Dysphonia Outperforms Voice Change as a Clinical Predictor of Dysphagia

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Introduction

Although the clinical swallowing evaluation (CSE) can provide information on overall dysphagia severity (Rangarathnam & McCullough, 2016), clinical indicators of dysphagia remain poorly defined. Due to the shared anatomy and physiology of the larynx during both voicing and swallowing, especially the role of the vagus nerve, some clinicians assess voice quality when commenting on dysphagia at the bedside. However, studies of perceptual and/or acoustic analysis of voice as a clinical indicator of dysphagia demonstrate conflicting results. This may be due to methodological differences and/or the use of binary or ordinal scales (Daniels et al., 1998; Hasson et al., 2014; Logemann et al., 1999; Malandraki et al., 2011; McCullough et al., 2005; Nishiwaki et al., 2005; Rajappa et al., 2017).

This aim of this study was to evaluate if perceptual judgements of dysphonia before swallowing and/or voice change after swallowing may predict dysphagia.

We assessed the predictive value of voice quality using regression analyses with a revised Penetration-Aspiration scale (rPAS), similar to that suggested by Steele and Grace-Martin (2017), and the Normalized Residue Ratio Scale (NRRS; Pearson et al., 2013).

Methods

Design

Prospective, between-subjects design

Participants

• 30 adults referred for clinical VFSS by physician
• 12 female, 18 male (Mean age: 74.03 years)
• Outpatient: 21
• Inpatient: acute-care 3, rehabilitation hospital-6
• Contributed 84 voice samples
• 30 baseline samples (before swallowing any barium)
• 54 post-swallow voice samples

Procedures

• Fitted with cardioid headset microphone (AKG MicroMic C520) placed 4 cm from the right-sides of the mouth
• Voice samples collected with digital voice recorder (Zoom H6 Handy Recorder)
• Frequency settings at 44.1 kHz and 16 bits/s
• Participants recorded completing sustained /i/ for 5 seconds prior to initiation of MBS (“Baseline”)
• Post-swallowing voice samples collected

Voice

• CAPE-V Overall Severity score

Dysphagia

• Normalized Residue Ratio Scale (NRRS; Pearson et al., 2013)
• Revised Penetration-Aspiration Scale (rPAS; Steele & Grace-Martin, 2017)

Table 1

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<th>Scale</th>
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Outcome Measures

Baseline Voice Quality (Dysphonia)

An additional ordered logit model was investigated to determine if a model including medical diagnosis (i.e., pulmonary, esophageal, neurology, other medical), status (i.e., inpatient acute, inpatient rehab, and outpatient), and bolus type (i.e., thin liquids, thickened liquids, solids) explained significantly more variance in rPAS scores. Only bolus type significantly predicted higher rPAS scores, indicating that as bolus type thickened, the odds of higher rPAS scores decreased, b = 0.009, Wald χ2(1) = 9.16, p = 0.002.

Pharyngeal Residue

Simple linear regressions were conducted to evaluate if baseline dysphonia significantly predicted residue in the valleculae or pyriform sinuses. Baseline dysphonia significantly predicted residue in the pyriform sinuses, F(1,82) = 2.25, p = 0.009 but not in the valleculae, F(1,82) = 1.66, p = 0.20.

Multiple regression analyses were conducted to evaluate if the relationship was moderated by medical diagnosis, status, or bolus type. The model predicted significantly more variation (25.6%) in pyriform sinus residue above and beyond baseline dysphonia alone, R2 = 0.26, F-change(7,74) = 2.46, p = 0.03. Follow-up analysis revealed that medical diagnosis was the only significant predictor, with more residue in the pyriform sinuses of patients with a neurological diagnosis.

Post-Swallow Voice Change

Airway Invasion

A cumulative odds ordinal logistic regression was run to determine the effects of post-swallow change in perceptual judgement of voice on airway invasion. The final model did not significantly predict the dependent variable, χ2(1) = 0.54, p = 0.46. Further cumulative odds ordinal regression including medical diagnosis, status, and bolus type, did not significantly predict the outcome, likelihood ratio χ2(4) = 6.58, p = 0.16.

Pharyngeal Residue

Simple linear regressions were conducted to evaluate if post-swallow voice quality changes significantly predicted residue in the valleculae or pyriform sinuses. Post-swallow voice changes did not significantly predict residue in the valleculae, F(1,82) = 0.21, p = 0.65, or pyriform sinuses, F(1,81) = 0.42, p = 0.52. Further multiple regression analyses, including medical diagnosis, status, or bolus type, were not significant for vallecular residue, F(8,75) = 1.38, p = 0.22, or pyriform residue, F(8,74) = 1.37, p = 0.22.

Conclusions

Results of this study indicate that perceptual judgements of dysphonia prior to the administration of barium on MBS predicts airway invasion (i.e., penetration, aspiration) and pyriform sinus residue but not vallecular residue. Of the patients found to have dysphagia, airway invasion was most common with thinner boluses, while patients with neurological diagnoses were most likely to demonstrate pyriform sinus residue. Results also indicated that voice change after swallowing had no predictive quality on penetration, aspiration, or pharyngeal residue.

Given the relationship between voice and swallowing, the results may be related to impaired laryngeal vestibule closure and/or pharyngeal clearance, potentially due to involvement of the vagus nerve (Malandraki et al., 2011; Rajappa et al., 2017). Although future research should attempt to differentiate the causes, the current study suggests that speech-language pathologists should be attentive to dysphonia as a clinical indicator of dysphagia; however, caution should be used when interpreting voice change after swallowing as a clinical indicator of airway invasion or pyriform residue.

References


