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Original Article

Examination of factors associated with aspiration pneumonia following stroke

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ABSTRACT

Background: Studies have investigated factors related to aspiration pneumonia (AP) onset in stroke patients. However, no study has examined the influence of swallowing function assessment-based strategies.

Purpose: The purpose of this study is to investigate factors related to the onset of AP that differ before and after swallowing function assessment.

Methods and subjects: Subjects consisted of 143 patients admitted to acute-stage hospitals within 7 days of stroke onset. We examined the association between AP onset within 1 year after stroke and several parameters.

Results: AP incidence was 24.5% overall, 20.3% before swallowing function assessment, and 7.7% after assessment. In patients who developed AP prior to swallowing function assessment, the onset was associated with male gender [odds ratio (OR): 6.206, 95% confidence interval (CI): 1.871–28.937], dysarthria (OR: 5.683, CI: 1.432–38.713), and denture usage (OR: 2.843, CI: 1.011–8.048). In those who developed AP after swallowing function assessment, AP was associated with cerebral atrophy (OR: 4.225, CI: 1.071–16.705), infracted foci in the basal ganglia (OR: 8.914, CI: 1.489–77.776), and Barthel Index (BI) <100 points before admission (OR: 5.404, CI: 1.418–21.482).

Conclusions: Onset of AP after stroke was associated with gender, dysarthria, denture usage at before swallowing function assessment and cerebral atrophy, infarcted foci in the basal ganglia, and BI before admission at after swallowing function assessment. It is necessary to pay attention to the fact that factors related to AP differ before and after swallowing function assessment to identify patients at high risk of developing AP after stroke.

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1. Introduction

Pneumonia accounts for approximately 35% of deaths within 30 days of the onset of stroke. The mortality rate is three times higher than that in patients without pneumonia [1]. Therefore, pneumonia is considered to be an important complication in the acute stage of stroke. Most patients develop aspiration pneumonia (AP). After the onset of stroke, approximately 50% of patients experience aspiration, and one-third of them develop AP, requiring treatment [2]. Some studies have indicated that various factors, including the swallowing function, age, general condition, and oral state, are involved in the onset of AP [3,4]. One study reported that

swallowing function assessment via a videofluoroscopic swallowing study (VFSS) and appropriate strategies decreased the incidence of AP following stroke [5].

Strategies to prevent aspiration, such as the restriction of oral ingestion and adjustment of dietary features, can be established on the basis of results of swallowing function assessment. Therefore, factors related to AP may differ after swallowing function assessment. However, no study has examined factors related to AP considering the influence of strategies against aspiration on the basis of the results of swallowing function assessment in combination with previous studies on factors related to AP and screening tools of dysphagia/aspiration.

The purpose of this study was to investigate factors related to the onset of AP that differ before and after swallowing function assessment. We investigated the association of the onset of AP using a series of factors, including systemic and oral/pharyngeal functions and states with reference to the results of previous studies [3–20].

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2. Material and methods

2.1. Subjects

We selected 143 patients out of 145 who were admitted to the Departments of Neurology or Stroke Medicine in acute-stage hospitals within 7 days of the onset of stroke between May 1996 and November 2005 and underwent functional assessment under a tentative diagnosis of dysphasia, without other disorders that may affect the swallowing function.

The median patient age was 72 years (range: 43–92 years). There were 103 males (72.0%) and 40 females (28.0%). Concerning the type of stroke, cerebral infarction was observed in 104 patients (72.7%) and cerebral hemorrhage (including subarachnoid hemorrhage) in 39 (27.3%). The median interval from onset until swallowing function assessment was 27 days (7–135 days).

2.2. Methods

We retrospectively evaluated the association between the onset of AP within 1 year after stroke along with various other parameters. When risk factors are eliminated by restricting oral ingestion and adjusting dietary features on the basis of the results of swallowing function assessment, the onset of AP may be influenced. Therefore, concerning the onset of AP over 1 year after stroke, we classified the timing of the onset of AP onset into two phases: before and after swallowing function assessment. We then compared results between the two phases. The scientific and ethical committee of the involved institute approved the protocol for this study.

