Case Report

Dobutamine Infusion for Complex Congenital Heart Disease with Pulmonary Hypertension in an Infant Posted for Open Pyloromyotomy

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Abstract

Infantile hypertrophic pyloric stenosis (IHPS) is one of the most common gastrointestinal medical emergencies that occur during the first 2 months of life. Anaesthetic considerations in management of IHPS includes, aspiration prophylaxis and correction of metabolic derangements. An associated complex congenital cardiac lesion along with pulmonary hypertension and airway difficulties poses a further great challenge for the anaesthesiologist. We report a case of perioperative anesthetic management of a 2 month infant posted for open pyloromyotomy having complex congenital heart disease with pulmonary hypertension and bilateral cleft lip, the use of dobutamine in this setting is highlighted.

Key words: Congenital heart disease, infantile hypertrophic pyloric stenosis, patent ductus arteriosus, pulmonary hypertension

Introduction

Anesthetic management of patients with congenital heart disease (CHD) undergoing noncardiac surgery is based on precision in planning, good foundation on physiological and pharmacological principles, individual experience, and confidence in handling the case, which contributes to the successful completion of the procedure.[1] Although physiologically well-compensated patients may undergo noncardiac surgery with minimal risk, certain patient groups have been identified as high-risk: Children aged less than 1 year, pulmonary hypertension (PH), emergency surgery, and multiple coexisting diseases require more considerations for management.[2] We report the anesthetic management of an infant with the unusual combination of infantile hypertrophic pyloric stenosis (IHPS), complex congenital cardiac problem, PH, and bilateral cleft lip in a noncardiac setup.

Case Report

A 2-month-old male baby presented with diagnosis of IHPS for open pyloromyotomy. Term infant weighing of 2.5 kg was admitted with a history of nonbilious projectile vomiting, poor feeding, and weight loss. On examination the baby had isolated bilateral cleft lip, and cardiovascular examination revealed a heart rate (HR) of 116 bpm and pansystolic murmur [Figures 1 and 2].

Investigations reported hemoglobin (Hb) and 9 gm%. Serum electrolytes were: Sodium 134, potassium 4.5, and chloride 100 mEq/L. Renal and liver function tests were within normal ranges, coagulation profile was normal, and ultrasound abdomen confirmed IHPS with 4-mm thickness. Two-dimensional (2D) echocardiogram showed a 5-mm ostium secundum atrial septal defect, small apical ventricular septal defect of 2 mm, dilated pulmonary artery with pressure of 62 mmHg, 4 mm patent ductus arteriosus (PDA), all four chambers of heart dilated, and the ejection fraction 60%. Arterial blood gas analysis revealed pH 7.37, partial pressure of carbon dioxide (pCO_2) 36.4 mmHg, partial pressure of oxygen (PO_2) 46.3 mmHg, oxygen saturation (sO_2) 81.5%, and bicarbonate (HCO_3^-) 20.9 mmHg. The baby was preoperatively treated with furosemide and angiotensin-converting enzyme

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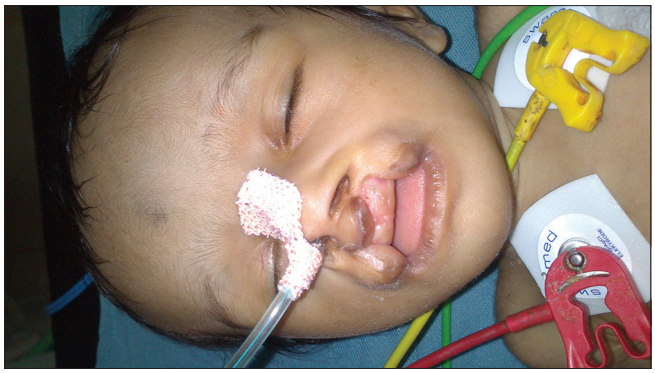

Figure 1: Infant with IHPS, CHD, and bilateral cleft lip

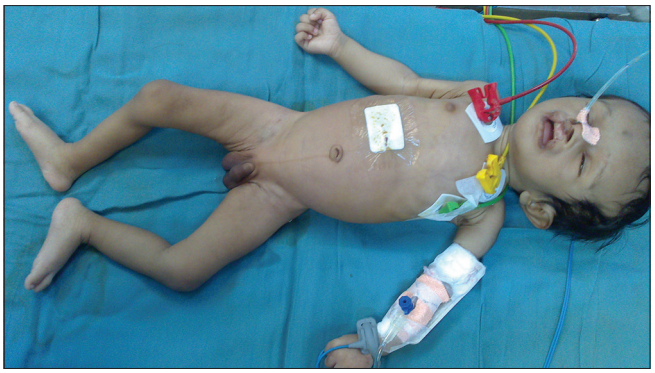

Figure 2: Infant with bilateral cleft lip

inhibitors (ACEI). Infective endocarditis prophylaxis was given prior to surgery. The baby was scheduled for surgery with American Society of Anesthesiologists (ASA) grade III risk. On the day of surgery, ACEI were withheld. The anesthetic considerations in our case were CHD, IHPS-associated electrolyte, acid-base changes and risk of aspiration, and difficult mask seal due to bilateral cleft lip.

