Case Report

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Persistent ventricular bigeminy during anesthesia in pediatric patients: a case report of an 11-year-old child

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Abstract: An 11-year-old male child with fractures in both bones in his left forearm presented for open reduction and internal fixation. The pre-anesthetic check-up and investigations did not reveal any pre-existing underlying cardio-respiratory disease. The patient had an uneventful peri-operative period during the operation and was comfortable without any anxiety or restlessness. After an uneventful induction and intubation as per routine protocol, the patient received 600 mg of amoxicillin + clavunate intravenously as an antibiotic. After 3 min, the patient developed persistent ventricular bigeminy with intermittent sinus rhythm, which returned to normal after 20 min. Open reduction and internal fixation of the fractures in both bones were done. Extubation and the post-op course were uneventful. To rule out the cause of arrhythmia, ECG, 2D-ECHO and serum electrolyte evaluation were done, however the results came back as normal. Many days later, the patient fell again on the same arm and revisited the ortho operation theatre for revision surgery. As the child was very cooperative and calm, he was given a supraclavicular block after proper counseling. Thirty minutes before tourniquet inflation as a routine method, 600 mg of amoxicillin + clavunate was administered. After 5 min, the patient developed persistent ventricular bigeminy. After 1 h, the child complained of chest pain and had redness of eyes and was restless. This was managed with 100% oxygen and an injection of 150 mg amiodarone intravenously. Surgery was postponed for further stabilization and optimization. Serum electrolytes were normal. The child was observed in the surgical intensive care unit with continuous ECG monitoring. Ventricular bigeminy with intermittent sinus rhythm persisted for 3 days. This was managed with metoprolol 12.5 mg BD and amiodarone 100 mg OD tablets. The opinion of a pediatric cardiologist was obtained and repeated 2D-ECHO results revealed no abnormality. After 5 days, the patient was discharged and surgery was rescheduled for 2 weeks later with continuation of metoprolol and amiodarone tablets. On the fourth occasion we avoided the injection of amoxicillin + clavunate and all anesthetic drugs, which might contribute to cardiac arrhythmia. The peri-operative period was uneventful. An in-depth discussion of the case and ventricular dysrhythmias in the pediatric population is emphasized in this case report.

Keywords: management of pediatric arrhythmias; pediatric cardiac arrhythmias; ventricular bigeminy.

Introduction

The overall incidence of arrhythmias is 13.9% out of 100,000 emergency room visits and 55.1% in 100,000 pediatric emergency room visits (children under 18 years of age) [1]. The present case report focuses on ventricular dysrhythmias, especially premature ventricular complexes (PVCs) in the pediatric population. PVCs are the premature depolarization of ventricles leading to early, less coordinated and systolic contraction of ventricles and routinely have a compensatory pause that follows them. PVCs commonly occur in infancy, decline in incidence in early childhood and become increasingly common again in adolescence and adulthood [2, 3].

In the pediatric population, the most common cause of ventricular dysrhythmias during general anesthesia is a light plain of anesthesia, hypotension, hypoxia, hypercarbia, electrolyte disturbances, apprehension and anxiety. However, many patients are symptomless and comfortable with stable vitals with underlying ventricular bigeminy with intermittent sinus rhythm [2, 3]. An injection of
amoxicillin + clavunate is the common antibiotic of choice for surgical procedures, and the incidence of ectopic rhythm reported in children aged 10–19 years is 1.67% \[4–6\]. The main aim of this case report is to present a systematic approach and the precautions to be taken for the successful management of such a case. This case report also emphasizes the documentation and counseling of patients, which are required to avoid future occurrences.

**Case presentation**

An 11-year-old male child weighing 35 kg and with fractures in both bones in his left forearm presented for open reduction and internal fixation. A pre-anesthetic check up was done. Two days before, he had fallen while playing, for which he underwent an emergency closed reduction under general anesthesia. The peri-operative period was uneventful, and there was no history pertaining to any underlying major disease. His routine investigations were under normal limits (Hb: 12.3 g%, TLC/DLC: WNL, blood sugar: 95 mg%, serum creatinine: 0.6 mg%, Na+: 139 mEq/lit, K+: 4.5 mEq/lit, liver function test: WNL, chest X-ray: WNL) blood group; B negative. On the table, his pulse rate was regular at −80/min and his blood pressure was 110/70 mmHg. His ECG showed normal sinus rhythm and oxygen saturation was 98%. An intravenous line was established, and the child was premedicated with 0.75 mg of midazolam, 50 μg of fentanyl, and 20 μg of glycopyrolate. After pre-oxygenation for 3 min, induction was done with intravenous 70 mg propofol and 70 mg suxamethonium.

