

# Can Manual Hyperinflation Maneuvers Cause Aspiration of Oropharyngeal Secretions in Patients under Mechanical Ventilation?

Armando Carlos Franco de Godoy<sup>1</sup>, Carla de Oliveira Yokota<sup>2</sup>, Izilda Ismênia Muglia Araújo<sup>3</sup>,  
Maria Isabel Pedreira de Freitas<sup>3</sup>

**Summary:** Godoy ACF, Yokota CO, Araújo IIM, Freitas MIP – Can Manual Hyperinflation Maneuvers Cause Aspiration of Oropharyngeal Secretions in Patients under Mechanical Ventilation?

**Background and objectives:** To evaluate whether manual hyperinflation maneuvers can cause aspiration of oropharyngeal secretions in patients under mechanical ventilation.

**Methods:** Adult patients under mechanical ventilation in whom a dye was injected in the oropharyngeal cavity and had their tracheal secretion aspirated after 30 minutes (min) participated in this study. In the event of dye slid, the patient was eliminated. The other patients were divided in Control Group: patients in whom tracheal secretions were aspirated after 30, 60, 120, and 180 min, and Experimental Group: after 30 min, manual hyperinflation maneuvers were performed and secretions were aspirated on the established intervals.

**Results:** Forty-three patients were enrolled in this study. In 13, dye slippage was observed after 30 min, before allocating them into two groups. In the remaining 29 patients, 226 secretion samples were collected. In only two samples the presence of dye in the secretion was observed after manual hyperinflation maneuvers in the experimental group.

**Conclusion:** Manual hyperinflation maneuvers did not cause aspiration of oropharyngeal secretions in patients under mechanical ventilation.

**Keywords:** Respiratory Aspiration; Respiration, Artificial; Intensive Care; Critical Care; Physical Therapy (Specialty).

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## INTRODUCTION

Aspiration of contaminated oropharyngeal secretions is among the causes of pneumonia associated with mechanical ventilation, which increases costs, mortality, and prolongs the stay of patients in the intensive care unit<sup>1</sup>.

Respiratory physiotherapist is integrated in the multi-professional team of Intensive Care Units (ICUs) in several countries. These professionals have several resources to help patient recovery, and among them it can mention manual hyperinflation maneuvers or bag-squeezing<sup>2</sup>. This maneuver uses the physiologic phases of coughing. The physiotherapist

disconnects the patient from the mechanical ventilator and, with a self-inflatable manual resuscitator (AMBU®), he/she slowly inflates the lungs, produces an inspiratory pause of about two seconds and then performs a sudden decompression of the resuscitator bag. The objective of this technique is to prevent and/or reexpand collapsed alveoli, and to improve blood oxygenation and lung complacency, besides causing the flow of pulmonary secretions to the upper airways and ready to be aspirated<sup>3</sup>.

The objective of the present study was to evaluate whether manual hyperinflation maneuvers can cause the aspiration of oropharyngeal secretions in patients under mechanical ventilation.

## METHODS

This study was undertaken in the Clinical and Surgical Trauma Emergency Admission Units of a University Hospital in the country area of the state of São Paulo, from October 2003 to February 2004, after approval by the Ethics on Research Committee of the institution (CEP # 323/02).

Patients older than 18 years of age under mechanical ventilation participated in this study, whose parameters could be adjusted during data collection, as follows: volume-controlled ventilation (8 mL.kg<sup>-1</sup>), positive end-expiratory pressure of 5 cmH<sub>2</sub>O, and inspiration/expiration ration of 1:2; in addition,

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1. Professor; Physiotherapist responsible for the Emergency Ward and the Trauma Surgery Ward of the Hospital das Clínicas da Unicamp

2. Professor; Physiotherapist, Hospital das Clínicas da Unicamp

3. Professor; Nursing Department, Faculdade de Ciências Médicas da Unicamp

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Correspondence to:

Dr. Armando Carlos Franco de Godoy  
Rua Hercules Florence, 100 ap 23  
13020170 – Campinas, SP, Brazil  
E-mail: armandogodoy@ig.com.br

patients should be sedated, on RAMSAY scale 4, 5, or 6, and remain in the Fowler position at 35° throughout the study.

Selected patients were placed in the Fowler position at 35°, intra-cuff pressure of 20 mmHg, and bronchial, nasal, and oral secretions were aspirated. Afterwards, a mixture of 2.0 mL of dye copper chlorophyllin and 2.0 mL of distilled water (total of 4.0 mL) was instilled under direct visualization in the oropharyngeal cavity with a 5.0 mL syringe. The dye copper chlorophyllin was used according to Resolution # 44 – CNNPA (the Brazilian National Commission of Norms and Standards for Food) of the Ministry of Health, 1977.

