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Bedside Thyroid Palpation Technique as Indicator for Penetration/Aspiration Risk in Stroke Patients

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Background: Bedside thyroid cartilage palpation technique is a quick and non-invasive swallowing screening test. However, the correlation between thyroid cartilage movement and penetration/aspiration risks in stroke patients has not been conclusive to date. Therefore, we compared the result of videofluoroscopic swallowing study (VFSS) and bedside thyroid cartilage palpation to determine the penetration/aspiration risks in stroke patients.

Material and methods: Our study included 53 patients admitted to a medical center for rehabilitation within 6-months of stroke onset. We recorded penetration-aspiration scale by VFSS and compared it with a bedside thyroid cartilage palpation technique.

Results: Our results show significant higher rates of penetration/aspiration in patients with thyroid elevation ≤ 1.5 finger widths during palpation compared to > 1.5 finger widths ($p=0.0223$). For the prediction of penetration/aspiration on VFSS, palpation ≤ 1.5 finger width has a sensitivity of 77.42% (95% CI: 58.90% to 90.41%) and specificity 54.55% (95% CI: 32.21% to 75.61%).

Conclusion: Our results indicate that a ≤ 1.5 finger width elevation of thyroid cartilage during palpation technique is a sensitive, quick and non-invasive swallowing screening test to evaluate possible risks of penetration/aspiration in stroke patients or used as a follow up examination after VFSS. (Tw J Phys Med Rehabil 2019; 47(2): 109 - 115)

Key Words: dysphagia; penetration; aspiration; thyroid cartilage; palpation

INTRODUCTION

Dysphagia is a common morbidity after stroke. A meta-analysis in 2005 demonstrated that the incidence of dysphagia after stroke from lowest (37% to 45%) by

simple screening to highest (64% to 78%) by instrumental testing.^[1,2] Dysphagia often leads to malnutrition, dehydration and pulmonary complication (such as aspiration pneumonia). In dysphagic patients, silent aspiration has been documented in over 40% patients.^[3]

Decreased range of hyoid and laryngeal movement

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during swallow is thought to be associated with increased risk of aspiration,^[1,4] but how much the range of hyoid/laryngeal movement associated with aspiration didn't reach a conclusion in researches of videofluoroscopy swallowing study (VFSS).^[1,5] Although VFSS is currently regarded as gold standard for dysphagia identification and evaluation, a couple of disadvantages hinder its serial follow-up in dysphagic patients including inconvenient portability of huge equipment for examination, exposure to radiation during examination as well as risk of post-VFSS aspiration.^[6-10] Clinically the physician or speech-language pathologist evaluate laryngeal movement by palpating the patients' throat but there is no standard procedure or grading system of palpation till now. Joseph Murray proposed that larynx elevated less than 2cm during swallowing in adult by palpation is inadequate.^[2] However, no existing evidence determines correlation of this palpation technique to VFSS result. In this study we intend to find out whether this palpation method is applicable to detect the risk of penetration/aspiration and comparable to the results of VFSS.

MATERIALS AND METHODS

Participants

During August 29th, 2017 till May 1st, 2018, dysphagic patients that met the following inclusion criteria were enrolled: (1) in-patient of our medical center hospital aged 18 to 80 years, (2) first episode of stroke (ischemic, hemorrhage or both), (3) stroke onset within 6 months, (4) those who can complete the VFSS. Patients with any one of the following criteria were excluded: (1) dysphagia symptoms present before the stroke, (2) diseases that may cause dysphagia, such as head/neck cancer, oral facial deformity, history of head/neck surgery, parkinsonism..., (3) severe comorbidities such as pneumonia or systemic infection, (4) still with tracheostomy tube at the time of VFSS examination, The research ethics boards of Chung-Shan Medical University Hospital approved this study.

Palpation technique

Each patient underwent palpation examination modified from Joseph Murray during dry swallowing

performed by two physicians before VFSS.^[2] The palpation method is shown as Figure 1. Examiner's ring finger was put horizontally above superior border of superior thyroid notch. Middle finger and index finger are placed at the most anterior part of hyoid bone and submental area, respectively. The patients then followed instruction to perform dry swallow, and in the meanwhile, the examiner recorded the movement distance of thyroid cartilage in numbers of finger width. In our study, 2cm approximates 1.5 finger width (from the ulnar edge of ring finger tip to the middle of middle finger tip) of our examiner. Ahead of starting the formal study, two examiners have palpated several normal subjects and gotten consensus about the feeling of thyroid cartilage elevation of 1.5 finger width (or more). During formal study, every patient was palpated by each examiner independently and then subdivided to laryngeal elevation ≤ 1.5 finger width or > 1.5 finger width group under both examiners' mutual agreement. If agreement could not be made, then both examiners perform the palpation once (or twice) again and reach a consensus after discussion.

