A Novel Risk Score to Predict Dysphagia After Cardiac Surgery Procedures

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Background. **Although the exact cause of dysphagia after cardiac operations is unknown, timely diagnosis is critical to avoid a devastating aspiration event. Accordingly, we sought to generate the risk of dysphagia in cardiac surgery (RODICS) score to identify patients at risk for its development after heart surgery.**

Methods. **All adult heart surgery patients at our institution between January 2011 and March 2012 were analyzed. A videofluoroscopic swallow study stratified patients into two groups based on the presence or absence of dysphagia. Covariates ($p < 0.20$) were included in a multivariable model to determine the strongest independent predictors of postoperative dysphagia. Based on the relative odds ratios of significant variables, the RODICS score was generated. Risk cohorts were then created based on easily applicable, whole-integer score cutoffs.**

Results. **During the study period, 115 of 1,314 patients (8.8%) undergoing heart surgery were diagnosed with clinically significant dysphagia. The 38-point RODICS score comprises seven patient-specific characteristics and perioperative factors. The low risk (less than 4), intermediate risk (5 to 9), and high risk (more than 9) cohorts had postoperative dysphagia rates of 3.0%, 6.8%, and 21.6%, respectively ($p < 0.001$). The intermediate-risk cohort (odds ratio 2.3, 95% confidence interval: 1.33 to 4.27, $p = 0.01$) and high-risk cohort (odds ratio 8.9, 95% confidence interval: 5.22 to 15.32, $p < 0.001$) were at significantly higher risk of dysphagia developing. The RODICS score demonstrated excellent discriminatory ability (area under the curve 0.75).**

Conclusions. **The incidence and impact of dysphagia after open cardiac operations is significant. This novel scoring system could lead to prompt identification of patients at high risk for postoperative dysphagia and potentially minimize the complications of aspiration.**

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Dysphagia after cardiac surgery can result in clinically important aspiration and, if unrecognized, increase the risk of postoperative pneumonia [1–3]. Although previous studies have identified risk factors for postoperative dysphagia, most were conducted before the routine use of transesophageal echocardiogram (TEE) and, therefore, focused mainly on the impact of this intraoperative adjunct on postoperative dysphagia rates [2–5].

Currently, TEE is used in most heart surgery operations. Therefore, a better understanding of the influence of other patient-specific characteristics and perioperative factors could aid in the identification of high-risk patients, and might prevent aspiration events through early consultation with a speech-language pathologist (SLP) to manage dysphagia symptoms and expedite initiation of enteral nutrition. Furthermore, although the mechanisms of dysphagia are known to involve a derangement in the normal physiologic process of swallowing, few studies have categorized the type of postoperative dysphagia based on radiographic imaging. Accordingly, we sought to generate a risk of dysphagia in cardiac surgery (RODICS) score to identify patients at high risk for postoperative dysphagia, and also characterize the specific pathophysiologic processes responsible for its development.

Material and Methods

Approval for this study was obtained from The Johns Hopkins Institutional Review Board (00001068).

Patient Population

All adult patients (aged 18 years or more) undergoing heart surgery at our institution between January 2011 and March 2012 were included in the analysis. Patients who required more than one operation during the same hospital admission were characterized by their index procedure. The Society of Thoracic Surgery database was used to abstract patient demographics, preoperative comorbidities, intraoperative variables, and postoperative outcomes. At our institution, enteral nutrition is considered

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Abbreviations and Acronyms

BMI = body mass index
CI = confidence interval
IQR = interquartile range
OR = odds ratio
RODICS = risk of dysphagia in cardiac surgery
SLP = speech-language pathologist
TEE = transesophageal echocardiogram
VFSS = videofluoroscopy

within 2 hours of extubation after successful completion of a bedside, nurse-administered swallow test. By protocol, patients with certain baseline characteristics (history of cerebrovascular accident, intubation more than 72 hours, stridor on extubation, or signs and symptoms of dysphagia at nurse-administered bedside screen) are formally evaluated by an SLP before permitting any oral intake.

