G2	Laryngofissure, mucosal graft	Decannulated
5 25 / F	PGS, G2 and anterior SGS	G2, anterior glottic and SGS, normal EMG	G2, anterior glottic and SGS	Posterior cricoid split, anterior CCG, stent	Decannulated
6 40 / M	Supraglottic stenosis, post-multiple CO <sub>2</sub> laser	Supraglottic stenosis	Severe supraglottic, PGS, G2	supraglottoplasty, laryngofissure, mucosal graft, stent	Decannulated
7 82 / F	Tracheal stenosis, TEF, bilat VC paralysis	Normal EMG Rt side, Lt paralysis, Lt VC dislocation (?), PGS, G2	PGS, G3, tracheal stenosis, TEF	1st tracheal resection, closure TEF, 2nd posterior cordotomy	Still with cannula
8 35 / M	Anterior and posterior glottic stenosis, CO <sub>2</sub> laser procedures	No EMG, G4	Anterior and posterior scarring, G3	Anterior and posterior costal cartilage grafts, stent	Decannulated
9 23 / M	Complete tracheal suprastomal obstruction	No EMG	Complete tracheal stenosis, PGS, G4	Tracheal resection and anastomosis, posterior mucosal grafting	Still with cannula
10 20 / M	Complete glottic and SGS, post- CO <sub>2</sub> laser	No EMG	G4, ossified PC scarring	No surgery	Permanent stoma

VC = vocal cords, EMG = electromyography, DL = direct laryngoscopy, PC = posterior commissure, SG = subglottic, SGS = subglottic stenosis, PGS = posterior glottic stenosis, G (1-4) = grades (1-4), Lt = left, Rt = right, bilat = bilateral, CCG = costal cartilage grafting, TEF = tracheoesophageal fistula, CA = cricoarytenoid joint.

anterior to the arytenoids in patients with posterior glottic stenosis. The distinction between fixation and paralysis may be based on clinical history and indirect laryngoscopy. Cohen and team [4] recommended the use of a clinical score based on grading indexes for the following parameters: posterior scarring, arytenoid erosion, posterior glottic gap, vocal fold motion, and the history of either neck surgery or prolonged intubation. The summation of the indices may differ between the two. Yet the variability of laryngotracheal pathologies encountered in our series necessitates electrophysiological studies, besides clinical cues, as guiding parameters, especially in revised cases.

Electromyographic studies changed the primary diagnosis in four of our patients. Also, direct laryngoscopy detected grade 1 rather than grade 2 stenosis in one patient. In particular, it was found that the clinical appearance of grade 1 stenosis mimicked grade 2. Therefore, laryngeal electromyography and direct laryngoscopy under general anesthesia were found essential for establishing a precise diagnosis.

Previous reports emphasized the non-removal of scar tissue responsible for stenosis [11]. This concept improves graft-take and minimizes local infection or further excessive scar re-formation. Others suggested the removal of scar tissue prior to tissue graft implantation, with successful results [1]. The use of posterior cricoid interposition grafting, instead of splitting and stenting, enhances re-epithelialization and minimizes development of granulation tissue, fibrosis and wound contraction. This results in reduced duration of stenting and shorter time to decannulation [6].

Goldberg [12] described an endoscopic technique for advancement of a vascularized mucosal flap instead of an open procedure via a midline thyrotomy. The use of an endoscopic approach prevents scarring of the anterior commissure, which may cause postoperative hoarseness, and minimizes granulation tissue formation, ulceration and stenosis that may be caused by stent insertion. In our series all grafting was performed via laryngofissure with extra caution taken in performing a midline thyrotomy and with double translaryngeal or transtracheal sutures that minimized stent motion and friction.

The parameter of breathiness in the voice quality scoring system is affected by the extent of the interarytenoid gap. Naturally, a compromise was made between maintaining an excessive posterior gap that would lead to aspiration or hamper voice quality and airway patency. False cord voice production [Table 1, patient 8] is a reasonable compensation for tracheostomy dependency.

## Conclusions

Posterior glottic stenosis may present as an isolated lesion or as part of a complex laryngeal pathology that challenges laryngologists. Electromyographic studies and direct laryngoscopy must be included in the diagnostic workup. Costal cartilage or buccal mucosa grafts are reliable, safe and successful in terms of graft incorporation and subglottic remodeling.

## References

1. Hoasjoe DK, Franklin SW, Aarstad RF, Day TA, Stucker FJ. Posterior glottic stenosis mechanism and surgical management. *Laryngoscope* 1997;107:675-9.
2. Bogdasarian RS, Olson NR. Posterior glottic laryngeal stenosis. *Otolaryngol Head Neck Surg* 1980;88:765-72.
3. Gardner GM. Posterior glottic stenosis and bilateral vocal fold immobility: diagnosis and treatment. *Otolaryngol Clin North Am* 2000;33:855-78.
4. Cohen SM, Garrett CG, Netterville JL, Courey MS. Laryngoscopy in bilateral vocal fold immobility: can you make a diagnosis? *Ann Otol Rhinol Laryngol* 2006;115:439-43.
5. Gaboriau H, Laccourreye O, Laccourreye H, Brasnu D. CO2 laser posterior transverse cordotomy for isolated type IV posterior glottic stenosis. *Am J Otolaryngol* 1995;16:350-3.
6. Thome R, Thome DC, Behlau M. The use of buccal mucosal graft at posterior cricoid splitting for subglottic stenosis repair. *Laryngoscope* 2001;111:2191-4.
7. Zalzal GH. Rib cartilage grafts for the treatment of posterior glottic and subglottic stenosis in children. *Ann Otol Rhinol Laryngol* 1988;97:506-11.
8. Cotton RT. The problem of pediatric laryngotracheal stenosis: a clinical and experimental study on the efficacy of autogenous cartilaginous grafts placed between the vertically divided halves of the posterior lamina of the cricoid cartilage. *Laryngoscope* 1991;101(Suppl 56):1-34.
9. Ma EP, Yiu EM. Multiparametric evaluation of dysphonic severity. *J Voice* 2006;20:380-90.
10. Langman AW, Leo KC, Dedo H. The endoscopic Teflon keel for posterior and total glottic stenosis. *Laryngoscope* 1989;99:571-7.
11. Montgomery WW. Posterior and complete laryngeal (glottic) stenosis. *Arch Otolaryngol* 1973;98:170-5.
12. Goldberg AN. Endoscopic postcricoid advancement flap for posterior glottic stenosis. *Laryngoscope* 2000;110:482-5.

**Correspondence:** Dr. M. Wolf, Dept. of ORL Head Neck Surgery, Sheba Medical Center, Tel Hashomer 52621, Israel.  
Phone: (972-3) 530-2442, Fax: (972-3) 530-5387  
email: wolfm@post.tau.ac.il; michael.wolf@sheba.health.gov.il

### *Knowledge comes, but wisdom lingers*

Lord Alfred Tennyson (1809-1892), Poet Laureate of the United Kingdom and one of the most popular English poets. Tennyson wrote a number of phrases that have become commonplaces of the English language, including: "better to have loved and lost" and "Theirs not to reason why/Theirs but to do and die." He is the second most frequently quoted writer in the English language, after Shakespeare.