*The Journal of Laryngology & Otology (2009), **123**, 96–102.*

doi:10.1017/S002221510800323X

Main Article

Perceived vocal morbidity in a problem asthma clinic

A E Stanton, C Sellars*, K MacKenzie†, A McConnachie‡, C E Bucknall

Abstract

Aims: Asthma treatment has the potential to affect patients' voices. We undertook detailed characterisation of voice morbidity in patients attending a problem asthma clinic, and we determined how patients' perceptions related to objective assessment by an experienced observer.

Methods: Forty-three patients took part in the study. Subjects completed the self-administered voice symptom score (VoiSS) questionnaire and underwent digital voice recording. These voice recordings were scored using the grade–roughness–breathiness–asthenicity–strain system (GRBAS). Laryngoscopy was also performed.

Results: The median VoiSS was 26 (range three to 83). VoiSS were significantly lower in the 17 patients with normal laryngeal structure and function (range four to 46; median 22), compared with the 26 patients with functional or structural laryngeal abnormality (range three to 83; median 33) (95 per cent confidence intervals for difference 0.0–21.0; $p = 0.044$). The overall grade score for the GRBAS scale did not differ between these two groups, and only 13 patients had a GRBAS score of one or more, recognised as indicating a voice problem. There were positive correlations between related GRBAS score and voice symptom score subscales. Although voice symptom scores were significantly more abnormal in patients with structural and functional abnormalities, this score performed only moderately well as a predictive tool (sensitivity 54 per cent; specificity 71 per cent). Nevertheless, the voice symptom score performed as well as the more labour-intensive GRBAS score (sensitivity 57 per cent; specificity 60 per cent). Patients' inhaled corticosteroid dose (median dose 1000 μg beclomethasone dipropionate or equivalent) had a statistically significant relationship with their overall grade score for the GRBAS scale ($r = 0.56$; $p < 0.001$), but not with their VoiSS. Only one patient had evidence of laryngeal candidiasis, and only two had any evidence of abnormality suggesting steroid-induced myopathy.

Conclusions: Vocal morbidity is common in patients with asthma, and should not be immediately attributed to steroid-related candidiasis. The VoiSS merits further, prospective validation as a screening tool for ENT and/or speech and language therapy referral in patients with asthma.

Key words: Asthma; Voice; Vocal Quality; Laryngoscopy

Introduction

Inhaled asthma medication has the potential to directly affect the larynx. Therefore, asthma, or its treatment, may have a direct effect on patients' voices. Up to 50 per cent of patients using inhaled corticosteroids may suffer from dysphonia, which is usually reversible.[1] Such dysphonia is usually attributed to fungal infection or to steroid-induced adductor myasthenia of the larynx,[2] although laryngoscopy or voice laboratory assessment may reveal more complicated problems such as apposition abnormalities and cycle-to-cycle irregularity.[3,4] Recent work has demonstrated the impact of dysphonia without significant structural laryngeal disease on patients' quality of life, compared with normal subjects,[5] as measured by the short form 36 (SF-36) questionnaire. Much of the voice literature is focused on those patients who attend otolaryngology clinics; however, Baker *et al.* found that 50 per cent of 80 young adults with asthma or allergy had vocal quality abnormalities (as assessed by speech and language therapists).[6] Voice morbidity in patients with asthma has not been extensively studied.

The voice assessment performed by voice scientists, speech and language therapists, and others can include sophisticated perceptual, acoustic, aerodynamic and endoscopic methods which enable diagnosis and treatment planning for voice disorders.[7] There are a number of protocols available for perceptual analysis of the voice, with the grade–roughness–breathiness–asthenicity–strain (GRBAS) score scale being the

From the Departments of Respiratory Medicine, *Speech and Language Therapy, and †Otolaryngology, Glasgow Royal Infirmary and the ‡Robertson Centre for Biostatistics, University of Glasgow, Scotland, UK.
Presented in abstract form to the European Respiratory Society meeting, 7 September 2004, Glasgow, Scotland, UK, and published previously as Stanton *et al.* Perceived vocal morbidity in a problem asthma clinic. *Eur Resp J* 2004;**24**(suppl 48):A2887.
Accepted for publication: 27 May 2008. First published online 22 July 2008.