Formal SLP consultation involves an initial bedside evaluation for signs and symptoms of aspiration. The presence of dysphonia, dysarthria, cough with swallowing, or an abnormal gag reflex or voluntary cough have been established as signs of increased risk for aspiration [6, 7]. Patients demonstrating any of these signs are then referred for an instrumental assessment using videofluoroscopy (VFSS). In addition to confirming the presence of aspiration, the VFSS can also identify the type of swallowing impairment, facilitating a targeted intervention, such as chin tuck or selection of certain food consistencies.

Diagnosis of Dysphagia, Videographic Classification, and Benefit of Dietary Modifications

For the purposes of this study, a diagnosis of dysphagia required documentation by a formal VFSS performed by an attending radiologist in concert with a consulting member SLP. If present, dysphagia was classified as being due to (1) retention (contrast material remaining in the pharynx after the first swallow); (2) laryngeal penetration (contrast entering the airway above the vocal folds); (3) tracheal aspiration (contrast entering the airway below the vocal folds); or (4) a combination of those processes (Figs 1 and 2). The SLP therapeutic recommendations consisted of dietary modifications (eg, nothing by mouth status, thickened liquids, or texture modifications), volume modifications, or compensatory swallowing strategies. Furthermore, the SLP also engaged the patient in practicing certain maneuvers to rehabilitate aspects of the swallow and to promote long-term beneficial mechanical changes.

To verify that most episodes of dysphagia were captured in our analysis, the medical records of all patients undergoing heart surgery during the study period were reviewed for the occurrence of postoperative aspiration pneumonia (documented infection with a computed tomography scan exhibiting the typical findings consistent with an aspiration-driven pulmonary infection) or the coding of dysphagia in a discharge problem list.

Statistical Analysis

Stratification of the study population based on dysphagia was performed. Patient-specific characteristics, intraoperative variables, and postoperative outcomes were compared between patients with and patients without dysphagia. Patient-specific variables included age, race, sex, and body mass index (BMI) as well as a history of diabetes mellitus, tobacco use, congestive heart failure, chronic lung disease, cerebrovascular disease, dialysis dependence, dyslipidemia, and hypertension. Intraoperative variables included the index operation and utilization of circulatory arrest as well as operative and bypass times. Postoperative outcomes included duration of mechanical ventilation, need for reintubation, length of stay, inhospital mortality, stroke, pneumonia, and renal failure. Continuous variables, reported as mean ± SD or median (interquartile range), were compared using Student's *t* test (parametric) or the Wilcoxon rank sum test (nonparametric) when appropriate. Categoric variables, reported as number and percentage, were analyzed using

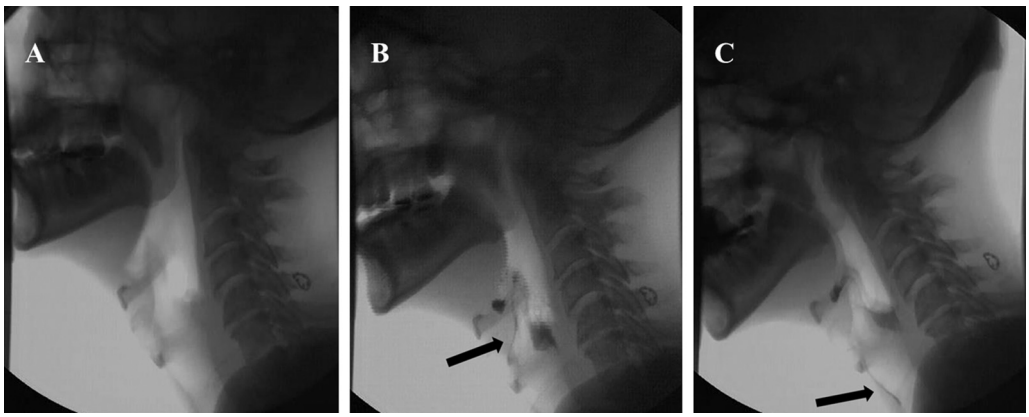

Fig 1. Videofluoroscopic swallow study demonstrating (A) no penetration or aspiration, (B) penetration (black arrow indicates contrast above the level of the vocal cords), and (C) aspiration (black arrow indicates contrast below the level of the vocal cords).