



Clinical Paper

Relationships between pre-hospital characteristics and outcome in victims of foreign body airway obstruction during meals[☆]



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ABSTRACT

Objective: The purpose of this study is to determine the outcome of foreign body airway obstruction according to the initial actions taken for choking victims during meals.

Methods: Our subjects were patients who became unresponsive or unconscious because of foreign body airway obstruction (FBAO) during meals in the presence of bystander witnesses. We investigated the associations between outcome and the following factors: age, gender, type of foreign body, chest compressions after the patient became unresponsive or unconscious, episode of cardiac arrest, efforts by a bystander to remove the foreign body, eating-related activities of daily living, time elapsed from the 119 call to arrival of emergency medical technicians (EMTs), and time elapsed from the 119 call to hospital arrival (primary endpoint).

Results: Of the 138 patients enrolled during the study period, 35 (25.4%) received chest compressions by bystanders after becoming unresponsive or unconscious and 69 (50.0%) suffered cardiac pulmonary arrest. Chest compressions by a bystander after the victim became unresponsive or unconscious ($p < 0.0001$) and no CPA ($p < 0.0001$) were significantly related to good outcome. Chest compressions by a bystander were both associated with good neurological outcome (odds ratio, 10.57; 95% CI, 2.472–65.059, $p < 0.0001$). No CPA after FBAO was another independent predictor (odds ratio, 50.512; 95% CI, 13.45–284.41; $p < 0.0001$), but efforts to remove the foreign body before the arrival of EMTs did not affect outcome.

Conclusion: Chest compressions by a bystander, a support received by only 25% of the patients, proved to be essential for improved outcome for choking victims who became unresponsive or unconscious. Education for lay-rescuer response to choking might further improve overall outcome.

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1. Introduction

Foreign body airway obstruction (FBAO) is a critical, life-threatening condition that can occur in persons of all ages, particularly in the elderly and persons requiring nursing care. Adult FBAO is often witnessed by bystanders because it usually occurs during meals.^{1,2} The culprit foreign body in FBAO is often a piece of meat or fish, or any other type of food in a half solid state.³ If better informed of the early actions to take and emergency treatment as lay rescuers, bystanders could improve the neurological outcome of patients who suffer anoxic/ischemic brain injury caused by FBAO. The most common maneuvers recommended for removal of the

foreign bodies in FBAO are Heimlich abdominal thrusts, back blows, and chest thrusts. These essential maneuvers have been confirmed to relieve FBAO in responsive or conscious victims. If an adult choking victim becomes unresponsive or unconscious during attempts to relieve FBAO, the lone lay rescuer should call emergency medical services and begin cardiopulmonary resuscitation (CPR) at once.⁴ Few reports have described the actual situation and treatment for human FBAO victims on the scene. The purpose of this study is to clarify the actual situation on the scene and determine outcome according to the initial actions taken for food-choking victims during meals in four urban districts of Tokyo, Japan.

2. Materials and methods

2.1. Target area

The target area for this study was the west-northwest area of Tokyo (4 of the 23 administrative districts of Tokyo: Toshima, Kita,

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Itabashi, and Nerima wards), a medical zone covering an area of 113.9 km². This zone is serviced by 30 emergency medical service ambulance units and three hospitals operating as Grade 3 emergency and critical care centers, of which our hospital is one. A residential population of 1,778,762, about 14% of the population of Tokyo, lived within this zone in 2013. Males make up 42.1% of the residents within the zone, and 21.3% of the residents are more than 65 years old.

2.2. Study patients

The protocol for this study was approved by the Clinical Research Institutional Review Board (IRB: RK-140711-12) of this hospital.

The study was designed as a single-institution retrospective observational investigation using a database of patients treated at our hospital from January 2003 to December 2013. The subjects suffered from FBAO in the presence of bystanders during meals and ultimately became unresponsive or unconscious.

Pre-hospital data on the patients were obtained from the emergency medical technicians (EMTs) or lay rescuers or bystander witnesses who were present when the patients became unresponsive or unconscious because of FBAOs during meals in this study. Every morning, team members in the emergency department (physicians, nurses, a pharmacologist, and an emergency medical technician) held a conference to review and discuss the details of the clinical record for every patient newly transferred to our department, including many of the factors related to the neurological outcome for this study. Our medical staff input this information into the patient database not only for patients with FBAO, but for all patients newly admitted to our emergency department. This database was updated and revised after each patient case was discussed. The analyses were performed for all new patients. All data for this study were obtained from the database and our patients' clinical records. Patients were excluded from this study if they were younger than 20 years old or if details were missing on pre-hospital events such as first aid on the scene or type of foreign body.