VFSS examination

All the VFSS were performed by an experienced physician using a fluoroscopy unit (Axiom Luminos dRF, Siemens, Germany), and the images were digitally recorded and analyzed with INFINITT Picture Archiving and Communication System (PASC, INFINITT health-care Co., Ltd. Korea). The VFSS was performed with lateral projection with the patients sitting in upright position. Each patient was under instruction to ingest 2 ml and 5 ml barium-mixed fluid (Baritop-120, barium sulfate 120W/V% 300ml/bot) of different consistency: thin fluid (International Dysphagia Diet Standardization Initiative, IDDSI level 0),^[11] nectar-thick fluid (IDDSI level 1), honey-thick fluid (IDDSI level 4) and paste (IDDSI level 5). For this investigation, only 5 ml thin fluid boluses were analyzed.

Penetration-Aspiration assessment

We use the 8-point Penetration-Aspiration Scale (PAS) for VFSS rating by referring those with $PAS \geq 2$ as penetration/aspiration (PA) group and those with $PAS=1$ as non-penetration/aspiration (NPA) group.^[12] Penetration was defined as bolus dropping into laryngeal inlet but

above the true vocal cord, and aspiration was defined as the passage of bolus beyond true vocal cord.^[13]

Statistical Analysis

We used GraphPad Prism 7.01 (GraphPad Software, Inc., San Diego, CA) to do the statistical analysis in our study. We used Non-parametric Mann-Whitney U tests to compare age between NPA/PA group. We used Fisher's exact test to compare gender, stroke type, affected side and laryngeal elevation by palpation (>1.5 finger width or ≤ 1.5 finger width) with NPA/PA group.

RESULTS

A total of 53 patients met our inclusion criteria as are

shown in Table 1. No significant difference was found between NPA and PA group in gender ($p=0.57$), age ($p=0.84$), stroke type ($p=0.8391$) and affected side ($p=0.0912$).

Dysphagic patients with thyroid cartilage elevation ≤ 1.5 finger widths during palpation showed significant higher rate of penetration/aspiration compared to those with thyroid cartilage elevation >1.5 finger widths ($p=0.0223$) (Table 1). For the prediction of penetration/aspiration on VFSS by palpation, thyroid cartilage elevation ≤ 1.5 finger width has a sensitivity of 77.42% (95% CI: 0.5890-0.9041) and a specificity of 54.55% (95% CI: 0.3221-0.7561) (Table 2).

Table 1. Patient demographics and the results of palpation and VFSS

	NPA group (PAS=1)	PA group (PAS=2~8)	p value
Patient demographics			
Gender ^a	22	31	0.57
Male	13	21	
Female	9	10	
Age ^b (years)	60.0 \pm 11.2	60.5 \pm 12.7	0.84
Finger palpation ^a			
> 1.5 finger width	12	7	0.0223*
≤ 1.5 finger width	10	24	
Stroke type ^a			0.8391
Ischemic	6	11	
Hemorrhagic	14	17	
Mixed	2	3	
Affected Side ^a			0.0912
Left	4	12	
Right	14	18	
Bilateral	4	1	

The results are expressed as mean with standard deviations. Significance was set at $p<0.05$ (two-tailed) with asterisk. NPA: non-penetration/aspiration group. PA: penetration/aspiration group. ^a: number of subjects. ^b: mean \pm standard deviation.

Table 2. Sensitivity and specificity of ≤ 1.5 finger width by palpation in prediction of aspiration/penetration on VFSS.

Parameters	Value	95% Confidential interval
Sensitivity	77.42%	58.90% to 90.41%
Specificity	54.55 %	32.21% to 75.61%

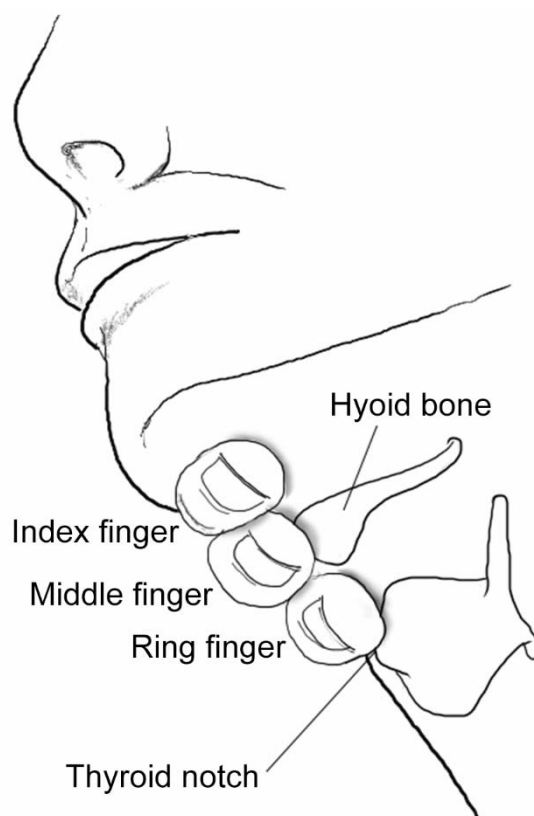


Figure 1. Palpation method to detect laryngeal elevation during swallows.

