Effect of Laser Arytenoidectomy on Respiratory Stridor Caused by Multiple System Atrophy

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Respiratory stridor in patients with multiple system atrophy is a complication that occasionally causes nocturnal sudden death. Continuous positive airway pressure (CPAP) therapy has been proposed as an alternative to tracheostomy to treat nocturnal stridor associated with multiple system atrophy. However, some patients cannot tolerate CPAP therapy and experience sleep disturbances, even if the pressure is controlled; also, CPAP therapy can be less effective in patients with a narrow glottic opening

during sleep. This report describes the effect of laser arytenoidectomy on respiratory stridor caused by multiple system atrophy.

Keywords: CPAP, endoscopic surgery, laser arytenoidectomy, multiple system atrophy, respiratory stridor

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Respiratory stridor in patients with multiple system atrophy is a complication that occasionally causes nocturnal sudden death.¹ Continuous positive airway pressure (CPAP) therapy has been proposed as an alternative to tracheostomy to treat nocturnal stridor associated with multiple system atrophy.^{2,3} However, some patients cannot tolerate CPAP therapy and experience sleep disturbances, even if the pressure is controlled; also, CPAP therapy can be less effective in patients with a narrow glottic opening during sleep. This report describes the effect of laser arytenoidectomy on respiratory stridor caused by multiple system atrophy.

REPORT OF CASE

A 55-year-old woman presented with a 2-year history of snoring and sleep apnea. She also had a 6-month history of occasional stridor during wakefulness and other symptoms, such as vesicorectal failure. Her voice quality was normal and scored as G₀ using the grade-roughness-breathiness-asthenicity-strain system. Laryngeal fiberscopy revealed that vocal fold abduction was restricted on inspiration during wakefulness, but functioned normally on phonation. In contrast, during sleep induced by intravenous injection of 5 mg diazepam, we observed a very narrow glottic space on inspiration due to vocal fold adduction, but vocal fold abduction functioned normally on expiration, indicating the presence of paradoxical movement (**Figures 1A, B**).⁴ There was no floppy epiglottis⁵ or airway obstruction at the arytenoids. Brain and neck magnetic resonance imaging revealed no abnormal findings. She was referred to the neurology clinic at the hospital and diagnosed with Shy-Drager Syndrome.

CPAP was applied with AutoSet titration. The 95th percentile pressure (the pressure at or below which the patient spent 95% of the time that night) was 10 cm H₂O, and the median pressure was 9.8 cm H₂O. This improved the SpO₂ and reduced the volume of stridor. Polysomnography showed improvement in the apnea index, apnea-hypopnea index, lowest SpO₂, and

duration of SpO₂ < 90% (**Table 1**). However, her arousal index increased, and sleep architecture and daytime sleepiness worsened. Therefore, CPAP therapy was abandoned.

She underwent laser arytenoidectomy and tracheostomy (**Figure 2**). The posterior glottis was exposed under a microscope, and an incision was made along the superior portion of the right arytenoid cartilage from the tip of the vocal process to the apex, using a CO₂ laser at 6-10 W continuous mode. The vocal process of the arytenoid cartilage was vaporized anteriorly to the posterior macula flava of the vocal fold. The arytenoid cartilage was vaporized laterally near the muscular process. The posterior portion of the thyroarytenoid muscle was then vaporized. The wound was covered with preserved mucosa of the posterior glottis using fibrin glue. The laryngeal wound stabilized 7 weeks postoperatively and the tracheal stoma was closed.

The procedure widened the posterior glottal airway by removing the body and vocal process of the arytenoid cartilage, but left the muscular process of the arytenoid cartilage intact. The widened posterior glottis was recorded during diazepam-induced sleep (**Figure 3**). Her voice quality was G₀ after closure of the stoma. Polysomnography 7 weeks postoperatively showed that the procedure improved not only the apnea and apnea-hypopnea indices, but also the arousal index both with and without CPAP (**Table 1**). Furthermore, the percentage of total sleep time spent in stage 2 sleep increased. Surgery alone was sufficient for her to sleep without CPAP, and her daytime sleepiness improved. However, snoring caused by glossoptosis gradually appeared 7 years postoperatively. CPAP with a titrated 95th percentile pressure of 10 cm H₂O controlled her sleep disordered breathing without tracheostomy.