recognised 'gold standard' tool in the UK.[8] Speech and language therapists use this tool to assess a number of aspects of vocal impairment, using a four-point scale.[9] The tool assesses the voice's overall grade (i.e. overall degree of voice deviance), roughness (i.e. impression of irregular pulses or of low frequency noise), breathiness (i.e. audible turbulent air leakage), asthenicity and strain. Several studies have shown reasonable inter-rater reliability in the use of this scale.[10–13]

It is unclear how the degree of voice impairment determined by speech and language therapists relates to patients' own perceptions. The voice symptom scale is a 30-item questionnaire which has been thoroughly evaluated as a tool for the self-assessment of voice quality.[14,15] This scale comprises a total score plus three robust subscales assessing voice impairment, emotional reaction and laryngopharyngeal symptoms (i.e. physical component).

The aim of this study was therefore to characterise the vocal quality and laryngeal appearance in patients attending a problem asthma clinic, and to relate this to patients' and speech and language therapists' perceptions of vocal morbidity. This evaluation was conducted in parallel with assessment of upper airway physiology and nasal disease, the results of which have been previously reported.[16–18] A secondary aim was to assess the local inter-rater reliability of the GRBAS scale among speech and language therapists; these results will be reported separately.

Methods

Patients were recruited to the study from a problem asthma clinic based in a central teaching hospital. All patients attending the problem asthma clinic were eligible for inclusion in the study. Letters of invitation to take part in the study were sent to patients attending the clinic, and this invitation was reinforced by telephone or in person when patients attended the clinic. The study protocol involved attendance on a single afternoon. The study was conducted in accordance with the recommendations of the Helsinki Declaration of 1975, and was approved by the North Glasgow University Hospitals NHS Trust local research and ethics committee (REC reference number 03RE002). All patients gave written, informed consent for their participation in the study.

Patients completed the 30-item, self-administered VoiSS questionnaire. Voice recordings were then performed in a soundproof booth housed within the otolaryngology department. Recordings were made using digital tape recorder and digital audio tape. Patients were instructed to speak approximately 10 to 15 cm away from the microphone. They were asked to speak spontaneously for a few seconds (giving their name, how they had travelled to hospital that day, and what they had eaten for dinner and had watched on television the previous evening) before reading the standard 'Rainbow passage'.[19] These recordings were made in the presence of one of two independent observers who were not involved in any further data analysis.

Following the topical application of co-phenylcaine to the nose, each patient had their larynx and laryngopharynx visualised by a single observer (KMacK) using standard naso-laryngoscopic technique. The larynx structure and function were assessed. Laryngeal appearance was noted, as was the mobility of the vocal folds on phonation, inspiration and expiration.

The patients' digital audio tape voice recordings were transferred onto two compact discs (CDs), such that both CDs contained every patients' voice recording plus anonymised personal details, but in a different, randomised order. Individual patient's recordings therefore corresponded to different individual tracks on each CD. A master list was kept in which track numbers were linked to patient names; this list was not seen by the voice raters.

The voice raters were three experienced speech and language therapists familiar with the GRBAS scale. Raters graded patients' voices according to this scale, with a further assessment of voice quality fluctuation (i.e. instability).[20] Each subscale was assessed on a four-point scale (i.e. zero to three) in order to determine the degree of vocal impairment. Each CD was listened to and independently rated by the three speech and language therapists during listening sessions at least seven days apart. Every patient therefore had their voice recording scored by three speech and language therapists on two occasions.

The voice symptom score questionnaires were scored according to the total score and the three subscales of voice impairment (15 items; score range zero to 60), emotional reaction (eight items; score range zero to 32) and physical symptoms (seven items; score range zero to 28). A higher score indicated greater vocal morbidity.

