

# Analysis of Complaints from Patients During Mechanical Ventilation After Cardiac Surgery: A Retrospective Study

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**Objectives:** This study analyzed major complaints from patients during mechanical ventilation after cardiac surgery and identified the most common complaints to reduce adverse psychologic responses.

**Design:** Retrospective.

**Setting:** A single tertiary university hospital.

**Participants:** Patients with heart disease who were on mechanical ventilation after cardiac surgery (N = 800).

**Interventions:** The major complaints of the patients during mechanical ventilation after cardiac surgery were analyzed.

**Measurements and Main Results:** Patients' comfort was evaluated using a visual analog scale, and the factors affecting comfort were analyzed. The average visual analog scale score in all patients was  $5.8 \pm 2.0$ , and most patients presented moderate discomfort. The factors affecting

comfort included dry mouth, thirst, tracheal intubation, aspiration of sputum, communication barriers, limited mobility, fear/anxiety, patient-ventilator dyssynchrony, and poor environmental conditions. Of these factors, 8 were independent predictors of the visual analog scale score. Patients considered mechanical ventilation to be the worst part of their hospitalization.

**Conclusions:** The study identified 8 independent factors causing discomfort in patients during mechanical ventilation after cardiac surgery. Clinicians should take appropriate measures and implement nursing interventions to reduce suffering, physical and psychologic trauma, and adverse psychologic responses and to promote recovery.

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**KEY WORDS:** cardiac surgery, comfort, ventilator, ICU

MECHANICAL VENTILATION is often necessary for patients with complicated postoperative treatment and respiratory dysfunction after cardiac surgery.<sup>1</sup> Although methods vary among countries and centers, many patients need mechanical ventilation during and sometimes after cardiac surgery,<sup>2</sup> and this is costly and uncomfortable for the patients. During ventilation, it is always difficult for patients to communicate with the medical staff. Their complaints cannot be handled correctly, which causes a painful experience for the patients and can have a negative impact on their recovery.<sup>3</sup>

The authors hypothesize that specific factors are responsible for the discomfort of mechanical ventilation. The authors performed a retrospective investigation of the major complaints of a group of patients with heart disease during mechanical ventilation after surgery. The aim of the present study was to summarize the physiologic and psychologic needs of patients during mechanical ventilation. Analysis of patients' comfort was performed using a visual analog scale (VAS), which is a psychometric scale for subjective characteristics that cannot be directly measured and used in postoperative pain analysis.<sup>4</sup> The authors' specially created survey with VAS is presented in Appendix A. This study may help medical personnel carry out treatments and medical care specifically to reduce the suffering caused by discomfort of mechanical ventilation.

## METHODS

### Subjects

This retrospective study was performed in 800 consecutive patients who underwent cardiovascular surgery from January 2009 to December 2012 at the authors' hospital. The study was approved by the ethical committee of the hospital, and the need for individual patient consent was waived by the committee. Inclusion criteria were as follows: (1) >18 years old; (2) underwent open cardiac surgery under direct vision with general anesthesia, cardiopulmonary bypass, and endotracheal intubation; (3) received mechanical ventilation for at least 4 hours; (4) was conscious during mechanical ventilation; (5) experienced the transition from full ventilator support to a spontaneous breathing trial; (6) was able to communicate with the hospital staff, and communication was not limited because of the use of a specific dialect or low education level; and (7) without any complications.

### Clinical Techniques

Anesthesia was induced using intravenous midazolam, 0.1 mg/kg; etomidate, 0.2 to 0.4 mg/kg; sufentanil, 0.5 to 1 µg/kg; and vecuronium bromide, 0.08 to 0.12 mg/kg. Orotracheal intubation was performed, and an anesthesia machine was connected for mechanical ventilation. Initial parameters were tidal volume of 8 to 10 mL/kg, respiratory frequency of 10 to 15 breaths/min, inspiratory/expiratory ratio of 1:2, and fraction of inspired oxygen of 60%. The parameters were adjusted according to the individual situation to obtain a satisfactory result of mechanical ventilation. For anesthesia maintenance, sufentanil, 0.3 to 1.0 µg/kg/h, was intravenously infused, sevoflurane, 1.5% to 2.5%, was inhaled, and a single dose of vecuronium bromide, 0.1 to 0.3 mg/kg, was administered (repeat dosing was allowed at minimal intervals of 45 min). Moderate hypothermic cardiopulmonary bypass was performed.

After surgery, the mechanical ventilation mode was bilevel positive airway pressure, with parameters set for most patients as follows: pressure of 15 cmH<sub>2</sub>O, positive end-expiratory pressure of 5 cmH<sub>2</sub>O, and sensitivity of 2 L/min (Evita 4;

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Dräger Medical, Lubeck, Germany). For patients with a short (not overnight) anticipated mechanical ventilation time, no sedative or analgesic was used. In patients who needed mechanical ventilation overnight, intravenous infusion of midazolam, 0.03 to 0.2 mg/kg/h; sufentanil, 0.1 to 0.3 µg/kg; and vecuronium bromide, 0.02 to 0.05 mg/kg/h, was performed continuously. The infusion was stopped before extubation.