DISCUSSION

Adequate hyolaryngeal movement is considered to be important in airway protection and upper esophageal sphincter opening during swallowing.^[14] Previous studies showed a positive correlation between decreased hyoid elevation and aspiration, and as a result, hyoid bone movement was commonly measured as the indicator of movement adequacy.^[4,15-21]

A systematic review in 2015 compared several bedside examinations (such as observation of clinical signs for dysphonia, dysarthria, oral dyskinesia, et al.) to the result of VFSS or fiberoptic endoscopic evaluation of swallowing (FEES) for the diagnosis of dysphagia. However, none of them provided adequate prediction of aspiration.^[22] It is observed that normal subjects elevate larynx around 2-2.5 cm during swallowing.^[2] Given that 1.5 finger width of our examiners measured around 2cm, laryngeal elevation ≤ 1.5 finger width is considered

inadequate. This method offered clearer as well as easier measurement of the track and the numbers of finger width by which thyroid cartilage travelled. It also showed good sensitivity in predicting penetration/aspiration when thyroid elevation ≤ 1.5 finger widths during palpation with a sensitivity of 77.42% (95% CI: 0.5890-0.9041) and a specificity of 54.55% (95% CI: 0.3221-0.7561). It is a simple and straightforward way to evaluate patients of suspected high risk of penetration/aspiration at clinic without VFSS facilities available as well as to follow-up swallowing ability after VFSS examination due to serial VFSS exposure considered to be hazardous. The major function of laryngeal elevation (thyroid cartilage) is to stretch open upper esophageal sphincter (UES), with traction to anterior wall of the sphincter during swallowing.^[2] Inadequate laryngeal elevation such as ≤ 1.5 finger width perhaps indicates insufficient muscle power from stroke to complete the elevation of larynx. Thus, there is higher risk of penetration/aspiration in those patients with laryngeal elevation ≤ 1.5 finger width.

CONCLUSION

Our VFSS demonstrates that when patients' thyroid cartilage fails to elevate more than 1.5 finger width (approximate 2 cm width) by our palpation technique during swallowing, a significant higher penetration/aspiration risk occurs. This palpation technique may be used as a simple test for screening of those stroke patients with higher risk of penetration/aspiration or used as a follow up examination after VFSS.

LIMITATIONS

Our study has some potential limitations. First, small sample size may affect our results. Second, our study focused on stroke patients within 6 months from onset without any other comorbidities, thus, the results may not applicable to stroke patients in chronic stage or with other comorbidities.

Finally, though in our study, 2cm approximates 1.5 finger width of our examiner, it may not be universal true in every person. Thus, adjustment should be made accordingly. Nevertheless, this study still offered us an idea of using simple palpation technique to predict aspiration/penetration risk in stroke patients.

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以床邊甲狀軟骨觸診預測中風病人吸入／噎入風險

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背景：床邊甲狀軟骨觸診是一個迅速且非侵入式的吞嚥篩檢測試，然而截至目前為止甲狀軟骨的移動與中風病人吸入／噎入的風險仍未有結論。因此我們藉著比較床邊甲狀軟骨觸診與螢光吞嚥攝影檢查結果，來找出甲狀軟骨移動與中風病人吸入／噎入風險的關係。

方法：我們的研究收錄 53 位中風六個月內住在醫學中心的病人，並記錄吞嚥時觸診的甲狀軟骨移動距離與吞嚥攝影的吸入／噎入分數(PAS score)做比較。

結果：我們的結果顯示吞嚥時甲狀軟骨觸診上升距離 ≤ 1.5 指幅(約 2 公分)的病人吸入／噎入的風險比上升 >1.5 指幅的病人高，且有統計學上顯著差異($p=0.0223$)。而用 ≤ 1.5 指幅甲狀軟骨上升來預測病人吸入／噎入風險與吞嚥攝影做對照，敏感性及特異性分別可達 77.42% (95% CI: 58.90% to 90.41%)、54.55% (95% CI: 32.21% to 75.61%)。

結論：我們的結果顯示以吞嚥時觸診甲狀軟骨上抬距離 ≤ 1.5 的指幅來預測中風病人吸入／噎入風險是一個敏感性高、迅速且非侵入性的篩檢方法，並作為螢光吞嚥攝影檢查後吸入／噎入高風險患者的追蹤評估方式。(台灣復健醫誌 2019；47(2)：109 - 115)

關鍵詞：吞嚥障礙(dysphagia)、噎入(penetration)、吸入(aspiration)、甲狀軟骨(thyroid cartilage)、觸診(palpation)