Data analysis

Mean values for each GRBAS(I) scale score were calculated, from the six scores given by the three raters, for each patient. The total GRBAS scores were calculated using the means for each of these subscales; the mean for the instability subscale was not used in this calculation as this is not in widespread use. Spearman rank correlations were then calculated between the GRBAS score subscales and each VoiSS subscale, as well as the total VoiSS. Mann–Whitney U tests were used to compare the VoiSS of subgroups of patients with abnormalities identified laryngoscopically. Minitab™ software (version 14; Minitab Inc., Coventry, UK) was used to perform these calculations. We used conventional methods to calculate the sensitivity and specificity and the positive and negative predictive values of the VoiSS and the GRBAS scores for detecting an abnormality at laryngoscopy.[21]

Results

Sixty patients initially agreed to take part in the study but 17 subsequently withdrew; therefore, 43 patients were ultimately included. Thirty-four patients had documented, objective evidence of asthma (i.e.

TABLE I

VOICE SYMPTOM SCORES

Subscale	Range	Mean (SD)	Median (IQR)
Impairment	0–47	15.7 (11.2)	16 (7–20)
Emotional reaction	0–21	3.1 (5.3)	0
Physical symptoms	3–27	11.0 (4.9)	10 (7–14)
Total	3–83	30.5 (18.5)	26 (16–40)

SD = standard deviation; IQR = interquartile range

significant diurnal variability in peak expiratory flow rate, significant bronchodilator reversibility or response of airflow obstruction to oral corticosteroid trial, or histamine challenge confirming bronchial hyper-reactivity). Four patients gave a very good clinical history of asthma from an early age but had normal lung function whenever this was tested. Five patients had no definite evidence of asthma. Patients' median dose of inhaled corticosteroids was 1000 μg beclomethasone dipropionate or equivalent (interquartile range 800–2000), and all but three patients were taking inhaled corticosteroids at the time of assessment.

The VoiSS are shown in Table I. There was no relationship between VoiSS and inhaled corticosteroid dose ($r = 0.23$; $p = 0.117$).

The mean of the six GRBAS(I) score assessments (two each from the three speech and language therapists) was calculated for each patient, to give their final GRBAS(I) scores (Table II). Thirteen of our 43 (30.2 per cent) patients had an overall grade score, for the GRBAS scale, of one or more, which is recognised as denoting definite abnormality. A statistically significant correlation was observed between patients' overall grade score, for the GRBAS scale, and their inhaled corticosteroid dose (Spearman $r = 0.56$; $p < 0.001$; Figure 1).

Patients' laryngoscopy results were divided into structural and functional findings, with each patient being assessed separately for each category (Figure 2). Laryngitis was defined as diffuse reddening and swelling of the glottis consistent with an inflammatory process, and was graded subjectively as mild, moderate or severe. Only one patient had laryngeal thrush in addition to mild laryngitis.

Patients with a normal laryngoscopic appearance had lower median VoiSS than those with abnormalities, as shown in Table III. The mean overall grade

TABLE II

GRBAS(I) SCORES

Subscale	Range	Mean (SD)	Median (IQR)
Grade	0–2.83	0.59 (0.57)	0.50 (0.17–1.0)
Roughness	0–2.5	0.88 (0.49)	0.83 (0.5–1.17)
Breathiness	0–2.17	0.43 (0.53)	0.33 (0–0.5)
Asthenicity	0–1.5	0.27 (0.36)	0.17 (0–0.5)
Strain	0–2.83	0.62 (0.57)	0.50 (0.17–1.0)
Instability	0–1.83	0.24 (0.38)	0.17 (0–0.33)
Total	0.33–10.83	2.79 (2.1)	2.0 (1.25–3.83)

GRBAS(I) = grade–roughness–breathiness–asthenicity–strain–instability scale; SD = standard deviation; IQR = interquartile range