DISCUSSION

Respiratory stridor occurs in up to 30% of patients with multiple system atrophy. It traditionally has a poor prognosis

Figure 1—Fiberoptic findings during sleep on expiration (A) and inspiration (B) **Figure 2**—Intraoperative photograph

The body and vocal process of the right arytenoid cartilage were vaporized submucosally with the muscular process of the arytenoid cartilage left intact. The wound was covered with preserved mucosa from the posterior glottis using fibrin glue (white arrow). PM, preserved mucosa, PA, posterior airway, R, right vocal fold, L, left vocal fold.

and is managed by tracheostomy. Isozaki et al. found that the stridor is caused by persistent hyperactivity of the intrinsic laryngeal muscle and neurogenic atrophy of the posterior crico-arytenoid muscle. There are two patterns of inspiratory vocal cord position during sleep: one in which the posterior glottis is still open and another in which it is almost completely closed over the total length of the cords. Tracheostomy should be considered in the latter pattern.⁴ Permanent tracheostomy is a logical and effective treatment for removing airflow obstruction. However, it can limit daytime activity in patients with other disorders, as in patients with multiple system atrophy. Accordingly, we felt it worthwhile to prevent airflow obstruction by widening the glottis, a method that does not require permanent tracheostomy.

Vocal cord lateralization⁶ and laser arytenoidectomy^{7,8} can successfully treat nocturnal stridor. These procedures are minimally invasive and are generally used for bilateral median vocal fold fixation in bilateral vocal fold paralysis. These procedures

Figure 3—Fiberoptic findings 7 weeks postoperatively

The widened posterior glottis after arytenoidectomy was recorded on inspiration during sleep. PA, posterior airway.

Table 1—Polysomnographic results before and after Laser arytenoidectomy

	Before surgery		After surgery	
	No treatment	CPAP	Surgery alone	CPAP
TST (m)	392	296.5	437	356
SE (%)	65.2	63.7	66.2	58.7
%Stage1	28.6	22.4	24.3	15.7
%Stage2	35.1	38	49.9	48.3
%Stage3+4	1.6	3.2	0.3	4.6
%REM	7.6	5.7	6.7	10.5
Ar-I	47	49.6	27.3	24.7
AI	18.2	7.9	0	0
AHI	50.1	27.5	3.8	0.5
Lowest SpO ₂ (%)	87	94	94	96
SpO ₂ < 90% (%)	1.8	0.8	0	0

CPAP, continuous positive airway pressure; TST, total sleep time; SE, sleep efficiency; %Stage1, percentage of stage 1 sleep time in TST; %Stage2, percentage of stage 2 sleep time in TST; %Stage3+4, percentage of stage 3 and stage 4 sleep time in TST; Ar-I, arousal index; AI, apnea index; AHI, apnea hypopnea index; SpO₂ < 90%, duration of SpO₂ less than 90%.

restrict the movement of a movable vocal fold.⁶ One unsuccessful case of vocal cord lateralization has been reported.⁸ The thread used in lateralization may break following this procedure due to the glottic closing force. Widening of the posterior glottis by laser arytenoidectomy is more reliable and physiologically appropriate because the posterior glottis is respiratory,⁷ while the anterior glottis is phonatory. Laser arytenoidectomy can restore an adequate airway in patients with respiratory disturbance due to multiple system atrophy without disrupting voice quality. Laser arytenoidectomy to widen the posterior glottis is highly recommended in cases of sleep disordered breathing that

cannot be controlled by CPAP or those with respiratory stridor during wakefulness.

CPAP is a safe, noninvasive, and effective long-term therapy for nocturnal stridor and allows avoiding tracheostomy in some cases.^{2,3} A small number of patients with stridor cannot tolerate CPAP, and the pressure of CPAP on the closed glottis may cause the observed difficulties. The widening procedure may promote tolerance to CPAP therapy, even if sleep disordered breathing arises due to other conditions. However, the disappearance of sleep disordered breathing does not treat multiple system atrophy. Severe depletion of neurons in the ventral medullary surface can occur, leading to dysfunction of the pontomedullary network that plays a critical role in the respiratory control of automatic breathing. Even after elimination of stridor, patients with multiple system atrophy can die from respiratory arrest of central origin, cerebellar ataxia, autonomic dysfunction, or parkinsonism.

CONCLUSION

Laser arytenoidectomy for respiratory stridor caused by multiple system atrophy is recommended as an effective treatment for patients who cannot tolerate CPAP.

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