



Original Contribution

Prehospital removal improves neurological outcomes in elderly patient with foreign body airway obstruction



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ABSTRACT

Objective: In Japan, the number of patients with foreign body airway obstruction by food is rapidly increasing with the increase in the population of the elderly and a leading cause of unexpected death. This study aimed to determine the factors that influence prognosis of these patients.

Methods: This is a retrospective single institutional study. A total of 155 patients were included. We collected the variables from the medical records and analyzed them to determine the factors associated with patient outcome. Patient outcomes were evaluated using cerebral performance categories (CPCs) when patients were discharged or transferred to other hospitals. A favorable outcome was defined as CPC 1 or 2, and an unfavorable outcome was defined as CPC 3, 4, or 5.

Results: A higher proportion of patients with favorable outcomes than unfavorable outcomes had a witness present at the accident scene (68.8% vs. 44.7%, $P = 0.0154$). Patients whose foreign body were removed by a bystander at the accident scene had a significantly high rate of favorable outcome than those whose foreign body were removed by emergency medical technicians or emergency physician at the scene (73.7% vs. 31.8%, $P < 0.0075$) and at the hospital after transfer (73.7% vs. 9.6%, $P < 0.0001$).

Conclusions: The presence of a witness to the aspiration and removal of the airway obstruction of patients by bystanders at the accident scene improves outcomes in patients with foreign body airway obstruction. When airway obstruction occurs, bystanders should remove foreign bodies immediately.

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1. Introduction

Foreign body airway obstruction is a critical, life-threatening condition for individuals of all ages. In Japan, the number of patients with foreign body airway obstruction is rapidly increasing with the increase in the population of the elderly. Foreign body airway obstruction is a leading cause of unexpected death. In 2015, deaths from this cause (9356) were higher than those from traffic accidents (5646) and falling (7992) [1]. The prevention and medical treatment of foreign body airway obstruction has thus become a critical social issue.

Foreign body airway obstruction usually occurs during meals [2]. If the elderly at high risk of airway obstruction have a meal in the presence of family members or caregivers who are familiar the procedure of removing a foreign body, the elderly can be quickly saved by these people.

There is still less information about prognostic factors in this cohort. We collected data on patients with foreign body airway obstruction from medical records and analyzed it retrospectively. This study

aimed to determine the factors that influence prognosis of these patients.

2. Methods

2.1. Study patients

The Nippon Medical School Hospital is located in the central medical district in Tokyo. Patients at this hospital are transferred from the central and northeast medical districts. In 2010, 757,562 people lived in the central medical district (63.55 km²) and 1,329,308 people lived in the northeast medical district (98.19 km²). The northeast and central medical districts have one and six emergency and critical care centers officially certified by Japanese Ministry of Health, Labour and Welfare, respectively, and the Nippon Medical School Hospital has the highest number of intensive care unit beds in these areas. Only patients with severe conditions, including cardiovascular collapse, respiratory failure, or disturbance of consciousness, are transferred to this emergency and critical care center.

A total of 11,739 patients were transferred to this emergency and critical care center between 2008 and 2014. Of these, 156 patients

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diagnosed with foreign body airway obstruction were included. All but one patient were over 50 years old and 1 year-old patient was excluded in this study. We collected the following data from their medical records: age, sex, past medical history, cause of airway obstruction, accident location, presence of a witness to the accident, individual who remove foreign bodies, and the location at which the foreign body was removed. We also collected the following data on patients who had out-of-hospital cardiac arrest (OHCA): presence of a witness to OHCA, bystander cardiopulmonary resuscitation (CPR), and return of spontaneous circulation. Patient outcomes were evaluated using cerebral performance categories (CPCs) when patients were discharged or transferred to other hospitals. A favorable outcome was defined as CPC 1 (good recovery) or 2 (moderate disability), and an unfavorable outcome was defined as CPC 3 (severe disability), 4 (vegetative state), or 5 (death).

We analyzed these data to determine the factors associated with patient outcome by comparing favorable and unfavorable outcome groups. Patients were further divided into three groups: those whose foreign bodies were removed by a bystander at the accident scene, those whose foreign bodies were removed by emergency medical technicians (EMTs) or emergency physicians at the scene, and those whose foreign bodies were removed by physicians at the hospital; outcomes were compared among these three groups. Lastly, we analyzed the data on patients who had OHCA by comparing favorable and unfavorable outcomes.

2.2. Prehospital setting

Emergency medical services in Tokyo are governed by the Tokyo Fire Department. All EMTs can perform the Heimlich maneuver and use Magill forceps to relieve choking patients; however, only certified EMTs can intubate, establish an intravenous line in, and administer epinephrine to patients with cardiac arrest. Because only physicians can intubate alive patients in Japan, emergency physicians travel to accident scenes in cars when EMTs request them. Only four hospitals in Tokyo employ the physician-staffed car, and they do not service the entire city. Therefore, EMTs secure airways of cardiac arrest patients at the scene by intubation and those of other patients by removing foreign body using any measure except intubation.