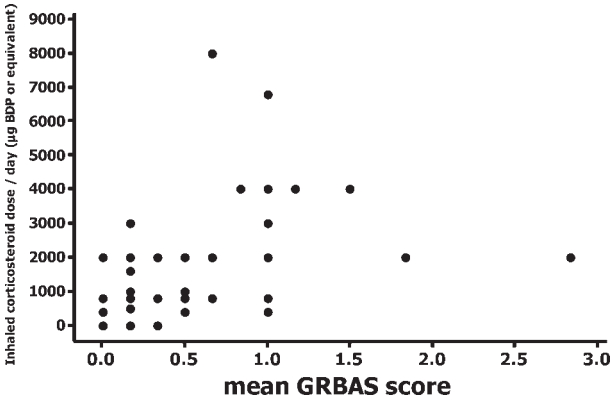

FIG. 1

Relationship between inhaled corticosteroid dose and overall grade score for grade–roughness–breathiness–asthenicity–strain (GRBAS) scale. Spearman $r = 0.56$; $p < 0.001$. BDP = beclomethasone dipropionate

score, for the GRBAS scale, did not differ between these two groups. However, there were significant differences in GRBAS subscale scores in the group with functional abnormalities, compared with those with no functional abnormalities, as shown in Appendix A (which relates VoiSS and GRBAS(I) subscale scores to laryngoscopic findings). Spearman Rank correlations between patients' median GRBAS(I) rating and their VoiSS (totals and subscale scores) are shown in Table IV. Nonsignificant p values are not shown.

Relationship between voice assessment scores and laryngoscopic appearance

We found that the VoiSS and the GRBAS score predicted laryngoscopic abnormality equally (Table V).

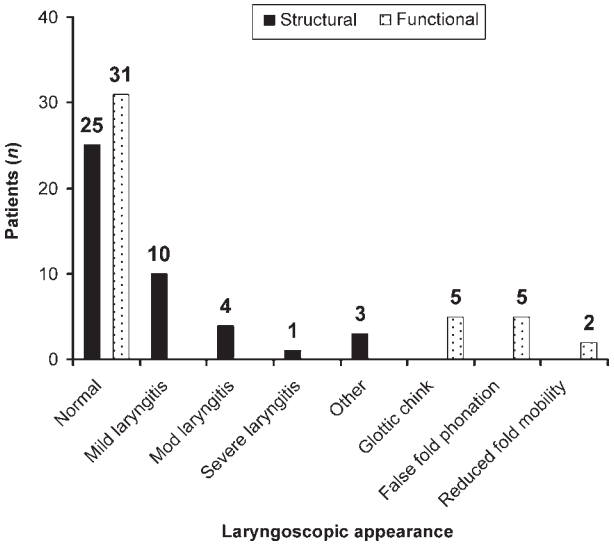

FIG. 2

Patients' laryngoscopy results. Each patient was assessed on both structural and functional appearance. Other abnormalities comprised arytenoid abnormality, vocal fold polyp, and benign thickening of tongue base causing hypopharyngeal narrowing. Mod = moderate

TABLE III

VOISS AND OVERALL GRBAS SCORES, BY LARYNGOSCOPIC APPEARANCE

Laryngoscopy	VoiSS		GRBAS score	
	Range	Median	Range	Median
Normal structure & function*	4–46	22	0–1.0	0.34
Abnormal structure or function†	3–83	33	0–2.8	0.67
95% CI, difference *vs* normals		0.0, 21.0‡		−5.0, 0.0**

*$n = 17$; †$n = 26$. ‡$p = 0.044$; **$p = 0.15$. GRBAS = grade–roughness–breathiness–asthenicity–strain scale; VoiSS = voice symptom score; CI = confidence intervals

A total VoiSS of 30 was chosen as a cut-off because of its relationship with the median total VoiSS for the study group. An overall grade of one or more on the GRBAS scale is recognised as identifying significant vocal morbidity[9] and was therefore used as the cut-off for this analysis.

