Annals of Clinical Anesthesia Research

Case Report
Published: 28 Mar, 2019

An Opioid and Paralytic Free Approach to Craniosynostosis Surgery in the Anaphylactic Patient: A Case Report

Karla EK Wyatt[1], Sara Anvari[2], Renata S Maricevich[3] and Sandi K Lam[4]*

[1]*Department of Anesthesiology, Baylor College of Medicine/Texas Children's Hospital, USA*

[2]*Department of Immunology, Allergy and Rheumatology, Baylor College of Medicine/Texas Children's Hospital, USA*

[3]*Department of Plastic Surgery, Baylor College of Medicine/Texas Children's Hospital, USA*

[4]*Department of Neurosurgery, Baylor College of Medicine/Texas Children's Hospital, USA*

Abstract

Non-syndromic infants with sagittal craniosynostosis are suitable candidates for endoscopic strip craniectomy when diagnosed at a young age. When compared with open cranial vault remodeling, endoscopic strip craniectomy is typically associated with a shorter length of stay and decreased morbidity and mortality. At our institution, the anesthetic management includes an opioid and inhalation-based technique for both endoscopic and open cranial vault remodeling procedures. We present a case in which a 9-month-old underwent an opioid-free and paralytic-free anesthetic for open cranial vault remodeling. This approach was following anaphylaxis after induction for aborted endoscopic strip craniectomy at 8-weeks of age; diagnosis was made with suggestive skin prick and intra dermal testing.

Keywords: Anaphylaxis; Craniosynostosis; Craniofacial surgery; Pediatric anesthesia; Endoscopic craniectomy

OPEN ACCESS

Correspondence:
Karla EK Wyatt, Department of Anesthesiology, Baylor College of Medicine/Texas Children's Hospital, 6621 Fannin St. A3300, Houston, TX 77030, USA, Tel: 832-842-5800; Fax: 832-825-5801;
E-mail: karla.wyatt@bcm.edu

Received Date: *21 Feb 2019*
Accepted Date: *26 Mar 2019*
Published Date: *28 Mar 2019*

Citation:
Wyatt KEK, Anvari S, Maricevich RS, Lam SK. An Opioid and Paralytic Free Approach to Craniosynostosis Surgery in the Anaphylactic Patient: A Case Report. Ann Clin Anesth Res. 2019; 3(1): 1020.

Introduction

Endoscopic Strip Craniectomy (ESC) is effective for correction of non-syndromic sagittal craniosynostosis in cases with early diagnosis. When compared with open Cranial Vault Remodeling (CVR) for this procedure, ESC is associated with reduced operating times, length of stay, lower rates of transfusion and decreased overall morbidity and mortality [1-3]. The most important consideration for ESC suitability is age at presentation [1]. At our institution, 2 to 3 months is the ideal age range for endoscopic repair. These cases are routinely performed with an inhaled anesthetic-opioid technique [3]. We present a case in which a 9-month-old underwent an opioid-free and paralytic-free anesthetic for open cranial vault remodeling. This approach was following anaphylaxis after induction of anesthesia with aborted endoscopic strip craniectomy at 8 weeks of age; the diagnosis was made with suggestive skin prick and intra dermal testing. This alternative anesthetic approach at 9 months of age was carried out safely and successfully, with result comparable to peers undergoing the same surgery in terms of length of stay and post-operative medication consumption.

Case Presentation

Parental written informed consent was obtained for patient inclusion in this report.

First surgery and subsequent management

An 8-week old 5 kg male with non-syndromic sagittal synostosis presented for cranial vault remodeling via an endoscopic strip craniectomy. The patient was the product of a 37-week dizygotic-twin pregnancy, delivered via cesarean section with an uncomplicated and routine nursery course. His preoperative work up revealed no evidence of increased intracranial pressure or cardiopulmonary anomalies. Parents reported no known drug or food allergies. His medical history was otherwise unremarkable and he was not on any medications. The infant was transferred to the operating room, standard ASA monitors were attached, and general anesthesia was induced with N_2O/O_2 (70%/30%) mixture followed by sevoflurane titration. Intravenous access was

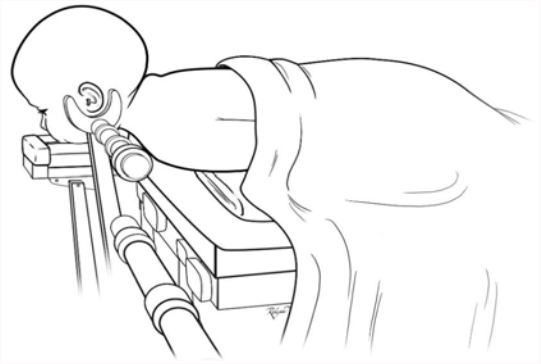

Figure 1: Sphinx position.

