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Labor Analgesia Considerations in a Patient with Mitochondrial Disease: A Case Report

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Background

- Mitochondrial diseases (MD): Rare inherited genetic conditions with diverse clinical manifestations, affecting approximately 1 in 5000 individuals.
- Detection and diagnosis of MD pose significant challenges, partly due to the variability in inheritance patterns and the presence of point mutations.
- Similar mutations across the population lead to inconsistent and broad phenotypic expression, making it difficult to predict the specific clinical presentation in individuals with MD.
- Despite varied phenotypes, patients with MD carry significant considerations for anesthesia, especially in the context of pregnancy, where there is limited literature on safe anesthetic care during labor or cesarean section.

Medication	Mitochondrial Effects
Barbiturates	Complex I inhibition
Etomidate	Complex I inhibition, mild Complex II inhibition
Propofol	Acylcarnitine transferase, Complexes I/II/IV inhibition
Benzodiazepines	Complex I/II/III inhibition
Ketamine	Increase energy consumption +/- Complex I inhibition
Dexmedetomidine	None reported
Fentanyl, Remifentanil	Minimal
Morphine	Mild Complex I inhibition
Volatile Anesthetics	Complex I inhibition
Nitrous Oxide	None reported
Bupivacaine	Mild Complex I

Table 1. Listed above are common anesthetic agents and the sites affected by each. Table adapted from original source[5].

Methods

A retrospective review of one case was performed, including review of relevant existing literature.

The patient gave consent for this case report to be written and shared. The case report does not contain any personally identifiably information and is exempt from IRB review per Hartford Healthcare policy.

Case Report

A 21-year-old female G2P0010 at 39 weeks 5 days presented to labor and delivery for elective induction of labor. Her past medical history was notable for mitochondrial disease (MD) via MT-ATP8 mutation. The manifestation of the patient's disease included mildly prolonged QT interval, a history of an isolated non-epileptiform seizure four years prior with negative workup, chronic urinary tract infections, long-segment scoliosis, and peripheral neuropathy. Biyearly ECGs and echocardiograms reveal QT intervals 480-500ms and an ejection fraction of 61% with no other notable abnormalities, no UTI was noted within the last 2 years prior to pregnancy.

On admission, the patient was started on maintenance fluids of D5NS as well as oxytocin infusion and subsequently induced. Initial lab work was remarkable for leukocytosis of 17,500, hemoglobin of 10.4 with MCV of 76, and elevated alkaline phosphate at 242. Anesthesia consultation stated that neuraxial anesthesia would be preferred early on and was safe. However, the patient declined placement of epidural, opting for nitrous oxide therapy as a substitute for analgesia. The patient progressed spontaneously into active labor and subsequently delivered 8 hours after induction of labor without any fetal or maternal complications.

On post-partum day 1, patient was ambulating and voiding without issue; all appropriate medications was administered aside from routine vaccinations such as varicella and hepatitis B for which the patient was non-immune; the patient declined receiving vaccination on the grounds of a thought to be correlation to receiving an unknown vaccine in the past and subsequently experiencing a seizure. On day 2 the patient was discharged home with appropriate follow up.

Discussion

- MD are due to mitochondrial DNA genetic mutations, which result in alterations to oxidative phosphorylation and the creation of adenosine triphosphate (ATP)[2].
- MD disorders present at any age with phenotypically heterogeneous manifestations typically in tissues with high energy requirements such as the CNS, heart, and muscle. Complications may present as hypertrophic cardiomyopathy and conduction defects, epilepsy, or encephalopathy as well as myopathy[3].
- This patient's family history of ATP8 variant was noted to have 80% heteroplasmy in her mother's blood with no symptoms. The patient herself expressed 88% heteroplasmy with peripheral neuropathy, long-segment scoliosis, non-epileptiform seizures, and recurrent urinary tract infections.
- Current literature lacks consensus on optimal safe administration of labor analgesia via neuraxial or general anesthesia to patients with MD. Physiologic shifts that place a metabolic burden on patients should generally be avoided.
- In the setting of labor analgesia or cesarean sections, regional and neuraxial techniques are strongly favored to avoid large swings in metabolic demand as well as a reduction in labor-associated oxygen consumption and resultant acidosis from early pain management[3].
- In patients declining neuraxial anesthesia or with a requirement for general anesthesia, it is well documented that almost every general anesthetic depresses mitochondrial function in vitro resulting in inhibited oxidative phosphorylation[1].
- In this case report, the patient did not utilize neuraxial analgesia nor general anesthesia, and labor analgesia was achieved via nitrous oxide which allowed for uncomplicated vaginal delivery without large homeostatic changes or any post-partum anesthetic concerns.
- While the above strategies have been noted to have success in cases of MD reported in literature, the favorable outcome and preparation for this parturient with MD is an example of a safe, non-neuraxial approach to a complex and uncommonly seen patient.

Learning Point:

Pregnant patients with MD require pre-operative assessment and screening for major cardiac, neurologic, or muscular abnormalities. In the setting of laboring patients with MD, tighter homeostatic parameters are required specifically in the setting of labor analgesia and pain management.

The management of this parturient with nitrous oxide as the primary analgesic without neuraxial anesthesia demonstrates safe and favorable outcomes for patients with MD in labor and suggests an alternative that is stable and non-invasive in patients with MD.

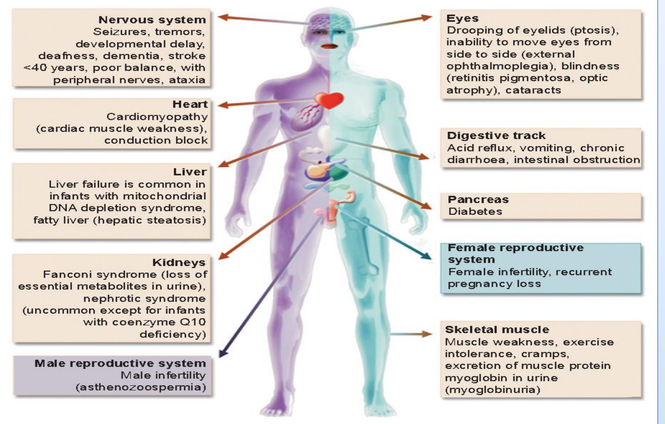

Figure 1. Schematic picture showing clinical features and organs affected by mitochondrial diseases[6].

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