CLINICAL VIGNETTE

A Pediatric Patient with Patau Syndrome: Anesthetic Considerations

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Introduction

Patau syndrome, or Trisomy 13, is a chromosomal disorder first described in 1960.[1] It is the third most common autosomal trisomy disorder, after Trisomy 21 and Trisomy 18, with an estimated prevalence of 8 to 15 per 100,000 live births.[2,3] A majority of prenatal diagnoses are terminated or spontaneously lost, with 20% of cases resulting in live births.[4] Median life expectancy is 5 to 12 days and over 90% of infants die within the first year, with a majority of deaths occurring in the first month of life.[2,5,6] Patau syndrome phenotype is characterized by multiple craniofacial and congenital organ malformations, particularly involving the cardiac and central nervous systems.[7] These anatomic and functional changes present potential challenges to anesthetic management. We present a case of a patient with Patau Syndrome who underwent monitored anesthesia care (MAC) for a magnetic resonance imaging (MRI) of the lumbar spine.

Case Presentation

A 3-year-old female child was brought to the hospital as an outpatient for a repeat lumbar spine imaging in preparation for possible neurosurgical intervention. Her past medical history included a prenatal diagnosis of Trisomy 13, Lennox Gastaut Syndrome, global developmental delay, sacrococcygeal teratoma with tethered cord, optic nerve atrophy, bicuspid aortic valve, patent ductus arteriosus (PDA), atrial septal defect (ASD), pulmonic valve dysplasia, suspected obstructive sleep apnea (OSA), urogenic bladder complicated by multidrug resistant urinary tract infections, failure to thrive, and constipation. The patient was born at full term via cesarean section. Her medications included levetiracetam, oxcarbazepine, clobazam, inhaled albuterol, inhaled fluticasone, 0.5 to 1 L/min night-time home oxygen, doxazosin, polyethylene glycol, and lactulose. The patient had no known drug allergies and family medical history was non-contributory. She had no prior surgical history but her anesthetic history included multiple MRI's under MAC anesthesia without event. Additionally, she had two prior intubations for respiratory failure secondary to respiratory syncytial virus pneumonia two months prior and respiratory failure secondary to aspiration two years prior to her scheduled MRI. Review of systems was negative on presentation.

The patient had a transthoracic echocardiogram prior to the scheduled MRI that demonstrated aortic root dilation to 26 mm at end diastole, PDA with left to right shunt, and mild pulmonic regurgitation. However, aortic valve visualization and pulmonary artery systolic pressure assessment were limited. Her other recent diagnostics were notable for right ventricular hypertrophy on electrocardiogram and an increased right heart size on chest x-ray.

On physical examination, vital signs were within normal limits: temperature 36.1°C, heart rate 95 beats per minute, respiratory rate 25 breaths per minute, blood pressure 102/65 mmHg, and SpO2 of 99% on room air. The patient was underweight measuring 106 cm and 13.77 kg, with a BMI of 12.26 kg/m^2, less than 1st percentile for age and sex. The airway exam was limited due to the lack of cooperation. She had syndromic facies, cutis aplasia, systolic click, nontender suprapubic mass, bilateral lower extremity rigidity, sluggish pupils, and inability to track light, objects, or faces. The patient was nonverbal and unable to follow commands, consistent with her baseline.

Prior to the start of the case, oral midazolam was given for anxiolysis. In preparation for the procedure, the American Society of Anesthesiology's standard monitors (EKG, non-invasive blood pressure, pulse oximetry, capnography) were placed, and a peripheral intravenous (IV) access was obtained with a 24-gauge catheter in the left hand. The patient was positioned supine, head neutral, and all pressure points padded. Propofol was titrated to the patient's level of sedation. The patient maintained spontaneous respirations throughout the procedure with 6 L/min of supplemental oxygen via face mask. The 41-minute procedure proceeded uneventfully, and the patient was then transported to the post-anesthesia care unit (PACU) with continued oxygen supplementation at 4 L/min via face mask. She continued to do well in the PACU and was discharged later the same day.

Discussion

Given the breadth of possible congenital abnormalities associated with Patau Syndrome, anesthetic management for these patients emphasizes diligent preoperative planning and intraoperative vigilance. Anesthetic goals include seizure prevention, maintenance of hemodynamic stability, and prevention of and monitoring for apnea.