In the operation theater, prior preparation for difficult airway was done. The baby had preoperative vitals of HR 108 bpm, blood pressure (BP) 54/38 mmHg, peripheral capillary oxygen saturation (SpO_2) 97% at room air. A 22-G intravenous cannula was already secured, and warm lactated Ringer's solution was started with care not to introduce air bubbles into the tubing. Intravenous (IV) induction was done with thiopentone 15 mg, fentanyl 4 μg, and atracurium besylate1.5 mg. Difficulty in mask seal was overcome by using gauze to seal off the cleft lip. The airway was secured with uncuffed 3.0-mm oroendotracheal tube, and the position was confirmed with end-tidal carbon dioxide ($ETCo_2$) and secured. Postinduction dobutamine infusion was started at 5 μg/h in view of dilated heart chambers to improve the cardiac contractility and ventricular function.[3,4] After starting the infusion, intraoperative vitals improved to HR 130 bpm and BP 70/48 mmHg. Anesthesia was maintained with O_2, air, isoflurane, and atracurium. The baby was stable throughout the procedure with minimal fluctuations of HR, BP, temperature, and $ETCo_2$. The rest of the surgical procedure was uneventful. At the end of the procedure, anesthesia was reversed with injection neostigmine 0.15 mg IV and inj. glycopyrrolate 0.02 mg IV; 3 mg of lignocaine 2% was given and extubated. The baby had good respiratory efforts after extubation; HR was 134 bpm; and SpO_2 suddenly dropped to 90% but recovered to 99% with mask ventilation. There was a slight difficulty due to inadequate mask seal because of cleft lip, which was overcome by using a rolled gauze seal. The baby was kept in the neonatal intensive care unit (NICU) under observation with dobutamine infusion for 24 h, which was tapered gradually and stopped. The baby was hemodynamically stable throughout.

Discussion

The population of patients with CHD requiring anesthesia care for noncardiac surgeries is growing as large as the non-CHD population, emphasizing the need for increasing care of these patients in a variety of settings. Management of such complex cardiac pediatric patients for coincidental surgeries in a noncardiac setup is especially challenging and requires knowledge of pathophysiology of the common CHD lesions, careful preoperative assessment and preparation, and communication with the patient's cardiologist and surgeon, which are all essential to provide optimal care in the best setting for such patients.[5] The challenges for the anesthesiologist depend on the patient's age, complexity of the heart lesion coupled with the patient's capacity to compensate, the urgency of surgery, and multiple coexisting diseases. IHPS being among the most common gastrointestinal medical emergencies during the first 2 months of life, it is associated with preoperative dehydration, electrolyte imbalance, and metabolic alkalosis. Obstruction of the pyloric outlet can lead to a significant buildup of gastric fluid in the stomach, predisposing infants to pulmonary aspiration and limited oxygen reserve, which consequently can lead to rapid oxygen desaturation and potential cardiac arrest during induction of general anesthesia prior to the establishment of a secured airway. Though minimal, a bilateral cleft lip can pose a difficulty in securing an adequate mask seal and slipping of the laryngoscope blade. Due to the complexity of cardiac problems in our patient we selected dobutamine as a background infusion to maintain hemodynamic stability.

Dobutamine is a β1-selective synthetic catecholamine, less effective in activating vasodilatory α2 receptors. Dobutamine consists of two isomers, administered as a racemic mixture. The (+) isomer is a potent β1 agonist and α1 receptor antagonist. The (-) isomer is a potent β1 agonist, capable of causing significant vasoconstriction when given alone. This action tends to reduce vasodilation and may also contribute to the positive inotropic action caused by the isomer with predominantly α-receptor activity. Dobutamine increases cyclic adenosine monophosphate (AMP) levels in both the heart and vascular smooth muscle, resulting in inotropic, chronotropic, systemic vasodilator, and pulmonary vasodilator effects. Though dobutamine by itself frequently produces no change or only small decreases in pulmonary artery pressure, it decreases pulmonary vascular resistance in experimental PH and has been extensively used in patients with PH after cardiopulmonary

bypass and for evaluation of pulmonary vascular reactivity before cardiac transplantation.[6,7] Dobutamine augments ventricular contractility and thus enhances cardiac output, especially stroke volume, in patients with depressed cardiac function by stimulating β1-adrenoceptors in the heart while producing relatively little increase in chronotropic activity or any significant elevation in systemic BP with decrease in PVR, as Acosta *et al*. stated.[7] Thus, in contrast to a nonselective β-adrenoceptor stimulant such as isoproterenol, which increases cardiac output primarily by increasing HR, dobutamine's actions increase cardiac output without being accompanied by either a marked increase in HR or a significant increase in systemic vascular resistance. Additionally, in contrast to dopamine, it does not produce a significant proportion of its cardiac effects through the release of norepinephrine from adrenergic nerves. Dobutamine exerts a greater effect on the contractile force of the heart relative to its effect on the HR and less increase in the oxygen demands on the heart than dopamine. We observed satisfactory hemodynamic stability after starting the dobutamine infusion intraoperatively, along with other measures such as avoiding hypoxia and hypercarbia, nitrous oxide, adequate fluid therapy, adequate analgesia, and preventing air embolism.

Conclusion

Dobutamine as the ionotropic agent of choice in a complex cardiac scenario was useful in the anesthetic management of our patient and should be considered in such situations. An adequate preoperative preparation of IHPS infants, prior planning for anticipated challenges in a difficult airway, and prompt and early initiation of preventive measures for a complex CHD can lead to a better perioperative outcome in this group of patients.

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Conflicts of interest

There are no conflicts of interest.

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