Discussion

The patients we studied were representative of those attending our problem asthma clinic, with a majority having objective evidence of asthma and receiving moderately high doses of inhaled corticosteroids. We identified voice morbidity as a problem in this population. While other authors have investigated the frequency of voice problems in patients with asthma,[2,22] these studies used only self-administered questionnaires to identify voice problems. Our study is novel in that it included a comprehensive vocal assessment undertaken variously by patients (using the VoiSS), by speech and language therapists (using the GRBAS scale) and by an ENT specialist (using direct visualisation of the larynx). Although selection bias may have operated, the impact of this would have been diluted by the fact that patients were invited to take part in a broad-based assessment of their upper airway (including the nose). Additional data from a control group would have strengthened our findings. However, the present research was a pilot study designed to generate hypotheses. Further evaluation of the VoiSS and the GRBAS score in an asthmatic cohort should take into account the need for a control group. Our analyses of the interrelations between VoiSS, GRBAS score and laryngeal findings were not affected by these considerations.

A significant proportion of patients had abnormal laryngeal findings, with abnormalities of function in 28 per cent (12/43) and laryngitis in 35 per cent (15/43). Five patients had glottic chinks, a further five were phonating with the false vocal folds and two had reduced vocal fold mobility; all these are likely to affect voice quality. All laryngoscopies were performed by a single observer; thus, although consistency was achieved, the impact of recognised inter-observer variability in the reporting of laryngoscopic findings was not assessed.

The VoiSS has been extensively investigated and refined in over 800 subjects, and its subscales have shown good internal consistency, in contrast to the self-administered questionnaires used in earlier studies of patients with asthma.[2,22] Although there are other instruments available for the self-assessment of voice quality, such as the vocal handicap index and the voice-related quality of life questionnaire, we chose the VoiSS because of its rigorous development process in a UK population, which included laryngopharyngeal symptom assessment.[14,15] Hitherto, there have been no published VoiSS data for patients with asthma. Our patients' scores were less abnormal than those reported for 144 functional dysphonics and 145 patients with structural laryngeal pathology (mean total scores of 43.3 and 46.5, respectively).[15] The GRBAS scores from our study are not readily comparable with those reported elsewhere, as the latter have been assessed differently (e.g. using visual analogue scales)[23] or in such a manner as to determine inter-rater reliability.[10]

TABLE IV

SPEARMAN RANK CORRELATIONS BETWEEN VOISS AND GRBASI SCORE

GRBAS(I) subscale	VoiSS subscale			
	Total	Impairment	Emotional	Physical
Grade	0.24	0.33 ($p = 0.034$)	0.28	0.05
Roughness	0.08	0.15	0.09	−0.09
Breathiness	0.40 ($p = 0.008$)	0.43 ($p = 0.004$)	0.38 ($p = 0.013$)	0.06
Asthenicity	0.47 ($p = 0.002$)	0.43 ($p = 0.004$)	0.33 ($p = 0.032$)	0.15
Strain	0.25	0.30 ($p = 0.05$)	0.26	0.21
Instability	0.18	0.21	0.14	0.10
Total	0.34 ($p = 0.027$)	0.38 ($p = 0.012$)	0.32 ($p = 0.036$)	0.13

GRBAS(I) = grade–roughness–breathiness–asthenicity–strain–instability scale; VoiSS = voice symptom score

TABLE V

PREDICTIVE VALUE OF OVERALL GRBAS SCORE AND VOISS FOR LARYNGOSCOPIC ABNORMALITY*

Parameter	Sensitivity (%)	Specificity (%)	NPV (%)	PPV (%)
GRBAS grade ≥1 (mean (SD))†	57.1 (10.7)	59.8 (11.4)	50.1 (6.5)	68.7 (5.8)
VoiSS ≥30‡	53.8	70.6	50	73.7

*Any abnormality. †Six scorings; ‡single, self-completed scoring. GRBAS = grade–roughness–breathiness–asthenicity–strain scale; VoiSS = voice symptom score; NPV = negative predictive value; PPV = positive predictive value

Higher voice symptom scores were associated with laryngeal pathology (Table III). We did not evaluate quality of life, but the emotional domain of the VoiSS may reflect this parameter. Dysphonia has been shown to adversely affect patients' quality of life;[5] in another study, self-rated voice quality was significantly related to a range of personality, psychological distress and quality of life measures.[24] The contribution of dysphonia to asthma patients' impaired quality of life merits further exploration.

