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**Malignant Hyperthermia**

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**Introduction:**

**What is the topic?**

Malignant Hyperthermia

**Presentation of Case/Process**

- A 20-year-old male patient presented following a motor vehicle crash with altered mental status and a laceration to the posterior region of his head.
- The prehospital care providers reported that the patient was the driver of the vehicle that struck a concrete guardrail at a high speed.
- Initial assessment revealed a GCS of 10. The decision was made to intubate the patient based on continued deterioration of his mental status.
- Vital signs during intubation were stable at HR of 88, blood pressure 152/70, SpO2 100%, and his temperature was maintained near 37°C prior to induction.
- Patient was preoxygenated with a non-rebreather mask and high-flow nasal cannula and given 5.5 mg/kg of both ketamine and succinylcholine.
- After the administration of succinylcholine, the patient experienced prolonged muscle fasciculations of his pectoral and abdominal muscles, and then developed tachypnea despite ongoing ventilation with a non-rebreather mask and nasal cannula.
- The patient’s electrocardiogram was easily visualized with a video laryngoscope, and his vocal cords continued to abducted/adduct.
- The emergency medicine resident was able to pass the tube successfully on the first attempt. The patient was then placed on continuous waveform capnography, and the end-tidal CO2 (ETCO2) was 71 mmHg.
- The patient also became tachycardic within 2 min of induction, with a heart rate noted in the 130-140 range.
- The treatment team initially felt the patient was inadequately sedated and administered midazolam and fentanyl.
- Despite providing adequate ventilation and sedation, the patient remained hyperthermic and tachycardic, with his ETCO2 ranging from 50 to 70 mmHg and heart rate 140-160.
- The team suspected MH at this stage and activated the MH protocol. The protocol, prompts a pharmacist to respond to the patient location with dantrolene (Rynovyl) and cooling agents in a designated cart.
- The initial CAT scan showed muscle edema, elevated liver enzymes, and rhabdomyolysis; there were no other injuries and no intracranial abnormality noted.
- Fluids, 5L of point-of-care chemistry revealed a pH of 7.37, base deficit of 1.9, venous pH of 7.19, PO2 of 65 and bicarbonate of 25.
- The patient was administered 2.5 mg/kg of dantrolene. His temperature at this time was 37.1°C (99.1°F).
- The patient was admitted to the trauma intensive care unit and progressed to mechanical ventilation within 3 hr of last positive.
- The patient continued to receive additional doses of dantrolene (Rynovyl) 250 mg (5 mg/kg) every 6 hr for 24 hr.
- He was discharged on Day 7/postictus. Patient was neurologically intact and scheduled to follow up for orthopedic care.

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**Why choose Malignant Hyperthermia?**

- Anesthesia providers and perioperative nurses play a crucial role in the identification and successful management of the condition.
- For a patient to survive a malignant hyperthermia crisis, prompt recognition and treatment is vital (Mulins, 2018).
- With proper education and understanding of the pathophysiology of the disorder, negative patient outcomes can be prevented (Rice, 2018).
- Malignant hyperthermia is an essential anesthetic care provider.

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**Signs and Symptoms**

- **MH may present anytime during general anesthesia and the early postoperative phase (Smith, 2018).**
- Early and specific sign of MH is an unexpected rise in end-tidal CO2 levels with increased ventilations. If succinylcholine is used, the rise in CO2 may be more rapid (Smith, et al., 2018).
- **MH can lead to tachycardia and dysrhythmia, along with hyperthermia, increased respiratory rate and hyperreflexia (Smith, et al., 2018).**
- **Progression of the crisis leads to respiratory and metabolic acidosis, increased serum lactate levels, and myoglobinuria may occur.** The patient may also suffer from acute renal failure and/or disseminated intravascular coagulation (Smith, et al., 2016).

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**Pathophysiological Processes**

**Normal Physiology**

- In a normal muscle contraction, an action potential causes membrane depolarization which releases calcium from the sarcoplasmic reticulum (SR).
- The calciton moves into the sarcoplasm via the ryanodine receptor. The receptor voltage-gated ion channels. The calcium interacts with the troponin-tropomyosin complex. It creates the cross-bridge between actin and myosin and a muscle contraction occurs.
- At the end of muscle contraction, calcium migrates back into the sarcoplasmic reticulum, and another stimulus is needed to release calcium for a muscle contraction (Schmiedberger et al., 2014).

**Underlying Pathophysiology**

- **MH is a rare yet life-threatening autosomal dominant disorder (affected individual has one copy of a causative gene).**
- Early and specific sign of MH is an unexpected rise in end-tidal CO2 levels with increased ventilations. If succinylcholine is used, the rise in CO2 may be more rapid (Smith, et al., 2018).
- **MH can lead to tachycardia and dysrhythmia, along with hyperthermia, increased respiratory rate and hyperreflexia (Smith, et al., 2018).**
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**Implications for nursing care**

- The severity of a MH crisis depends on how quickly the disease process is suspected and treated and how rapidly an appropriate treatment is initiated (Schneiderbanger et al., 2014).
- **Nurses should coordinate staff efforts as they prepare for a severe MH episode.**
- **Every minute delay in administering dantrolene increases the risk of further complications.**
- **The patient presentation in the PACU must know the response plan for an MH event.**

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**Conclusion**

- The prevalence of MH is estimated at 1-3/10,000 administered anesthetics, but this is likely underestimated (Borth, 2019).
- Half of the patients diagnosed with MH have received a prior treatment with a muscle relaxant that depresses muscle relaxant (Borth, 2019).
- **Without treatment, the mortality rate for a MH episode is as high as 80%**. (Borth, 2019)
- **Complications increase 3X per every 2°C increase in core temperature and a 1.6 X per 30-minute delay in dantrolene administration (Fishman, 2019).**
- **All staff members involved in the care of patients receiving MH-triggering agents should receive annual education on MH treatment (Borth, 2019).**
- **MH is a rare emergency, it is vital that the clinicians and patients are prepared and educated for the surgical procedure and the risk for complications with a detailed plan in place.**

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