ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2015;96:1277-83

ORIGINAL RESEARCH

Usefulness of Citric Cough Test for Screening of Silent Aspiration in Subacute Stroke Patients: A Prospective Study

Anna Guillén-Solà, MD,[a,b,c] Sandra Cecilia Chiarella, MD,[a] Juan Martínez-Orfila, MD,[d] Esther Duarte, MD, PhD,[a,b,c] Martha Alvarado-Panesso, MD,[a] Antoni Figueres-Cugat,[d] Núria Bas, MD,[a] Ester Marco, MD, PhD[a,b,c]

From the [a]Physical Medicine and Rehabilitation Department, Hospitals Mar-Esperança, Parc de Salut Mar, Barcelona, Catalonia; [b]Rehabilitation Research Group, Biomedical Research Institute Hospital del Mar, Barcelona, Catalonia; [c]Medicine Department, Universitat Autònoma de Barcelona, Catalonia; and [d]Radiodiagnosis Department, Hospitals Mar-Esperança, Parc de Salut Mar, Barcelona, Catalonia, Spain.

Abstract

Objective: To detect silent aspiration in a homogeneous sample of stroke patients using the citric acid cough test.

Design: Prospective study.

Setting: Public university tertiary hospital.

Participants: Consecutive subacute stroke patients (N=134; 74 men, 60 women; mean age ± SD, 62.2±11.9y; 11.7±9.9d after stroke) who had complained of dysphagic symptoms, referred for rehabilitation from December 2010 to October 2012.

Intervention: All patients were administered a citric acid cough test and underwent a videofluoroscopic swallowing study (VFSS). A reduced or an absent response on the citric acid cough test was considered when cough peaks were ≤4. A control group of healthy volunteers was also screened.

Main Outcome Measures: The citric acid cough test results were compared with the VFSS results, which were used as a criterion standard.

Results: There were 36 patients with a positive citric acid cough test, of which the VFSS revealed penetration in 14 cases (38.9%), aspiration in 5 (13.9%), silent aspiration in 5 (13.9%), and normality in 12 patients (33.3%). The sensitivity and specificity indexes for the reliability of citric acid cough test as a screening method for silent aspiration in comparison with the VFSS were .19 and .71, respectively. Other comparisons were made between silent aspirators (Penetration Aspiration Scale=8) and different subgroups of patients, but values remained poor.

Conclusions: The citric acid cough test using 1.0 (weight by volume)% for 1 minute does not seem to be a useful standalone tool to screen for silent aspiration in subacute stroke patients with suspected dysphagia.

Archives of Physical Medicine and Rehabilitation 2015;96:1277-83

Dysphagia is present in a significant proportion of subacute stroke patients, up to 85% depending on the series,[1-6] and is associated with an increase in medical complications such as aspiration pneumonia, malnutrition, and death.[7,8] Aspiration pneumonia, the most common respiratory complication, is responsible for approximately half of the deaths that occur in these patients; moreover, dysphagia triples the risk of developing pneumonia.[4]

Most studies suggest that weakness or absence of the cough reflex is correlated with an increased risk of pneumonia.[1] Silent aspiration is defined as the passage of a food bolus or airway secretions below the true vocal cords without triggering any clinical response such as coughing or respiratory distress; it has been described in 15% to 54% of stroke patients.[9-11] Coughing acts as a protective mechanism in the airway, removing waste by generating an expiratory flow.[8,12] The mechanisms associated with silent aspiration include poor pharyngeal muscle

Presented as an oral communication to the European Society for Swallowing Disorders, September 11–14, 2013, Malmö, Sweden.

Supported in part by the Institute of Health Carlos III (ISCIII) (grant no. PI10/01560)/Fundación Europea para el Desarrollo de la Regiones.

Disclosures: none.

0003-9993/15/$36 - see front matter © 2015 by the American Congress of Rehabilitation Medicine
http://dx.doi.org/10.1016/j.apmr.2015.02.028