- **Patients with asthma often complain of voice symptoms, which are usually attributed to treatment with inhaled corticosteroids**
- **Vocal morbidity in patients with asthma is a complex issue; it can be characterised using research instruments (e.g. the VoiSS and the GRBAS score) more routinely used in non-asthma populations**
- **In only a small proportion of cases can vocal morbidity be directly attributed to laryngeal candidiasis**
- **The VoiSS is a potential screening tool for vocal morbidity in patients with asthma**

As well as investigating the relationship between VoiSS responses and laryngoscopic findings, we also observed a relationship between the specialist, objective GRBAS scoring and the self-reported, subjective VoiSS. Since the overall grade score for the GRBAS scale is taken as a summary measure of voice deviance, we expected to observe a relationship between this component and the impairment domain of the VoiSS. We found weakly positive correlations between the related GRBAS score subscales and the total GRBAS score, and the VoiSS. The lack of a relationship between the physical subscale of the VoiSS and the GRBAS score was expected, as this subscale assesses non-vocal laryngopharyngeal symptoms. Murry *et al.* found a moderate correlation between total GRBAS score and voice-related quality of life scores (derived from a 10-item, self-administered questionnaire).[25] This study observed no breakdown of the relationship with individual GRBAS score subscales, and it is these, rather than the total score, which are pertinent to clinical practice. Our study therefore adds to the evidence that patients' perception of vocal morbidity correlates with that of an experienced observer. In addition, the overall grade score for the specialist, labour-intensive GRBAS scale was no better than the VoiSS in predicting laryngoscopic abnormality (Table V). For these reasons, we believe that further validation of the voice symptom score as a screening test for asthma patients with vocal morbidity is warranted.

We found a low incidence of laryngeal thrush (i.e. only one patient), suggesting that dysphonia should not immediately be attributed to this; we also found little evidence of steroid-induced myopathy (two patients). Lavy *et al.* also found a low incidence of candidiasis in a group of asthmatics complaining of dysphonia (four out of 22 patients), and they identified other laryngoscopic abnormalities (i.e. mucosal changes, apposition problems and supraglottic hyperfunction) which could explain patients' symptoms.[4]

Conclusion

We found that laryngeal structural and functional abnormalities occurred in a significant proportion of patients attending a problem asthma clinic. We also found that such abnormalities were associated with significant differences in patients' (self-reported) VoiSS but not in their (more labour-intensive, objective) GRBAS scores. Very few patients were found to have fungal infections or myopathy as a result of using inhaled corticosteroids, and we suggest that vocal morbidity should not be attributed to these without positive evidence. Our findings confirm relevant, positive correlations between VoiSS and GRBAS scores (the latter being our gold standard measurement), suggesting that these two instruments measure similar attributes. The results of this pilot study suggest that the VoiSS is a useful screening tool in asthma patients; however, further work is required, as is comparative data for normal subjects.

Acknowledgements

The authors would like to thank Catherine Dunnet and Linda Chapman for their assistance with the GRBAS(I) score data collection. This work was supported by the Ritchie Trust Research Fellowship from the Royal College of Physicians and Surgeons of Glasgow.

References

1 Barnes P. Corticosteroids. In: O'Byrne PM, Thomson NC, eds. *Manual of Asthma Management*. London: WB Saunders, 2001;173–96
2 Williamson IJ, Matusiewicz SP, Brown PH, Greening AP, Crompton GK. Frequency of voice problems and cough in patients using pressurized aerosol inhaled steroid preparations. *Eur Respir J* 1995;**8**:590–2

