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# Malign hyperthermia in beating heart coronary artery bypass surgery

Harun Zengin, Emine Nilgün Zengin, Nevriye Salman, Sumru Şekerci

*Department of Anesthesiology and Reanimation, Ankara Bilkent City Hospital, Ankara, Turkiye*

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**Corresponding Author:** Emine Nilgun Zengin, nilbavullu@gmail.com

## ABSTRACT

Malignant hyperthermia (MH) is a rare but one of the most serious complications of general anesthesia due to the hypermetabolic state of skeletal muscle. This case report aims to share the diagnosis and treatment of the patient who was diagnosed with MH intraoperatively during cardiac surgery. Consent was obtained from a 59-year-old patient who was scheduled for CABGx2 surgery on his beating heart. The patient had no comorbidities other than hypertension, was a non-smoker, and had no history of previous surgery. Hypermetabolic findings began in the 90th minute of the operation. The body temperature: 39°C; pCO2: 72 mmHg; pH: 7.15; potassium was 5.13 mEq/L and pulse was over 120 min-1. MH was considered when the color change in soda lime was observed. Following these findings, anesthesia was maintained with 100% oxygen and total intravenous anesthesia (TIVA). The patient, whose hemodynamic stabilization was achieved, was taken to the intensive care unit (ICU) in an intubated state at the end of the surgery. A single dose of 2.5 mg/kg iv dantrolene was administered in the ICU. After dantrolene, body temperature, hemodynamic and metabolic values returned to normal. The patient was extubated on the first postoperative day. The patient was followed up in the ICU for 2 days and in the ward for 5 days before being discharged without complications. Dantrolene is the specific antidote for MH. With early application, the risk of complications and mortality can be reduced. Therefore, attention should be paid to the clinical symptoms of MH, and as soon as MH is suspected, triggering agents should be removed immediately and dantrolene supply and treatment should be provided.

**Keywords:** Beating heart, coronary artery bypass surgery, malign hyperthermia

## INTRODUCTION

Malignant hyperthermia (MH) is an autosomal dominant condition, rarely encountered but considered one of the most serious complications of general anesthesia.[1] Triggering drugs such as volatile anesthetics and depolarizing muscle relaxants increase calcium release from the sarcoplasmic reticulum, leading to a continuous rise in intracellular calcium concentration and causing uncontrolled skeletal muscle hypermetabolism.[1] As a result, MH manifests as a hypermetabolic state with symptoms such as respiratory and metabolic acidosis, hyperthermia, rhabdomyolysis, tachycardia, fatal arrhythmias, and hypoxemia.[2]

Variability in the expression of malignant hyperthermia (MH) may also stem from anesthesia-related factors, including the triggering potency of the inhalation anesthetic employed, drug dosage, and the duration of anesthesia.[3] Factors such as age and gender can additionally influence MH expression. Studies have indicated that MH predominantly occurs in younger patients, and MH reactions are reported to be twice as frequent in males compared to females.[3,4]

Due to genetic diversity, the incidence and prevalence of MH exhibit significant variations among different populations. The remarkable decrease in MH mortality since the 1970s is attributed to increased awareness of MH, the growing use of non-triggering anesthetics, enhanced monitoring standards allowing for early diagnosis, and the availability of dantrolene sodium.[4] In this case, the intention is to share the diagnosis and treatment of a patient diagnosed with intraoperative malignant hyperthermia during cardiac surgery.

## CASE

The patient was 59-year-old and male. His body mass index was 30.4 kg/m$^2$. The patient presented with no comorbidities other than controlled hypertension. With a smoking history

of 20 pack-years, the patient was classified as ASA II. Informed consent was duly obtained from the patient. The surgical plan involved the on-pump beating heart protocol.

The patient was positioned on the operating table, and following monitoring, anesthesia induction was initiated with 200 mg propofol, 90 mg ketamine, 80 mg rocuronium, 100 mcg fentanyl, and 100 mg lidocaine. The maintenance involved the use of 1 minimum alveolar concentration (MAC) of Sevoflurane and a continuous infusion of 0.5 mcg kg min-1 remifentanil. Extracorporeal circulatory support was commenced at the 80th minute of the operation. A blood gas analysis at the 85th minute revealed mild acidosis (pH: 7.23) and an elevation in $pCO_2$ (54 mm Hg).

Upon repeating the blood gas analysis at the 90th minute, the pH remained constant, with $pCO_2$ at 72 mmHg, K at 5.13 mEq/L, a pulse rate of >120 min-1, and a body temperature of 39 °C. The observation of a change in soda-lime color prompted the consideration of malignant hyperthermia (MH). In response to this, 100% oxygen and total intravenous anesthesia (TIVA) were administered. Dantrolene was urgently requested from the pharmacy.

To address the potential MH crisis, the anesthesia circuit and soda lime were replaced, the respiratory circuit was flushed with maximum fresh gas flow, the patient underwent external cooling, and metabolic disorders were addressed. Once hemodynamic stabilization was achieved, the patient was intubated and transferred to the intensive care unit (ICU).

In the ICU, a single dose of 2.5 mg $kg^1$ intravenous dantrolene was administered. Following the administration of dantrolene, the patient's body temperature, hemodynamic parameters, and metabolic values normalized. Extubating was performed on the first postoperative day. The patient received intensive care for 2 days and continued to be monitored in the ward for an additional 5 days before being discharged without complications.

## DISCUSSION

Malignant hyperthermia continues to pose a serious and life-threatening condition, underscoring the importance of early detection to minimize mortality and MH-related complications. Early administration of dantrolene is crucial in mitigating the risk of complications and mortality associated with MH.

Dantrolene serves as a specific antidote for MH events. Early application is associated with a decreased risk of complications and mortality.[5] According to the European malignant hyperthermia group, dantrolene should be prepared for administration within 5 minutes of recognizing the first sign of MH.6 It is reported that the risk of complications increases by 1.6 times for every 30-minute delay between the first sign of MH and the administration of dantrolene.[4]

Upon the clinical diagnosis of MH, we promptly requested dantrolene from the pharmacy and incorporated it into the patient's postoperative treatment. Following the administration of dantrolene, the patient's clinical manifestations were completely resolved. Many patients have seemingly undergone uneventful general anesthesia with triggering agents before manifesting MH reactions.[7] The exact reasons for this phenomenon are not fully elucidated, but it could be related to factors such as the duration of surgery, the choice of volatile anesthetic agent, and the concentration of the agent administered during the surgery.[2] All potent inhalation anesthetics commonly used in general anesthesia (such as desflurane, sevoflurane, isoflurane, halothane, and methoxyflurane) and the depolarizing neuromuscular blocking agent succinylcholine have the potential to induce MH.[6,8]

## CONCLUSION

Dantrolene is a specific antidote for malignant hyperthermia (MH).[1] Early administration can reduce the risk of complications and mortality. It has been reported that for every 30-minute delay between the onset of the first MH symptom and the administration of dantrolene, the risk of complications increases by 1.6 times.[4] Therefore, careful attention should be given to clinical signs of MH, and as soon as MH is suspected, triggering agents should be promptly removed, dantrolene should be obtained, and treatment initiated.

## ETHICAL DECLARATIONS

### Informed Consent

All patients signed and free and informed consent form.

### Referee Evaluation Process

Externally peer-reviewed.

### Conflict of Interest Statement

The authors have no conflicts of interest to declare.

### Financial Disclosure

The authors declared that this study has received no financial support.

### Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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