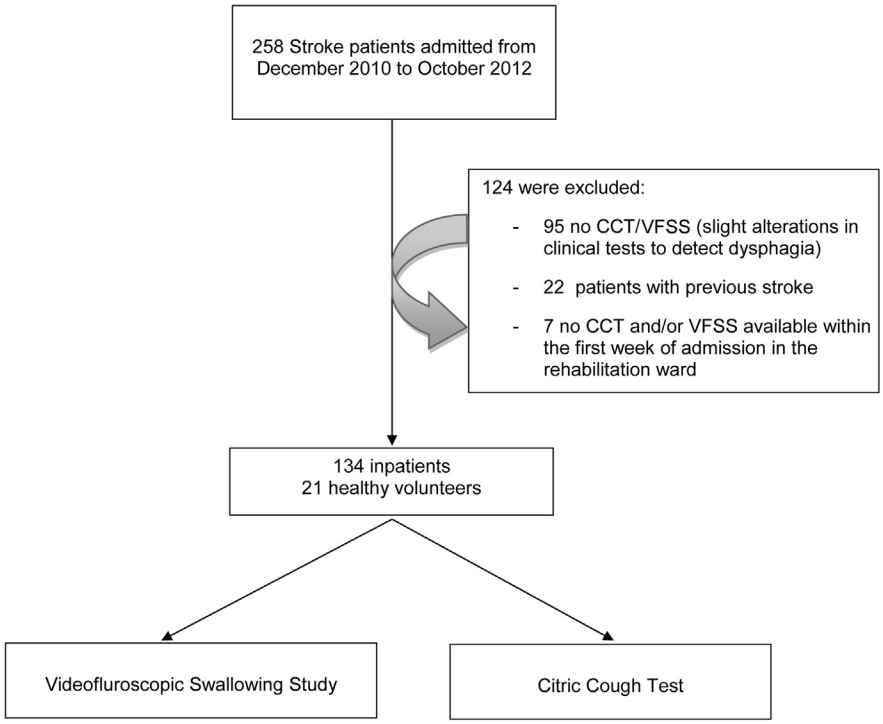

Fig 1 Study flowchart.

coordination, decreased sensitivity, and low laryngeal capacity to induce cough.[13,14]

The bedside clinical assessment of dysphagia is a cost-effective, noninvasive method that offers the possibility to begin prompt treatment of dysphagia.[15,16] Some validated screening protocols include Logemann's method,[17,18] Modified Assessment Swallowing Ability,[19,20] Toronto Bedside Swallowing Screening Test,[21] and Gugging Swallowing Screen.[22] However, none of these have the ability to detect silent aspiration, which is an interesting endpoint.[23] Only Leder et al[24] describes silent aspiration as volume dependent in a prospective and nonhomogeneous sample.

The European Respiratory Society guidelines on the assessment of cough highlight the lack of standardization of cough testing protocols and tussive agent dosage.[23] To date, several tussive agents—citric acid, capsaicin, and tartaric acid—have been used to assess the cough reflex,[13,25-28] but the lack of validated protocols makes it difficult to include them in the clinical assessment of dysphagia.

Wakasugi et al[13] report that a citric acid cough test, in combination with a water swallowing test, is useful in screening for silent aspiration in a nonhomogeneous sample of patients, with a sensitivity of .87 and specificity of .89. The administration of inhaled citric acid in a 0.8mol/L concentration inhibits cough in 68% of healthy volunteers, while a cough response is observed with the use of a 1.2mol/L concentration in 80% of individuals.[25] Miles,[25] Miles,[29] and colleagues describe good results when comparing cough reflex testing and instrumental assessment using both fiberendoscopic evaluation of swallowing and videofluoroscopic swallowing study (VFSS). Both studies show that lower concentrations of citric acid (0.4mol/L) provide better predictive values for silent aspiration in higher-risk populations, while higher concentrations (0.8mol/L) are useful as a screening tool in a low-risk population.[27]

Considering the properties of validity, reliability, feasibility, and accuracy of screening tests, we designed a prospective study to validate a cough reflex test as a standalone tool, using a 1mol/L citric acid cough test to detect silent aspiration in a homogeneous stroke sample, confirmed by VFSS as the criterion standard.

List of abbreviations:

NPV	**negative predictive value**
PAS	**Penetration Aspiration Scale**
PPV	**positive predictive value**
VFSS	**videofluoroscopic swallowing study**
w/v	**weight by volume**

Methods

Study design and participants

A prospective study of 258 consecutive stroke patients admitted to an inpatient intensive rehabilitation ward in a university's tertiary hospital was conducted from December 2010 to October 2012. Patients were eligible for inclusion if they met the following criteria: (1) they had a subacute stroke within 1 to 3 weeks of evolution; (2) they had a swallowing disorder suspected on clinical examination, based on the volume-viscosity swallow test[30,31]; and (3) there was no history of previous neurologic diseases.

Of the 258 patients admitted to the rehabilitation ward, 134 met the inclusion criteria. As summarized in figure 1, patients were excluded for the following reasons: (1) they had a low risk of silent aspiration defined by normal or nearly normal findings on