2.3. Parameters

2.3.1. General patient information

General patient information assessed included age, gender, and the presence or absence of the following concomitant disorders [21]: cardiovascular (hypertension, myocardial infarction, angina pectoris, and arrhythmia); respiratory, excluding pneumonia (bronchial asthma, bronchitis, and pulmonary emphysema); liver disease (hepatitis requiring treatment); kidney disease (renal failure and nephrotic syndrome); ulcerative disorders (gastric ulcer); and diabetes.

The presence or absence of history of pneumonia requiring treatment, dementia before and after admission, and habitual smoking (one or more cigarettes per day) before admission, regardless of the number of cigarettes, was also evaluated.

2.3.2. Classification of stroke

Stroke was classified into two types: infarction and hemorrhage (including subarachnoid hemorrhage). Patients with a history of recurring symptomatic stroke were regarded as relapse cases.

2.3.3. Classification on the basis of examination results

On the basis of computed tomography (CT)/magnetic resonance imaging (MRI), the presence or absence of cerebral atrophy of the parenchyma, regardless of the site or extent, was documented. Classification was based on the infarction site [6], and infarcted foci were categorized into five sites: (1) entire area of the middle cerebral artery (MCA); (2) deep MCA area (corresponding to the internal capsule, caudate nucleus, putamen, and pale globe sites); (3) cortex of the MCA area; (4) brain stem (medulla oblongata, pons, and midbrain); and (5) cerebral basal ganglia (extensive or multiple infarcted foci in the cerebral basal ganglia). When several lesions were present, they were duplicated for registration.

Classification was also based on the infarcted focus site [7]. MCA-area lesions were classified into three groups, namely left, right, and bilateral sides, on the basis of their localization.

Sites of blood flow reduction according to cerebral blood flow scintigraphy were also classified into three groups: left, right, and bilateral sides.

2.3.4. Grade of functional disorders

The Barthel Index (BI) was examined before admission and upon swallowing function assessment. Scores were classified, regarding the border as 60 (0–59, ≥60), 90 (0–89, ≥90), and 100 points (0–99, 100) [22].

The presence or absence of consciousness disorder upon swallowing function assessment was graded according to the Japan Coma Scale (JCS) [23]. Patients with a one-figure number or more were regarded as having a consciousness disorder.

The side (left, right) affected by quadriplegia (motor paralysis) was also documented.

2.3.5. Swallowing function assessment

The following items were evaluated by swallowing function assessment to assess oral/pharyngeal function and state:

(1) Presence or absence of dysarthria evaluated on the basis of auditory impression;
(2) presence or absence of pharyngeal reflex (test with a swab or dental mirror);
(3) whether volitional coughing is possible;
(4) whether dry swallowing is possible (once or more);
(5) presence or absence of oral dryness (dryness evaluated on inspection);
(6) presence or absence of residual teeth (presence of one tooth or more);
(7) presence or absence of dentures.

The presence or absence of aspiration was evaluated using VFSS. Patients were instructed to swallow 5 ml of an aqueous/viscous solution two or more times each in frontal and lateral views. If the sample passed through the vocal cords, it was regarded as aspiration [8].

Patients were screened for dysphagia by cervical auscultation. A stethoscope was placed on the skin above the lateral trachea immediately below the annular cartilage. Patients were instructed to swallow 3 ml of cool water, and sounds were classified into two types: "swallowing sounds" and "expired air sounds following swallowing" [9,10]. Prolonged or weak swallowing sounds were regarded as abnormal. For expiratory sounds following swallowing, patients were instructed to breathe immediately after swallowing. In comparison to "clear" expired air sounds before sample swallowing, "choking sounds," "moist sounds," and "bubble sounds" were regarded as abnormal.

2.3.6. Definition of AP

Among patients diagnosed with AP by attending physicians in the Departments of Neurology and Stroke Medicine, those with fever ≥37.0 °C and pneumonia on chest X-ray were selected as described by Kwon et al. [3] and Mann et al. [8].

2.3.7. Data analyses

To examine the association between the onset of AP before and after swallowing function assessment along with various associated parameters, univariate analysis was conducted (Fisher's exact test). When there was a significant difference, multivariate analysis (logistic regression analysis) was conducted by adjusting the data by age/gender, and the odds ratio (OR) and 95% confidence interval