Cardiac Failure in a Trisomy 9 Patient Undergoing Anesthesia: A Case Report

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A 27-year-old female with Trisomy 9 mosaicism presented to Children's Hospital Colorado for outpatient dental surgery under general anesthesia. The patient's past medical history was also significant for premature birth, gastroesophageal reflux, scoliosis and kyphosis, obesity, and developmental delay. Per her mother's report, the patient had no cardiac issues. She had undergone multiple previous general anesthetics, some of which documented respiratory complications such as laryngospasm, bronchospasm, and possible aspiration. During this anesthetic, the patient became hypotensive on induction, with sluggish response to intravenous fluids, glycopyrrolate, and ephedrine. Her electrocardiogram demonstrated what appeared to be left bundle branch block at baseline, with possible ST segment changes after induction. Due to her abnormal reaction to the induction and subsequent treatment for hypotension, an echocardiogram was performed. The patient was found to have an ejection fraction of 25%–30%. The anesthetic was uneventful for the remainder of the procedure, and following recovery, the patient was admitted by the heart failure team for further care.

Key Words: Trisomy 9 mosaic; General anesthesia; Cardiac failure; Cardiomyopathy.

Mosaic trisomy 9 is a rare chromosomal abnormality that is associated with limited survival.¹ The first description of an infant with trisomy 9 mosaicism was published in 1973. The child presented with a bulbous nose, low-set ears, micrognathia, congenital heart defects, and skeletal abnormalities; the infant survived for 28 days.² Subsequent literature, including via the Tracking Rare Incidence Syndromes project, has provided similar descriptions of trisomy 9 mosaicism, as well as additional phenotypic characteristics and associated medical conditions.³ Variably reported are such things as joint anomalies, craniofacial malformations, microphthalmia, microcephaly, renal issues, gastroesophageal reflux (GER), intestinal malrotation, laryngomalacia, seizures, and a wide spectrum of language and motor development.³ According to Bruns and Campbells' survey of 25 trisomy 9 mosaic patients, the most common physical characteristics were low-set ears (64%), micrognathia (52%), rocker bottom feet (28%),

microcephaly (16%), cleft palate (12%), and microphthalmia (12%).³ With regards to cardiac conditions, the literature reports the presence of at least 1 cardiac anomaly in one third to two thirds of patients. The most commonly reported congenital heart defects are ventricular septal defect, atrial septal defect, and patent ductus arteriosus; less common are conditions such as arch anomalies with vascular rings and aberrant left subclavian artery. Most of the studied children exhibited more than 1 cardiac condition.³ However, to the best of our knowledge, no case of cardiomyopathy has been described in these patients.

Following signed parental consent and patient assent, we report a case of undiagnosed cardiomyopathy in a trisomy 9 mosaic patient that was elucidated during a general anesthetic.

CASE PRESENTATION

A 27-year-old mosaic trisomy 9 female presented for a 2.5-hour dental rehabilitation with extractions under general anesthesia. Physically, she exhibited a bulbous

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nose, low-set ears, and microcephaly. Her past medical history was significant for premature birth (as a twin born at 34 weeks' gestation), developmental delay, scoliosis, and GER. On the morning of surgery, she weighed 72.2 kg, her height was 138.1 cm, and her body mass index was 37.9 kg/m². Preoperative blood pressure was 118/87 mm Hg measured in her right arm, pulse rate was 99/min and regular, respiratory rate was 16/min, and her peripheral oxygen saturation was 93% on room air. Her daily medications included lansoprazole for GER, hydrocodone/acetaminophen for dental pain, as well as paroxetine and risperidone as mood-stabilizing medications. Her chest and cardiac exams were within normal limits. The patient was reportedly asymptomatic from a cardiac standpoint, although her mother mentioned that she had gained weight recently and perhaps tired more easily with exertion. A review of our electronic medical record did not show any previous cardiology visits, and there was no obvious cardiac work-up of the patient. All reviewed previous anesthetic records showed normal sinus rhythm as the patient's electrocardiogram (ECG) pattern. The airway evaluation was significant for an anticipated difficult intubation due to the patient's body mass index, relatively short neck, and scoliosis/kyphosis with failed spine fusion. Also concerning for induction was the patient's medically treated GER. The patient's general anesthesia history included magnetic resonance imaging, tethered cord release/laminectomy, simple mastoidectomy, posterior spinal fusion, multiple nuclear medicine bone scans, dental surgery, and an upper gastrointestinal endoscopy. A review of the anesthetic records did reveal a history of moderate to severe obstruction with mask ventilation, but successful one-attempt direct visual laryngoscopies for intubation with Cormack-Lehane grade 1 or 2 views of the vocal cords. One previous attempt at using a laryngeal mask airway had been converted to an oral endotracheal tube (ETT). Also noted were 2 separate episodes of emesis on induction, both promptly treated with positioning, suctioning, and intubation. The first episode demonstrated decreased breath sounds on the left, but bronchoscopy and chest radiography showed no evidence of aspiration. The remainder of that anesthetic was uneventful. The second episode of emesis on induction occurred during a dental rehabilitation, and similarly no evidence of aspiration was identified on further investigation. The patient later showed signs of bronchospasm with oxygen saturations ranging from the low 80s% to mid 90s%, and the anesthetic was terminated after the most urgent dental needs were addressed. Two other anesthetic records noted laryngospasm and coughing, easily treated, with uneventful courses thereafter.