The patient was then intubated with a cuffed ET tube no. 6.0 and anesthesia was maintained on oxygen plus nitrous oxide plus sevoflurane. Atracurium was used as a muscle relaxant. An injection of 600 mg amoxicillin + clavunate was used as antibiotic prophylaxis and after 3 min, the monitor showed persistent ventricular bigeminy with intermittent normal sinus rhythm; the rest of the parameters were normal. The depth of anesthesia increased and the sample was sent for serum electrolytes, which were later found to be within normal limits. Ventricular bigeminy continued for 30 min and then regained normal sinus rhythm. Internal fixation of both fractures was done. The child was extubated and kept under observation for ECG monitoring for 24 h; the results later proved to be uneventful and the child was discharged. For total evaluation of cardiovascular system, post-op ECG (Figure 1) and two-dimensional (2D)-ECHO were done but they did not reveal any significant changes.

A month later the child fell again on the same side and had the same fracture; the patient presented for revision surgery. The pre-anesthetic check up and investigation were within acceptable limits. The child was very comfortable and had no anxiety or restlessness. The anesthesia plan was to perform surgery under a brachial plexus block using the suraclavicular approach. Prior to the surgery, the procedure was explained to the patient and his mother. After establishing an intravenous line, monitors were attached to the child. ECG and all vital parameters were within normal limits. Under all aseptic precautions, the supraclavicular block was given with a peripheral nerve stimulator via a 35-mm stimulating needle by injecting 10 mL 0.375% of bupivacaine and 10 mL of 1.5% lignocaine with adrenaline. After achieving anesthesia within 20 min, a tourniquet was applied. An injection of 600 mg amoxicillin + clavunate was used as an antibiotic prophylaxis. Within 3 min after antibiotic injection, the child again developed persistent ventricular bigeminy with intermittent sinus rhythm (Figure 2).

The surgical procedure was abandoned, and the child’s condition was managed by an injection of 60 mg hydrocortisone, Avil, and Xylocard were administered intravenously. Oxygen was supplemented on a ventimask. Other vitals were normal. However, the ventricular bigeminy persisted. After 1 h, the child complained of chest pain, had redness in both eyes and became restless. Next, 100% oxygen was supplemented using a mask and 150 mg of amiodarone was injected slowly over a period of 10 min. Continuous bigeminy converted to normal sinus rhythm with intermittent ventricular ectopics. Serum electrolytes were within normal limits. The child was comfortable and shifted to the surgical intensive care unit for continuous ECG monitoring. Metaprolol 12.5 mg tablets were given.

![Figure 1: Post-operative ECG WNL.](image-url)
twice a day. The child had frequent changing patterns of ectopic rhythm and bigeminy for 2 days (Figures 3 and 4). Again, 100 mg amiodarone tablets were given once a day. The bigeminy pattern persisted for 5 days with stable hemodynamics. The child was comfortable for all of this time. Later, the child was referred to a pediatric cardiologist for complete cardiac evaluation. Repeat 2D-ECHO was done and the results came back normal (Figures 5 and 6). The cardiologist continued the administration of metoprolol and amiodarone tablets for 2 weeks. The ECG showed normal sinus rhythm (Figure 7). An electrophysiological study was advised but was not possible due to institutional and financial limitations. After optimization, the
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The patient was taken in for revision surgery. As the patient was not ready for regional anesthesia, general anesthesia was planned. At that time, we deliberately avoided giving amoxicillin + clavunate injections to avoid amoxicillin-induced ventricular bigeminy, and instead, cefotaxim was used as an antibiotic. The child was premedicated with the intravenous injection of 0.1 mg glycopyrrolate plus 0.75 mg midazolam and 50 μg fentanyl. Induction was done with intravenous injection of 70 mg propofol and 30 mg rocuronium. The child was intubated and anesthesia was maintained on oxygen and isoflurane. An injection of vecuronium with intermittent fentanyl was administered. Intraoperative vitals were absolutely normal with normal ECG sinus rhythm. Internal fixation of both fractures was done. The extubation and post-operative period were uneventful. The patient was discharged after 2 days with instructions to the mother not to give amoxicillin + clavunate in any form in the future. The patient was advised to undergo electrophysiological study to avoid future episodes.

Discussion

PVCs are not uncommon in a healthy pediatric population. PVCs are even more common in the arena of anesthesia because of the multiple agents used in anesthesia practice, which may have direct (sympathomimetic, volatile anesthetics) or indirect effects (light plane of anesthesia, pain, ketamine) on the heart’s conduction system. It is imperative that anesthesiologists understand the context of when PVCs during anesthesia can become life threatening and this requires further investigation and referral. Most children who have PVCs or can be associated with underlying heart disease have MVP, prolonged QT syndrome, cardiomyopathies (dilated and hypertrophic), electrolyte imbalance, drug toxicities and hypoxia (1).

The patient’s history is a crucial factor in ascertaining which cardiac arrhythmias are significant or benign. Important elements include history of palpitation, syncope and chest pain, and family history. A referral to a pediatric cardiologist is essential when the patient is asymptomatic, the diagnosis is new, or when the ECG demonstrates a significant abnormality [2–4].

A Holter monitor provides a continuous rhythm recording from an adhesive electrode for a minimum of 24–48 h. This monitor provides information regarding minimum/average/maximum heart rate, longest pause, the number of pre-atrial contractions and PVCs and the number of SVTs and ventricular tachycardia. This is a useful monitor for children who are symptomatic with an irregular heart rate or a symptomatic child to isolate arrhythmias during the onset of symptoms [2, 4]. Meanwhile, exercise testing is a noninvasive way to observe the effect of enhanced sympathetic drive in children with an ECG or Holter monitor abnormality [2].