2.3. Statistical analysis

Unless stated otherwise, values are presented as means \pm standard deviation. Data were analyzed using the chi-square test. Statistical analyses were performed using StatFlex version 6.0 (Artech Co., Ltd., Osaka, Japan). A P value of <0.05 was considered statistically significant.

3. Results

A total of 155 patients (79 men and 76 women) with foreign body airway obstruction were transferred to the emergency and critical care center. Their mean age was 78.3 ± 14.5 years. Their past medical histories included cerebral infarction, dementia, schizophrenia, and Parkinson disease, however, many of them were not obtained or recorded because many patients suffered cardiac arrest. Accident locations comprised homes, nursing homes, restaurants, and the outdoors. The obstructed objects comprised rice, rice cake (it is sticky food with elasticity and called *mochi* in Japanese and eaten year-round, commonly for the New Year.), bread, meat, raw fish, and other foods. Nineteen patients were treated by bystanders at the accident scene, and 22 patients were treated by EMTs or emergency physicians at the scene. The remaining 114 patients were transferred to the hospital and treated by emergency physicians.

Foreign bodies were removed successfully by the Heimlich maneuver ($n = 10$), Magill forceps ($n = 9$), tapping ($n = 9$), mechanical suction ($n = 5$), intubation ($n = 4$), finger sweep ($n = 2$), and vacuum

Table 1
Patient characteristics in this study.

Age	78.3 \pm 14.5
Sex	Male 79/Female 76
Past medical history	
Cerebral infarction	27 (17.4%)
Dementia	19 (12.3%)
Schizophrenia	10 (6.5%)
Depression	7 (4.5%)
Parkinson's disease	6 (3.9%)
Accident location	
Home	84 (54.2%)
Nursing home	29 (18.7%)
Restaurant	17 (11.0%)
Outdoor	4 (2.6%)
Obstructed objects	
Rice	25 (16.1%)
Rice cake (<i>mochi</i>)	21 (13.5%)
Bread	13 (8.4%)
Meat	12 (7.7%)
Raw fish	10 (6.5%)
Others	49 (31.6%)
Witness of aspiration	77 (49.7%)
Securing airway	
By bystander at the scene	19 (12.3%)
By EMTs or emergency physicians	22 (14.2%)
Method of securing airway	
Heimlich maneuver	10 (6.5%)
Magill forceps	9 (5.8%)
Tapping	9 (5.8%)
Suction	5 (3.2%)
Intubation	4 (2.6%)
Removed with hand	2 (1.3%)
Vacuum	2 (1.3%)
Outcome	
CPC 1	22 (14.2%)
CPC 2	10 (6.5%)
CPC 3	12 (7.7%)
CPC 4	23 (14.8%)
CPC 5	88 (56.8%)

cleaner ($n = 2$) at the scene. These numbers didn't include failure of removal attempt. Thirty-two patients had favorable outcomes (CPC 1, 22 patients and CPC 2, 10 patients), and 123 patients had unfavorable outcomes (CPC 3, 12 patients; CPC 4, 23 patients; and CPC 5, 88 patients, Table 1).

We found no significant differences in age or sex between the patients with favorable and unfavorable outcomes. A higher proportion of patients with favorable outcomes than unfavorable outcomes had a witness present at the accident scene (68.8% vs. 44.7%, $P = 0.0154$). (Table 2).

Furthermore, patients whose foreign bodies were removed by a bystander at the accident scene had a significantly high rate of favorable outcome than those whose foreign bodies were removed by emergency medical technicians or emergency physician at the scene (73.7% vs. 31.8%, $P < 0.0075$) and at the hospital after transfer (73.7% vs. 9.6%, $P < 0.0001$). Patients whose foreign bodies were removed by EMTs or emergency physicians at the scene had a significantly higher rate of favorable outcome than those whose foreign bodies were removed at the hospital after transfer (31.8% vs. 9.6%, $P < 0.0001$). (Fig. 1).

A total of 119 patients were in cardiac arrest when EMTs arrived at the scene. Among them, 101 had accident witnesses and 39 received bystander CPR. Spontaneous circulation returned in 101 patients. Five OHCA patients had favorable outcomes (CPC 1, 1 patient and CPC 2, 4

Table 2
Patient characteristics and outcomes of the patients with foreign body airway obstruction.

	Favorable ($n = 32$)	Unfavorable ($n = 132$)	P value
Age	76.5 \pm 17.7	78.8 \pm 13.5	0.4173
Male/female	17/15	62/61	0.7841
Witness of aspiration	22 (68.8%)	55 (44.7%)	0.0154

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