<u>Neurologic:</u>
Abnormal intrauterine cerebral development is characteristic and results in severe cognitive impairment. Serious develop-

mental delay is reported in all patients surviving beyond the first year of life.[7] Microcephaly, corpus callosum defects, ventriculomegaly, and olfactory or optic nerve anomalies are among the most common findings.[7] Seizure disorders are present in 50% of patients.[7] Extreme care for seizure prevention should be taken with continuation of anti-epileptic medications on the day of surgery, maintenance of stable hemodynamics, and the consideration for bispectral index (BIS) monitoring.[8] Although sevoflurane is widely used for pediatric inhalation induction, its use may be associated with high epileptogenic activity. Hyperventilation and substitution of isoflurane with nitrous oxide may be used to decrease seizure risk.[9,10] Our patient's anti-epileptic regimen was continued, and inhalational anesthetics were not necessary for the MRI.

Cardiac:
Congenital heart disease (CHD) is present in 80% of patients with Patau syndrome, with most cases having multiple non-cyanotic lesions including PDA, ASD, and ventricular septal defect (VSD).[7,11] Less commonly, dextrocardia, Tetralogy of Fallot and transposition of the great arteries may be seen.[7] Most notably, uncorrected cardiac abnormalities may not be adequately diagnosed or optimized due to poor life expectancy. A full cardiac assessment inclusive of, but not limited to, a thorough physical examination, electrocardiogram, chest x-ray, and echocardiogram should be considered while maintaining a low threshold for cardiology referral.

Anesthetic choice is based on the nature and extent of the cardiac lesion, left ventricular function, the presence of pulmonary hypertension and the resultant blood flow, and the presence of shunting.[11] Cautious administration of IV and inhalational anesthetics are aimed to avoid drastic changes in systemic or pulmonary vascular resistance. For example, pulmonary vascular resistance should be optimized with mild hyperventilation, high FiO2, low airway pressures, and normothermia.[12] Noninvasive or invasive cardiac function monitoring may be necessary to adequately trend hemodynamic shifts. Additional risks of air embolism and endocarditis require further management in the setting of CHD.[11] Our patient had no clinical signs or symptoms of heart failure, and propofol was slowly titrated to effect and hemodynamic stability was maintained.

Respiratory:
A number of craniofacial abnormalities commonly reported in Patau Syndrome are associated with difficult ventilation and intubation and they include short neck, micrognathia, high arched cleft lip and palate and nasal malformation.[11] Cleft palate is reported in 75% of cases and is associated with increased risk of pulmonary aspiration and infection.[11] This risk is further increased with age due to development of thoracic kyphoscoliosis resulting in reduced lung volumes and ineffective cough.[13,14] Anticipation of difficult endotracheal intubation or supraglottic airway placement should prompt consideration of the use of intubation aids, such as video laryngoscope or fiberoptic bronchoscope.

Maintenance of spontaneous breathing should be considered whenever possible. Prolonged anesthetic duration may lead to apneic episodes, especially in those with history of central sleep apnea and obstructive sleep apnea.[7,8] Respiratory depressants, such as opioids, should be used with caution, and usage may require postoperative monitoring for apnea.[15] Our patient with suspected OSA was able to maintain spontaneous ventilation throughout the procedure, and she did not require the use of opioids. Multiple intubation modalities were made available in the room should the need for further airway management arise.

Renal:
Renal involvement, such as renal agenesis, hydronephrosis, and polycystic kidneys, is present in 60% of cases.[11] Care should be taken when using renally eliminated agents in the setting of impaired renal function. Intravascular fluid balance and adequate renal blood flow can be achieved with colloid preloading and a low dose dopamine infusion, respectively.[11]

Musculoskeletal:
Clenched hands, polydactyly, and rocker-bottom feet are prominent manifestations of Patau syndrome.[7] Joint contractures and subluxation may develop with age and may present additional challenges to direct laryngoscopy, intravenous access, positioning, and transportation of these patients.

Hematologic:
Long-standing hypoxemia due to CHD is associated with secondary erythrocytosis. This both increases thrombosis risk due to hyperviscosity and stasis and bleeding risk due to coagulation profile derangements.[16] Prophylactic phlebotomy, colloid hemodilution, anticoagulation, antifibrinolytics, and dynamic intraoperative coagulation monitoring with thromboelastography may be considered.[11,16]

Conclusion

Despite high mortality rates, cases of long-term survival past the first decade have been reported.[8,13,14] One-year survival rates have increased from 3% to 5-20% in recent years.[2,5,6,17] Although these estimates may be influenced by less severe genetic mosaicism and increased termination of pregnancies with major malformations, these reports have led to more physicians transitioning from palliative care to more aggressive inpatient management.[2,18] One year survival after first surgery increases to 70% in those with Patau syndrome; therefore, a deeper understanding of anesthetic management and its potential challenges in these patients benefit both the anesthesiologist and the patient.[2] This 3-year-old female patient safely underwent MAC anesthesia for an MRI of the lumbar spine in anticipation of possible neurosurgical intervention.

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