Scoliosis Repair in a Child with Mitochondrial DNA Depletion Syndrome and history of treatment for Malignant Hyperthermia

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Introduction

- Mitochondrial DNA Depletion Syndrome (MDS) is a group of rare autosomal recessive disorders characterized by hypotonia, psychomotor retardation, and seizures within the first year of life
- MDS is characterized clinically and genetically into myopathic, hepatopathic and encephalomyopathic subtypes
- Reduction in mitochondrial DNA negatively affects mitochondrial respiratory chain complex productivity
  - Leads to inefficient aerobic metabolism and a decrease in available cellular ATP
  - Increased anaerobic metabolism leads to profound lactic acidosis
- There is currently no cure for MDS and treatment focuses on supportive care

Case

- 9 year old female presented for a T11-T12 posterior spinal fusion & T11-L4 posterior vertebral tethering
- History of MDS, diagnosed via muscle biopsy, Episodic Ataxia Type 1, and essential hypertension
- Uncomplicated general anesthetics in the past
- Recently presented one day postoperatively following an elbow ORIF with muscle rigidity, fever, and perioral cyanosis
- Admitted to the PICU for a suspected Malignant Hyperthermia
- Treated with dantrolene and improved clinically

Case

- For her scoliosis repair, anesthetic considerations included both the avoidance of propofol, secondary to her MDS, and MH precautions
- 0.5 mg/kg of PO versed prior to arrival in the OR
- EMLA cream was applied for IV placement
- Mask inhalation of nitrous oxide 50% was used for IV placement
- IV induction with 2.0 mg/kg of ketamine and 1.0 mg/kg of rocuronium
- A size 5.5 cuffed endotracheal tube followed by an arterial line catheter was then placed without difficulty
- Anesthesia was maintained with IV infusions of remifentanil, dexmetetomidine, and ketamine
- A baseline ABG at the beginning of the procedure was significant for a pH of 7.28 (see below)
- Initial treatment included IV fluids and sodium bicarbonate, with worsening of acid/base status
- Patient remained intubated until electrolytes normalized
- She was sedated with dexmetetomidine and transferred to the PICU
- She was extubated approximately 12 hours after surgery once her electrolytes and ABG normalized, and remained stable

Arterial Blood Gas Results:	18Oct17 09:28	18Oct17 10:33	18Oct17 13:06	18Oct17 15:21	18Oct17 20:10
pH, Arterial	↓ 7.28	↓ 7.27	↓↓ 7.08	↓ 7.30	↓ 7.30
pCO2, Arterial	42	↑ 49	↑↑ 75	38	37
pO2, Arterial	↑ 293	↑ 272	↑ 437	↑ 157	↑ 153
HCO3, Arterial	↓ 19	↓ 21	↓ 17	↓ 19	↓ 18
Base Excess, Arterial	* -6.3	* -3.9	* -7.4	* -7.2	* -7.8
Oxygen Saturation, Arterial	↑ 99.5	↑ 99.4	↑ 99.2	↑ 99.2	↑ 99.1

Discussion

- MDS is a broad group of metabolic defects which present unique perioperative anesthetic considerations
- The cardiovascular, muscular and central nervous systems, as well as other high-energy requiring tissues are most affected
- Primary perioperative concerns include respiratory failure, cardiac depression, and conduction defects
- Perioperative goals included avoiding mitochondrial depressants and to blunt the stress response to surgery to prevent further metabolic demand
- IV infusions of remifentanil, dexmetetomidine, and ketamine were used to suppress nociception and neuroendocrine responses to surgical stimulation
- Volatile anesthetics and propofol were avoided due to potential mitochondrial depression
- Despite the avoidance of propofol, blunting the stress response, and MH precautions in our patient, she still demonstrated a profound metabolic acidosis
- The worsening acidosis was self-limited and recovered within 24 hours after surgery
- The history of both mitochondrial dysfunction and MH presented a unique complexity to this case

References

1. El-Hattab, A; Scaglia, F "Mitochondrial DNA Depletion Syndromes: Review and Updates of Genetic Basis, Manifestations, and Therapeutic Options
2. Finsterer, J; Ahting, U "Mitochondrial depletion syndromes in children and adults" *The Canadian journal of neurological sciences* 40 (5): 635–44
3. Niezgoda J, Morgan PG. Anesthetic Considerations in Patients with Mitochondrial Defects. *Paediatric anaesthesia*. 2013;23(9):785-793