The outcome was evaluated when the patient was discharged or transferred from our hospital. The primary endpoint was whether or not a good neurological outcome was achieved. Neurological evaluations were performed using the Pittsburgh cerebral-performance categories (CPC). A good outcome was defined as CPC 1 (good recovery) or 2 (moderate disability), and a poor outcome was defined as CPC 3 (severe disability), 4 (vegetative state), or 5 (death).⁵

As a secondary endpoint we also studied the possibility that the neurological outcome for all choking victims has improved year by year over the last decade.

The following factors related to outcome were analyzed based on medical records and the patient database: (1) age, (2) gender, (3) type of foreign body (4), whether or not chest compressions were performed for the patients who became unresponsive or unconscious, (5) the presence or absence of cardiopulmonary arrest (CPA) up to the point of hospitalization, (6) whether or not a bystander made efforts to remove the foreign body before or after the patient became unresponsive or unconscious, (7) eating-related activities of daily living before hospitalization, (8) time elapsed from the 119 call to the arrival of EMTs, (9) time elapsed from the 119 call to arrival at the hospital, and (10) the sequential changes in neurological outcome year by year during the study period.

All event times in the pre-hospital setting were measured by the dispatch center clock in the Tokyo Fire Department.

2.3. Statistical analysis

Statistical analyses were performed using JMP ver. 11.0 (SAS Institute, Cary, NC, USA). Logistic regression analysis was used to examine neurological outcome. The Student's *t*-test was used to compare continuous variables and the Chi-square test was used to compare categorical data. The outcome was predicted by performing a multiple logistic regression by the forced entry method and calculating the odds ratios and 95% confidence intervals (CIs). The forced entry method was used for the previously described factors related to outcome as explanatory variables.

For secondary endpoints, the differences in the neurological outcomes of the samples of patients for each year were studied on a year-over-year basis to determine if there was an increasing trend for improved outcomes over the duration of the study. Patients from January 2003 to December 2013 were enrolled for the 10-year observation period. The neurological outcomes of the samples over the study period were studied using single regression analysis. The data from the yearly changes over the 10-year study period were treated as continuous variable data.

Data are expressed as mean \pm SD or as the no. patients in percent terms (%). $p < 0.05$ was defined as statistically significant.

3. Results

One hundred and sixty-two consecutive cases who suffered FBAO during meals and became unresponsive or unconscious were enrolled during the study period. After excluding 6 children, 11 patients whose FBAO went unwitnessed before loss of consciousness, and 7 patients for whom pre-hospital care were unclear, 138 adult choking victims (57 males, 81 females) were included in this study. Thirty of the subjects suffered FBAO during meals at daycare centers for the elderly.

The average age of the patients was 77.3 ± 12.5 years old (76.5 ± 10.4 males, 78.0 ± 13.9 females; range 28–99 years old). Fifty-two (37.7%) of the patients required some help in eating-related activities of daily living at the time of the FBAO, and the other 86 (62.3%) did not. There was no significant difference, however, between the eating-related activities of daily living before choking and neurological outcome (Table 1).

The foreign body obstructions choking the subjects were composed of bread ($n = 27$), rice cake ($n = 21$), sushi or sashimi fish slices ($n = 11$), general snacks ($n = 10$), vegetables ($n = 9$), meat ($n = 6$), and various other foods. Though highly variable in type and quality, the foreign bodies were divided into two basic types: either solid masses of fairly large pieces of food clumped together (bread, rice cake, etc.), or non-solid masses made up of small particles or pieces of food clumped together (grains of rice, noodles, etc.). In total, there were 95 solid masses and 43 non-solid masses.

Bystanders made efforts to remove the foreign body in 36 (26.1%) of the patients between the time the patient became unresponsive or unconscious and the time the EMTs arrived (Table 1). The bystanders attempting to remove the foreign bodies did so using the finger sweep method ($n = 23$), mechanical suction (performed at daycare centers for the elderly) ($n = 17$), and a combination of both finger sweep method and mechanical suction. Other methods were back blows ($n = 17$) and the Heimlich maneuver ($n = 2$). Efforts to remove the foreign body had no significant influence on outcome.

The time elapsed from the 119 call to the arrival of the EMTs on the scene or the arrival of the patient at the hospital did not significantly differ between patients with good outcome and poor outcome. Of 138 patients, 35 (25.4%) received chest compressions by a bystander after becoming unresponsive or unconscious. Sixty-nine (50.0%) experienced CPA recognized by an EMT before

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