3 Crompton GK, Sanderson R, Dewar MH, Matusiewicz SP, Ning AC, Jamieson AH *et al*. Comparison of Pulmicort pMDI plus Nebuhaler and Pulmicort Turbuhaler in asthmatic patients with dysphonia. *Respir Med* 2000;**94**:448–53
4 Lavy JA, Wood G, Rubin JS, Harries M. Dysphonia associated with inhaled steroids. *J Voice* 2000;**14**:581–8
5 Wilson JA, Deary IJ, Millar A, MacKenzie K. The quality of life impact of dysphonia. *Clin Otolaryngol* 2002;**27**:179–82
6 Baker BM, Baker CD, Le HT. Vocal quality, articulation and audiological characteristics of children and young adults with diagnosed allergies. *Ann Otol Rhinol Laryngol* 1982;**91**(suppl 48):277–80
7 Carding P. Voice pathology clinics in the UK. *Clin Otolaryngol* 2003;**28**:477–8
8 Carding P, Carlson E, Epstein R, Mathieson L, Shewell C. Formal perceptual evaluation of voice quality in the United Kingdom. *Logoped Phoniatr Vocol* 2000;**25**:133–8
9 Hirano M. Objective evaluation of the human voice: clinical aspects. *Folia Phoniatr (Basel)* 1989;**41**:89–144
10 De Bodt MS, Wuyts FL, Van de Heyning PH, Croux C. Test-retest study of the GRBAS scale: influence of experience and professional background on perceptual rating of voice quality. *J Voice* 1997;**11**:74–80
11 Dejonckere PH, Obbens C, de Moor GM, Wieneke GH. Perceptual evaluation of dysphonia: reliability and relevance. *Folia Phoniatr (Basel)* 1993;**45**:76–83
12 Dejonckere PH, Remacle M, Fresnel-Elbaz E, Woisard V, Crevier L, Millet B. Reliability and clinical relevance of perceptual evaluation of pathological voices. *Rev Laryngol Otol Rhinol (Bord)* 1998;**119**:247–8
13 Webb AL, Carding PN, Deary IJ, MacKenzie K, Steen N, Wilson JA. The reliability of three perceptual evaluation scales for dysphonia. *Eur Arch Otorhinolaryngol* 2004; **261**:429–34
14 Deary IJ, Wilson JA, Carding PN, MacKenzie K. VoiSS: a patient-derived voice symptom scale. *J Psychosom Res* 2003;**54**:483–9
15 Wilson JA, Webb A, Carding PN, Steen IN, MacKenzie K, Deary IJ. The Voice Symptom Scale (VoiSS) and the Vocal Handicap Index (VHI): a comparison of structure and content. *Clin Otolaryngol* 2004;**29**:169–74
16 Stanton AE, Johnson MK, MacKenzie K, Carter R, Bucknall CE. Physiological evaluation of the upper airway in a problem asthma clinic. *Eur Respir J* 2004; **24**(suppl 48):P1712
17 Stanton AE, MacKenzie K, Carter R, Bucknall CE. The spectrum of upper airway problems in a problem asthma clinic – the role of the larynx. *Eur Respir J* 2004;**24**(suppl 48):P1711
18 Stanton AE, McGarry G, Carter R, Bucknall CE. The spectrum of upper airway problems in a problem asthma clinic – the role of the nose. *Eur Respir J* 2004;**24**(suppl 48):P1710
19 Fairbanks G. *Voice and Articulation Drillbook*, 2nd edn. New York: Harper, 1960
20 De Bodt MS, Van de Heyning PH, Wuyts FL, Lambrechts L. The perceptual evaluation of voice disorders. *Acta Otorhinolaryngologica Belg* 1996;**50**:283–91
21 Altman DG. *Practical Statistics for Medical Research*, 1st edn. London: Chapman & Hall, 1991
22 Ihre E, Zetterstrom O, Ihre E, Hammarberg B. Voice problems as side effects of inhaled corticosteroids in asthma patients – a prevalence study. *J Voice* 2004;**18**: 403–14
23 Millet B, Dejonckere PH. What determines the differences in perceptual rating of dysphonia between experienced raters? *Folia Phoniatr Logop* 1998;**50**:305–10
24 Deary IJ, Wilson JA, Carding PN, MacKenzie K. The dysphonic voice heard by me, you and it: differential associations with personality and psychological distress. *Clin Otolaryngol* 2003;**28**:374–8
25 Murry T, Medrado R, Hogikyan ND, Aviv JE. The relationship between ratings of voice quality and quality of life measures. *J Voice* 2004;**18**:183–92