Before extubation, the ventilation mode was set to continuous positive airway pressure. If blood gas results remained acceptable, aspiration of sputum was performed, and the tracheal tube was removed. The surgeon made the decision for extubation.

Patients' comfort was evaluated by the intensive care unit (ICU) physicians using a VAS.<sup>5</sup> The patients completed the forms by themselves if they were able to or with the help of the medical personnel if necessary.

In the authors' hospital, ICU rooms contain 3 to 6 beds. Family members are not permitted to visit patients staying in the ICU. The patient-to-nurse ratio is never >3:1.

### Evaluation Criteria

The VAS method developed by the U.S. National Institutes of Health was used to evaluate the comfort of the patients. A VAS consists of a 10-cm line divided into 10 equal parts marked 0 to 10 from left to right: 0 to 2 indicates comfortable; 3 to 4, mildly uncomfortable; 5 to 6, moderately uncomfortable; 7 to 8, severely uncomfortable; and 9 to 10, extremely uncomfortable. The patients drew a mark on the line according to their subjective feelings.

Recording patients' experience after mechanical ventilation as well as factors affecting their comfort is a standard procedure in the authors' hospital and is performed within 24 hours after extubation. The authors listed 14 factors that might affect the comfort of patients: tracheal intubation, aspiration of sputum, communication barriers, sleep disorders, patient-ventilator dyssynchrony, wound pain, dry mouth and thirst, limitation of motion, nervousness, anxiety and tension, surrounding environment, limited understanding of disease, lack of medical staff support, and financial burden. Each factor had 11 choices (0-10 scores), ranging from slight to severe. The patients were instructed to select a score to evaluate the factors according to their feelings, and this score indicated the degree of discomfort caused by this factor.

As a routine procedure after extubation, the nursing staff asks 4 questions: (1) Do you think that the surgery was a painful experience? (2) If yes, which period was the most painful—before surgery, in the operation room, in the ICU, or back in the wards? (3) What was the most uncomfortable period during the ICU stay—during intubation or after extubation? (4) What was the most uncomfortable event? The VAS and the questionnaire about the 14 factors were completed as part of question 4 (Appendix A).

### Statistical Analysis

Data were analyzed using SPSS for Windows version 13.0 (SPSS, Inc, Chicago, IL). Continuous variables were presented as means ± SD, and categorical variables were reported as proportions. Factors affecting patients' comfort were analyzed by multiple linear regression analysis; *p* values < 0.05 were considered statistically significant.

## RESULTS

### Patient Characteristics

The study included 420 male and 380 female patients ranging in age from 18 to 70 years. Surgeries performed were heart valve replacement in 285 cases, coronary artery bypass grafting in 137 cases, and procedures for congenital heart diseases in 378 cases. Preoperative New York Heart Association class was I in 306 patients, II in 341 patients, III in 88 patients, and IV in 65 patients. American Society of Anesthesiologists class was I in 554 patients, II in 62 patients, III in 78 patients, and IV in 106 patients. The aortic cross-clamp time was 73.2 ± 28.9 minutes.

Mechanical ventilation time was 7.8 ± 3.2 hours (range, 4-48 hours). After tracheal extubation, all patients were conscious and were able to remember their mechanical ventilation experience with normal verbal communication function (Table 1). Condition of patients was relatively stable (stable hemodynamics, acceptable blood gas values, and able to communicate) within 24 hours after extubation.

### VAS Scores

VAS scores are shown in Table 2. The mean VAS score of the patients with mechanical ventilation was 5.82 ± 2.03. Of patients, >50% felt moderately uncomfortable, and 24% felt severely uncomfortable. No patient felt extremely uncomfortable or comfortable with mechanical ventilation.

### Causes of Patient Discomfort

There were 14 causes of discomfort during mechanical ventilation evaluated including tracheal intubation, aspiration of sputum, communication barriers, sleep disorders, patient-ventilator dyssynchrony, wound pain, dry mouth and thirst, limitation of motion, nervousness, anxiety and tension, surrounding environment, limited understanding of the disease (ie,

**Table 1. Clinical Characteristics of Patients Who Underwent Cardiac Surgery and Mechanical Ventilation**

Clinical Characteristics	Value
Sex, n (%)	
Male	420 (52.5)
Female	380 (47.5)
Age (y)	38.6 ± 18.9
Invasive ventilation time (h)	7.8 ± 3.2
Disease category, n (%)	
Heart valve replacement	285 (35.6)
Coronary artery bypass grafting	137 (17.1)
Congenital	378 (47.3)
NYHA class, n (%)	
I	306 (38.3)
II	341 (42.6)
III	88 (11.0)
IV	65 (8.1)
ASA class, n (%)	
I	554 (69.1)
II	62 (7.8)
III	78 (9.8)
IV	106 (13.3)

Abbreviations: NYHA, New York Heart Association; ASA, American Society of Anesthesiologists.

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