obtained followed by rocuronium 0.6 mg/kg and fentanyl 1 μg/kg to facilitate endotracheal intubation. Arterial access was obtained for hemodynamic monitoring and repeated laboratory assessment. Following intubation he was ventilated using volume control auto-flow with tidal volumes of 6 ml/kg, and a respiratory rate titrated to an end-tidal carbon dioxide concentration of 35 mmHg to 38 mmHg. At this time his hemodynamic profile reflected a blood pressure of 77/43 mmHg, Mean Arterial Pressure (MAP) of 54 mmHg, heart rate of 132 bpm, and pulse oximetry of 100%. Maintenance of anesthesia included inhaled isoflurane and a remifentanil infusion at 0.3 mcg/kg/min. A tranexamic acid bolus of 30 mg/kg followed by an infusion of 1 mg/kg/hr, was initiated to reduce intraoperative blood loss. A precordial doppler was used for venous air embolism monitoring. The patient was arranged in the sphinx position with the head of the bed rotated 90° from the anesthesia work station (Figure 1). The skin was prepped with ChloraPrep® (CareFusion, El Paso, TX) chlorohexidine-based solution. Cefazolin 30 mg/kg was administered over 3 min. Within 2 min of antibiotic administration, the patient became hypotensive to 32/20 mmHg. Peak airway pressures increased from 15 cm to 27 cm H_20 following desaturation from 100% to 92%. Auscultation of the chest revealed bilateral wheezing. Albuterol (5 metered puffs) was administered via the endotracheal tube followed by a 1 mcg/kg bolus of intravenous epinephrine, and 15 ml/kg of IV fluid for suspected bronchospasm with hemodynamic compromise. Oxygenation and perfusion briefly improved with a blood pressure of 68/35 mmHg, pulse oximetry of 97% and a peak airway pressure of 16. However, this response was short lived and within 2 min bronchospasm with cardiovascular compromise recurred. Epinephrine was administered in five doses of 3 mcg/kg to 5 mcg/kg followed by an infusion of 0.05 mcg/kg/min to sustain MAPs of 50 mmHg. Removal of the drapes revealed no skin changes. Laboratory data and fluid status did not reveal any source for the persistent hemodynamic collapse. Diphenhydramine 1 mg/kg and dexamethasone 0.5 mg/kg were administered. A tryptase level was drawn 17 min after the onset of hypotension, which was normal. The patient remained intubated and was taken to the intensive care unit for further stabilization and workup of suspected anaphylaxis to cephazolin. Repeat tryptase level obtained 6 hr after symptom onset was again normal. Allergy and immunology consultation recommended skin prick and intra dermal testing at least 4 to 6 weeks from the reaction. Percutaneous Skin Testing (PST) and Intra Dermal Testing (ID) performed at 4-months of age showed negative antibiotic but positive fentanyl reactivity (Table 1). However, at the time of initial testing, the patient had an upper respiratory infection which is known to confound the results of allergy testing. Repeat allergy testing at 5 months old showed

Table 1: Percutaneous and Intradermal Skin Testing.
PST: Percutaneous Skin Testing; ID: Intradermal Skin Testing for medications; skin test wheal size (top number) and flare (bottom number) measured in millimeter. Positive test results are in RED; a positive test is a wheal size 3 mm larger than the negative saline control. NP: Test not performed.

	4 months old		5 months old		7 months old	
	PST	ID	PST	ID	PST	ID
Histamine	3/30	NP	3/25	NP	5/25	NP
Saline	0/0	0/0	0/0	2/2	0/0	0/0
Cefazolin 33 mg/ml	0/0				0/0	
Cefazolin 0.22 mg/ml		0/0				0/0
Chlorhexidine 5 mg/ml	0/5					
Chlorhexidine 2 mcg/ml		0/0				
Clindamycin 15 mg/ml	0/0				0/0	
Clindamycin .15 mg/ml		0/0				0/0
Fentanyl 50 mg/ml	0/0				0/0	
Fentanyl 50 mcg/ml						0/0
Fentanyl 5 mcg/ml		4/20				0/0
Rocuronium 10 mg/ml	0/0				0/0	2/25
Rocuronium 100 mcg/ml		0/0				0/0
Vancomycin 0.005 mg/ml	0/0	0/0				
Betadine full strength	0/00	NP				
Cistatracurium 2 mg/ml			0/0		0/0	7/35
Cistatracurium 20 mcg/m1				3/15		0/0
Hydromorphone 10 mcg/ml			0/0			
Hydromorphone 100 mcg/m1				10/30		
Morphine 1 mg/ml			2/13			
Morphine 10 mcg/ml				10/30		
Propofol 10 mg/ml			0/0			
Propofol 1 mg/m1				0/5		
Remifentanil 0.0 5 mg/ml			1/8		0/0	
Remifentanil 0.005 mg/ml				6/18		0/0
Vecuronium 4 mg/ml			1/4			
Vecuronium 0.4 mg/ml				8/15		
Ketamine 10 mg/ml					0/0	
Ketamine 1 mg/ml						8/30