APPENDIX A

RELATION OF VOISS AND GRBAS(I) SCORES TO LARYNGOSCOPIC FINDINGS

Subscale	Functional abnormality					Structural abnormality				
	Absent		Present		*p*	Absent		Present		*p*
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)		Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	
VoiSS										
Impairment	14.7 (11.4)	14 (5–19)	18.3 (10.7)	18 (11.5–26)	NS	13.9 (10.0)	13 (5–19)	18.3 (12.5)	16 (10.8–25)	NS
Emotional reaction	3.5 (5.8)	0 (0–6)	2.1 (3.7)	1 (0–2.75)	NS	1.8 (3.3)	0 (0–2)	4.9 (6.9)	1 (0–9.25)	NS
Physical symptoms	11.7 (5.3)	11 (9–15)	8.9 (3.3)	9 (6.25–10.75)	NS	10.4 (4.7)	10 (7.5–13)	11.7 (5.3)	11 (7–16.25)	NS
Total	30.5 (20.0)	25 (16–40)	30.6 (14.7)	32 (19–39.75)	NS	26.7 (13.6)	25 (16–37.5)	35.8 (23.0)	30 (21–49)	NS
GRBASI										
Grade	0.45 (0.56)	0.17 (0.17–0.68)	0.94 (0.44)	1.00 (0.68–1.13)	0.0015	0.58 (0.49)	0.50 (0.17–1.00)	0.60 (0.68)	0.50 (0.17–0.71)	NS
Roughness	0.82 (0.52)	0.83 (0.50–1.17)	1.04 (0.36)	1.00 (1.0–1.29)	NS	0.83 (0.46)	0.83 (0.42–1.17)	0.95 (0.53)	1.00 (0.79–1.17)	NS
Breathiness	0.31 (0.48)	0.17 (0.00–0.33)	0.72 (0.56)	0.50 (0.33–1.00)	0.0043	0.39 (0.47)	0.33 (0.00–0.42)	0.47 (0.62)	0.25 (0.00–0.75)	NS
Asthenicity	0.18 (0.26)	0.00 (0.00–0.33)	0.51 (0.48)	0.42 (0.17–0.83)	0.0154	0.25 (0.37)	0.00 (0.00–0.50)	0.31 (0.36)	0.17 (0.00–0.50)	NS
Strain	0.55 (0.60)	0.33 (0.17–0.67)	0.81 (0.47)	0.75 (0.38–1.29)	NS	0.61 (0.47)	0.50 (0.25–1.00)	0.64 (0.70)	0.42 (0.17–0.79)	NS
Instability	0.19 (0.36)	0.00 (0.00–0.17)	0.39 (0.40)	0.25 (0.17–0.5)	0.0335	0.23 (0.26)	0.17 (0.00–0.33)	0.27 (0.51)	0.00 (0.00–0.33)	NS
Total	3.00 (2.90)	1.83 (1.17–4.50)	5.18 (2.67)	4.5 (3.42–7.00)	0.0062	3.55 (2.57)	2.67 (1.25–5.83)	3.69 (3.53)	2.42 (1.50–4.50)	NS

GRBAS(I) = grade–roughness–breathiness–asthenicity–strain–instability scale; SD = standard deviation; IQR = interquartile range; VoiSS = voice symptom scale; NS = not significant

Address for correspondence:
Dr Andrew Stanton,
Osler Chest Unit,
Churchill Hospital,
Headington,
Oxford OX3 7LJ, UK.

Fax: +44 1865 225221
E-mail: andrewestanton@hotmail.com

Dr A E Stanton takes responsibility for the integrity of the content of the paper.
Competing interests: None declared