Thirty minutes after the administration of the dye, patient's tracheal secretions were aspirated and in case the dye was present in tracheal secretions the patient was excluded from the study. In case the dye was not present, patients were randomly divided into control or experimental group. Patients in the control group were aspirated after 30, 60, 120, and 180 minutes. If dye was not present in aspirated secretions, the patient was enrolled in the experimental group. In this group, six manual hyperventilation maneuvers were performed with the self-inflatable manual resuscitator (AMBU®). After the maneuvers, tracheal secretions were aspirated at 30, 60, 120, and 180 minutes to determine whether the dye was present in tracheal secretions.

The presence of dye in aspirated secretions was assessed by a professional who was not aware to which group the patient belonged. In case the dye was visible, the patient was excluded from the study.

The BioStat software, version 3.0 for Windows, was used in the statistical analysis (National Council for the Scientific and Technological Development, Brasília, Brazil). A value of  $p \leq 0.05$  for the  $\chi^2$  test was considered significant.

## RESULTS

Samples were obtained from 43 patients. Patient ages ranged from 19 to 85 years (mean  $52 \pm 19$  years), 33 (78%) were males and 10 (22%) females. The diagnoses of patients enrolled in the study included: acute abdomen ( $n = 18$ , 42%), gunshot wound ( $n = 3$ , 7%); and exogenous carbamate ( $n = 2$ , 5%), organophosphate ( $n = 2$ , 5%) or medication ( $n = 4$ , 9%) intoxications; knife wound ( $n = 5$ , 11%), head injury ( $n = 4$ , 9%), acute respiratory failure ( $n = 3$ , 7%), congestive heart failure ( $n = 1$ , 2%), and systemic lupus erythematosus ( $n = 1$ , 2%).

Time of intubation prior to the beginning of the study ranged from 24 to 120 hours. At the time of data collection the degree of sedation of patients according to the Ramsay scale was: 18 (41%) in grade four; 13 (31%) in grade five; and 12 (28%) in grade six.

Out of 43 patients, 13 (30%) had aspiration of the dye 30 minutes after the administration, demonstrating the dye had slid over the external wall of the endotracheal tube and were excluded from the study. From the other 30 (70%) patients who participated of the two moments of the study, 226 tracheal secretion samples were collected, 116 from the control group and 110 from the experimental group. It was observed

that the secretions of only two patients (2%) in the experimental group had dye staining. In both of them the secretion was collected after the manual hyperinflation maneuver (Table I).

**Table I** – Aspiration of Oropharyngeal Secretions in Patients under Mechanical Ventilation with or without Manual Hyperinflation Maneuver

	Tracheal secretions of patients under mechanical ventilation	
	Control group	Experimental group
With dye	0 (0%)	2 (2%)
Without dye	116 (100%)	108 (98%)
Total	116	110

## DISCUSSION

When this study was planned the hypothesis was that manual hyperinflation maneuvers, when performed in sedated adult patients on mechanical ventilation, could dislocate the endotracheal tube and change the closure of the cuff, which would allow the flow of secretions from the oropharyngeal cavity to the lungs. Since these secretions are potentially contaminated, as a result of the gastroenteral reflux and/or the conditions of the oropharyngeal cavity of the patient, if they are aspirated they may cause nosocomial pneumonia that can increase the hospitalization by four to 15 days and increase costs anywhere from US\$ 3 to US\$ 6 thousand dollars <sup>4</sup>.

We did not find references in the literature on the influence of respiratory physiotherapy techniques on aspiration of fluids from the oropharyngeal cavity on patients under mechanical ventilation.

In this study, we decided to use the copper chlorophyllin dye as a marker of aspiration, since it has low cost, is non-toxic and easy to handle. Blue dyes, such as methylene blue have not been approved by the Food and Drug Administration (FDA) due to their side effects like hyperbilirubinemia, recurring anemia, red blood cell dysmorphia, and systemic absorption of the blue dye <sup>5,6</sup>.

All variables that could interfere with the results, such as age, gender, time of intubation, intra-cuff pressure, diameter and trademark of endotracheal tube were controlled.

The high incidence of patients (30%) with spontaneous aspiration of secretions from the oropharyngeal cavity observed in the sample corroborates other studies that indicate high indices of aspiration in patients in the same conditions, i.e., sedated under mechanical ventilation <sup>5,6</sup>.

The occurrence of spontaneous aspirations can be explained by the presence of several types of tracheas, which hinder adequate closing by the cuff <sup>7</sup>. Furthermore, folds can occur on the walls of the cuff that behave as channels, facilitating aspiration of oropharyngeal secretions <sup>8</sup>.

Although a statistically significant difference between both groups was not observed, two patients (2%) in the experimental group showed aspiration of secretions after manual hyperinflation maneuvers, thus suggesting the need for aspiration of the oropharyngeal cavity before the physiotherapeutic treatment since this compartment may accumulate five to 15 mL of secretion <sup>9</sup>.

Considering the results, we observed that manual hyperinflation maneuvers did not cause aspiration of oropharyngeal secretions in patients under mechanical ventilation.