For this anesthetic, we secured a 22-gauge peripheral intravenous (IV) catheter in the preoperative area. The patient received 2 mg IV midazolam for anxiolysis and was transported to the operating room. Induction of anesthesia was carefully titrated with a total of 200 mg of propofol (2.8 mg/kg) over 6 minutes, 50 mg of lidocaine (0.7 mg/kg), and 100 mcg of fentanyl (1.4 mcg/kg). Sevoflurane (1%) was initiated once the patient was asleep to aid with intubation. At the same time, standard American Society of Anesthesiologists monitors were placed. Moderate obstruction was noted on mask ventilation. After administration of topical oxymetazoline, nasal intubation was successfully and atraumatically performed with a 6.0 nasal RAE ETT utilizing a size 4 Glidescope (Verathon, Inc, Bothell, WA, USA) as well as a red rubber catheter to guide the nasal RAE through the right naris. There was no vomiting or esophageal regurgitation noted during intubation.

The ECG, attached immediately after induction, demonstrated widened QRS segments suggestive of bundle branch block. Soon after intubation, a decrease in blood pressure from 118/87 mm Hg to 60/30 mm Hg occurred, associated with possible ST segment depression by ECG, but this was difficult to interpret in the presence of bundle branch block. The heart rate dropped to the low 70s. The patient was treated with glycopyrrolate, crystalloid, and 3 ephedrine boluses, with a sluggish but adequate response. Simultaneously, oxygen saturation decreased from 97% to the low 70s%. Breath sounds appeared diminished, especially in the left lung fields. Saturation improved with 100% oxygen, airway suctioning, albuterol sprayed down the ETT, and recruitment maneuvers, recovering to the mid to high 90s%. We placed a fiber optic scope down the ETT to ensure correct positioning above the carina, as well as performed direct laryngoscopy to ensure that the cuff was below the vocal cords. The ETT was secured in the appropriate location, but the patient would intermittently cough and buck, and the decision was made to use rocuronium to better control her ventilation. The anesthesia team had kept the patient spontaneously ventilating until this point. Once she began to breathe over the ventilator, she was switched to pressure support ventilation, and then to spontaneous ventilation at the end of the case. Hemodynamics and oxygen saturation improved and remained stable for the remainder of the surgery, with the patient requiring 2 more boluses of ephedrine over the course of the dental treatment. The patient was maintained on sevoflurane (0.8–2%) combined with a propofol infusion (30–100 mcg/kg/min), and received a dose of 200 mcg hydromorphone approximately halfway through the anesthetic.

In view of the hemodynamic and oxygen saturation problems encountered at induction, at the end of the

dental procedure a transthoracic echocardiogram was performed. Poor acoustic windows prompted transesophageal echocardiogram to be completed while the patient was still anesthetized. These tests demonstrated an ejection fraction of 25–30% with left ventricular dilation and moderate systolic dysfunction. With the images thus obtained, a thrombus in the apex of the left ventricle could not be ruled out, nor could the coronary arteries be optimally visualized. Once these echocardiograms were completed, the patient was extubated awake without incident.

With the patient's decreased systolic function in mind, after an uneventful postanesthesia care unit stay, the patient was admitted overnight for observation and seen by the cardiac failure team. Lab work for acute myocardial injury was negative: Creatine kinase-MB isoenzyme was 3.2 ng/mL (normal is 0–3.4) and troponin was <0.01 ng/mL (normal is 0–0.119). BNP was 94 ng/L (normal is <99). A repeat transthoracic echocardiogram the following day was unchanged from the intraoperative exam, and an ECG demonstrated left bundle branch block, which was then noted to be similar to an ECG from 7 years prior that was found during a deeper exploration of the patient's medical record. The heart failure team recommended either a computed tomography angiogram of the coronary arteries or a cardiac magnetic resonance imaging, and referred the patient, due to her age and condition, to the adult cardiac failure team at the University of Colorado Anschutz Medical Campus. The patient was discharged from Children's Hospital Colorado Post-Op Day 1, with newly prescribed lisinopril 5 mg and aspirin 81 mg once per day.