reproducible reactivity to synthetic and non-synthetic opioids and positivity to neuromuscular blocking agents. A third test at 7 months of age including ketamine was performed with inconsistent results (Table 1). However, cefazolin was again negative. Recommendation was to avoid opioids and neuromuscular blocking agents for the scheduled open cranial vault remodeling procedure.

Second surgery

The patient returned for an open cranial vault remodeling at 9-months of age (10 kg) for which the anesthetic plan was to avoid opioid and paralytics. Preoperatively, he received nebulized albuterol along with intravenous diphenhydramine 1.25 mg/kg, ranitidine 1 mg/kg and solumedrol 1 mg/kg. Intravenous induction of anesthesia and endotracheal intubation was achieved using lidocaine 2 mg/kg, propofol 2 mg/kg, ketamine 2 mg/kg and dexmedetomidine 0.5 mcg/kg. Anesthesia was maintained with infusions of ketamine 15 mcg/kg/min, propofol 75 mcg/kg/min, and dexmedetomidine 1 mcg/kg/

min in addition to 0.5 minimum alveolar concentration of inhaled sevoflurane. Following the open sagittal synostectomy and cranial vault remodeling he was extubated awake and taken to the recovery unit. FLACC scores were 0-2 over the first 24 hr post operatively. Following an uneventful hospital course, he was discharged on post-operative day 2 with acetaminophen and ibuprofen as needed.

Discussion

The recognition and management of anaphylaxis associated with general anesthesia is well described [4-8]. The European registry estimates an infant anaphylaxis prevalence of 0.9%. The incidence of infant anaphylaxis associated with anesthetic agents remains unknown. However, opioids and NMBAs are known triggering agents [6,7,9]. PST cannot predict anaphylaxis, and drug challenge is the gold standard to determining sensitivity. While ID is more sensitive than PST, the induced wheal may be smaller in infants <6 months of age [9,10]. However, after 1 month of age, there is usually some reactivity to both reagents. NMBA skin testing has a sensitivity of >95% and specificity of 96% to 98%, therefore there is a small risk of false positives and negatives. Opioids are mast cell destabilizers, and as such there is high risk for false positives on skin testing. Our patient demonstrated negative PST to opioids on all three tests, but positive ID opioid reactivity at 4 and 5 months of age. Likewise, his first test was negative for NMBA reactivity with PST and ID reagents but positive for ID reactivity on tests at 5 and 7 months of age. Additionally, we were unable to determine if these reactions were truly IgE mediated and hence suggestive of anaphylaxis versus anaphylactoid. With the confounding factors of an upper respiratory infection at 4 months, and the inconclusive results on PST and ID reagents, we opted to avoid NMBAs and opioids. After multidisciplinary discussion, we chose to use ketamine despite the positive ID at 7 months given the need for some opiate alternative for intraoperative analgesia; and with the thought that antihistamine-steroid premedication might abate potential allergic response. The goal of non-syndromic sagittal craniosynostosis repair is to allow for correction of the scaphocephalic head shape. The endoscopic approach to repair has reproducibly demonstrated decreased morbidity and mortality when compared to open CVR [1,3]. Comparatively, open repair is typically associated with longer surgical operating times, longer hospital stay, increased blood loss, and higher rates of blood product transfusion [1]. Age, bone thickness, brain growth and trajectory along the growth curve can be factors under consideration for the optimum timing for surgery. While there is no consensus on the age cutoff for endoscopic strip craniectomy, many centers use 2 to 3 months as the ideal timeframe, with some up to 5 to 6 months of age [1,2]. At our institution, we consider 2 to 3 months as the ideal age with a cutoff of 4 months. Given the time required for complete allergy evaluation, our patient exceeded the age of endoscopic consideration. Recently published data from the pediatric craniofacial working group reflects that nearly all craniosynostosis surgeries are managed with an inhaled anesthetic-opioid technique [3]. Our institutional, protocol includes an anesthetic-opioid technique, with routine use of NMBAs. Borrowing from the opioid-free anesthetic technique we are using as part of an enhanced recovery pathway for major urologic procedures, we chose to incorporate a multimodal approach [11]. Utilizing a combination of ketamine, dexmedetomidine, propofol and acetaminophen we eliminated perioperative opioid consumption and saw a 50% reduction in length of hospital stay, when compared to national averages for open CVR [3]. An opioid free technique may provide a reasonable alternative in patients undergoing cranial vault remodeling, potentially as part of an enhanced recovery pathway. Studies are needed to explore the role of an opioid-free balanced anesthetic technique for pediatric craniofacial surgery [12-14].