ECG is mandatory and 2D-ECHO should be done when there is a suspicion of cardiac structural disease. An electrophysiological study may be required to provide a more definitive etiology and diagnosis if a previous study failed to diagnose the condition properly. Furthermore, some arrhythmias (certain SVTs and VTs) can be mapped and ablated during this invasive study. PVCs can also appear regularly as part of organized rhythm called “ventricular parasystole”. If not treated in a timely manner, the chances of developing sustained dangerous (VT with pulse) or deadly (VT or ventricular fibrillation without pulse) rhythms are higher [5].

Anesthesia on its own contributes to PVCs due to hypoxia, tachycardia, hypertension and hypercarbia leading to the imbalance between myocardial oxygen supply and demand, which in turn, leads to ectopic ventricular rhythm in the pediatric population. Anesthesia management of PVCs is noted above to establish the causes and treat the most likely diagnosis once a life-threatening condition is addressed. β blockers are the most successful drugs for suppressing intermittent ventricular ectopic, especially with tachycardia. Thus, they should be the first line of treatment, while lidocaine and amiodarone should be reserved for cases where PVCs progress to run VT or persistent ventricular tachycardia. The early defibrillation or cardioversion indicated depends on the pulse [3].

Whenever persistent ventricular ectopic rhythm is observed intra-operatively, anesthesiologists should monitor the patient during the recovery phase. They should also consider urgent or early evaluation if dysrhythmias persist, once anesthesia medication has been
eliminated to a reasonable degree. In addition, surgery should be cancelled and cardiac consultation and cardiac stabilization should be done before rescheduling the patient for any surgical procedure.

A survey by the U.S. Federal Drug Administration (FDA) reported several articles about antibiotic induced arrhythmias. These antibiotics cause changes in the electrical activity of the heart and can also lead to electrolyte disturbances leading to arrhythmias, which may be fatal if left untreated. Increased incidences were reported with underlying cardiac abnormalities. From January 2004 to October 2012, a survey was carried out on amoxicillin-induced side effects and arrhythmias. The authors concluded a 0.8722% incidence of arrhythmias due to amoxicillin [6–8]. In the study carried out by Criticare Med in 2010 on amoxicillin+clavunate, even though this is a popular antibiotic, the incidence of induced heart palpitation, the incidence of palpitation and irregular cardiac rhythm of patients aged 10–19 years was 4.35%. The treato update and Ehealth Me also stated that amoxicillin causes irregular heartbeats.

Recently, the FDA carried out a large study involving 32,879 people. Among the sample, 480 people (1.46%) had an irregular heartbeat, and the incidences of arrhythmia were 98.33% for infants <1 month, 0.26% for children 1–9 years, and 2.04% for children 10–19 years [9–11].

In our case, the patient did not receive any antibiotic for the closed reduction during first exposure to anesthesia and the peri-operative period was uneventful. During the second exposure to general anesthesia, the child developed persistent ventricular bigeminy after receiving an injection of amoxicillin+clavunate, although he regained sinus rhythm within 2 h. Thus, we thought it might be due to the light pain of anesthesia or an underlying silent cardiac abnormality, which we might have missed during the pre-anesthetic check-up. Hence, to rule out the underlying cause, 2D-ECHO and 24-h ECG monitoring were done, although the results did not reveal any abnormality. During the third exposure, the child was very cooperative and comfortable when he was given a supraclavicular block. However, he again developed ventricular bigeminy, chest pain and redness of eyes after the injection of amoxicillin+clavunate, but the severity was more intense so it was treated with β blockers and amiodarone. It took 6–7 days for the patient to regain normal sinus rhythm.

The patient was referred to a pediatric cardiologist and a 2D-ECHO was done, the results of which were normal. We advised an electrophysiological study, but it was not possible due to institutional and financial limitations. We optimized the patient for 2 weeks and rescheduled the surgery. During the fourth exposure to anesthesia, we avoided the injection of amoxicillin+clavunate and all anesthetic drugs that may contribute to cardiac arrhythmia. The peri-operative period was uneventful. So we assumed that the ventricular ectopics may be due to the amoxicillin+clavunate, but confirmatory diagnosis has yet to be established as an electrophysiological study could not be performed.

The patient’s parents were instructed about sensitivity to amoxicillin+clavunate, and documentation was made to his discharge card. He was advised to undergo an electrophysiological study to avoid any future episodes.

Conclusions

Anesthesiologists are likely to encounter cardiac rhythm abnormalities during anesthesia. However, there are no clear guidelines or algorithms or protocols for the detection of cardiac arrhythmias in the pediatric population. The most common recommendation is the determination of the underlying cause to avoid a life-threatening event. A primary care physician, detailed history, 12 lead ECG mandatory and a referral to a pediatric cardiologist is necessary. Holter monitoring, exercise testing, 2D-ECHO and electrophysiological intervention are all available aids.

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