DISCUSSION

Trisomy 9 is an uncommon chromosomal abnormality, occurring in approximately 0.1% of conceptions. It is most commonly caused by a meiotic error and is associated with advanced maternal age, similar to other trisomy syndromes.^{4,5} It can occur in complete or mosaic form, and results in a distinct clinical picture.⁶ The phenotype of complete trisomy 9 includes growth restriction, micrognathia, a bulbous nose, low-set ears, cleft palate, skeletal abnormalities, heart abnormalities, hypoplastic genitalia, developmental delay, and renal and neurological abnormalities. It is almost always lethal in utero or early in the postnatal period, with survival generally not extending beyond 9 months of age.^{4,6–9}

The majority of live-born and surviving individuals with trisomy 9 have a mosaic karyotype (47XX/46XX or 47XY/46/XY). The phenotype is similar to that seen in full trisomy 9 syndrome.^{4,8,10,11} In the limited body of literature on children and adults with trisomy 9

mosaicism, a number of cases of congenital heart disease have been described.³ Patients with ventricular and atrial septal defects, patent ductus arteriosus, and arch anomalies with vascular rings have been reported.³ This, however, is the first description of a trisomy 9 mosaicism patient with a primary presentation of cardiomyopathy—in this case elicited in the setting of hemodynamic instability associated with the induction of general anesthesia.

A period of hemodynamic instability, as evidenced by a greater than 20% decrease in blood pressure from baseline during induction of general anesthesia is uncommon, and is an indication to investigate for more sinister causes—especially when the patient is sluggish to respond to normal maneuvers. The differential diagnosis in this situation includes hypovolemia, anaphylaxis/anaphylactoid reaction, cardiac arrhythmia, cardiac tamponade, decreased cardiac contractility, pneumothorax, pulmonary embolism, occult intravascular blood loss, and especially in adults, myocardial infarction. Such hypotension is usually corrected with lightening the depth of anesthesia, the administration of IV fluids, and occasionally giving vasoactive agents such as ephedrine. Failure to respond to these interventions should cue the anesthesia provider to consider administration of intermittent boluses of epinephrine, starting at 0.25 mcg/kg. If this does not improve the blood pressure, the anesthesiologist might abort the case if an elective procedure, or administer IV inotrope infusions of either dopamine at 3–5 mcg/kg/min or epinephrine at 0.03–0.05 mcg/kg/min. These infusions are then titrated to hemodynamic effect. Thought should be given to the placement of central venous and arterial monitoring. In the rare instance of the blood pressure not improving with these interventions, the patient may be in refractory shock. In a large hospital setting, this might prompt placing the patient on extracorporeal membrane oxygenation in an effort to bridge him or her to diagnosis and further treatment.

On initial examination, our patient demonstrated proper airway placement and mostly clear bilateral breath sounds (albeit somewhat diminished on the left). There was a lack of skin changes, no jugular venous distension, and while heart sounds were somewhat distant, the patient's body habitus could have been the culprit. The patient's heart rate remained in the low-normal range during the period of hypotension, and the ECG remained unchanged with bundle branch block and possible ST depression. Dental surgery had yet to begin, and generally elicits minimal blood loss. Our initial management therefore included an IV fluid challenge (800 mL of Lactated Ringer's Solution) as well as multiple doses of IV ephedrine to stimulate alpha and beta adrenergic receptors. The response was

languorous, but eventually satisfactory. Considering this information, we ruled out anaphylaxis/anaphylactoid reaction, pneumothorax, bleeding/hypovolemia, cardiac arrhythmia, and lowered our index of suspicion for cardiac tamponade and pulmonary embolism. With these causes sidelined, we focused on the possibility of significant cardiac dysfunction. Moreover, as the ECG demonstrated what appeared to be left bundle branch block, we were concerned about the efficiency of left ventricular contraction. Left bundle branch block is associated with hypertension, coronary artery disease, myocarditis, valvular heart disease, cardiomyopathies, and represents a primary cause of heart failure in the setting of left ventricular dyssynchrony.^{12,13} Consequently, we requested an echocardiogram, as it promised to provide the most useful information, especially when considering the possibilities of severe hypovolemia, pulmonary embolism, pericardial tamponade, and of course, general myocardial dysfunction. The images obtained confirmed our suspicion of poor cardiac contractility. The calculated left ventricular ejection fraction below 30% placed the patient squarely in the heart failure category, with increased risk of cardiac arrhythmia. Our next consideration was whether we caused the poor cardiac function—but markers of acute myocardial damage all returned normal, and a previous ECG demonstrated that left bundle branch block had been a previous issue. Accordingly, with a new diagnosis of decreased systolic function, and with the patient stable and at baseline, we handed her care over to the cardiac failure department for long-term treatment.

CONCLUSION

We present a case of cardiac dysfunction during dental surgery under general anesthesia in the hospital setting. Echocardiogram was used to diagnose acute heart failure and emergent management options were discussed.

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