Acknowledgement

The authors would like to thank Adam C. Adler, MD for his mentorship in reviewing this manuscript and Kathy Relyea for providing the artistic rendering.

Author Contributions

Conception and design: Karla Wyatt; Acquisition of data: all authors; Analysis and interpretation of data: all authors; Drafting the article: Karla Wyatt; Critically revising the article: all authors; Reviewed submitted version of manuscript: all authors.

References

1. Isaac KV, Meara JG, Proctor MR. Analysis of clinical outcomes for treatment of sagittal craniosynostosis: a comparison of endoscopic suturectomy and cranial vault remodeling. J Neurosurg Pediatr. 2018;22(5):467-74.
2. Han RH, Nguyen DC, Bruck BS, Skolnick GB, Yarbrough CK, Naidoo SD, et al. Characterization of complications Associated with Open and Endoscopic craniosynostosis surgery at a single institution. J Neurosurg Pediatr. 2016;17(3):361-70.
3. Sticker PA, Goobie SM, Cladis FP, Haberkern CM, Meier PM, Reddy SK, et al. Perioperative outcomes and management in pediatric complex cranial vault reconstruction. A Multicenter study from the pediatric craniofacial collaborative group. Anesthesiology. 2017:126(2):276-87.
4. Dewachter P, Mouton-Faivre C. [Allergic risk during paediatric anaesthesia]. Ann Fr Anesth Reanim. 2010;29(3):215-26.
5. Gurrieri C, Weingarten TN, Martin DP, Babovic N, Narr BJ, Sprung J, et al. Allergic reactions during anesthesia at a large United States referral center. Anesth Analg. 2011;113(5):1201-12.
6. Kannan JA, Bernstein JA. Perioperative anaphylaxis diagnosis, evaluation and management. Immunol Allergy Clin North Am. 2015;35(2):321-34.
7. Lieberman P, Nicklas RA, Randolph C, Oppenheimer J, Bernstein D, Bernstein J, et al. Anaphylaxis--a practice parameter update 2015. Ann Allergy Asthma Immunol. 2015;115(5):341-84.
8. Mertes PM, Laxenaire MC, Lienhart A, Aberer W, Ring J, Pichler WJ, et al. Reducing the risk of anaphylaxis during anesthesia: guidelines for clinical practice. J Investig Allergol Clin Immunol. 2005;15(2):91-101.
9. Ménardo JL, Bousquet J, Rodière M, Astruc J, Michel FB. Skin test reactivity in infancy. J Allergy Clin Immunol. 1985;75(6):646-51.
10. Grabenhenrich LB, Dölle S, Moneret-Vautrin A, Köhli A, Lange L, Spindler T, et al. Anaphylaxis in children and adolescents: The European Anaphylaxis Registry. J Allergy Clin Immunol. 2016;137(4):1128-37.
11. Boysen PG 2nd, Pappas MM, Evans B. An Evidence-Based Opioid-Free Anesthetic Technique to Manage Perioperative and Periprocedural Pain. Ochsner J. 2018;18(2):121-5.
12. Ebo DG, Fischer MM, Hagendorens MM, Bridts CH, Stevens WJ. Anaphylaxis during anesthesia: diagnostic approach. Allergy. 2007;62(5):471-87.
13. Miller J, Clough SB, Pollard RC, Misbah SA. Outcome of repeat anesthesia after investigation for perioperative anaphylaxis. Br J Anaesth. 2018;120(6):1195-201.
14. Woolf CJ, Chong MS. Preemptive analgesia—treating postoperative pain by preventing the establishment of central sensitization. Anesth Analg. 1993;77(2):362-79.