

Immediate cardiac arrest after neostigmine administration

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Abstract

Many drugs used in anaesthesia have some potential fatal consequences; for example complete heart block and Q-Tc interval prolongation. Since the parasympathetic system in children is not fully developed, electrical transmission of the heart is not stable. Neostigmine is used in order to reverse neuromuscular block but it may also lead to prolongation of Q-Tc interval. We present a case of an 18-month-old male patient weighing 12kg subjected to a surgical operation because of congenital glaucoma. In order to reverse neuromuscular block at the end of operation, atropine and neostigmine were injected intravenously. However, cardiac arrest developed immediately after administration.

Keywords: Neostigmine, Anaesthesia, Child, Cardiac arrest.

Introduction

Neostigmine is a parasympatomimetic agent, and often preferred to reverse neuromuscular block. Neostigmine

may interfere with atrioventricular conduction even without high doses. The interruption of conduction may lead to bradycardia, life-threatening dysrhythmia, and cardiac arrest. Paediatric and geriatric patients are usually considered more prone to these actions. During recovery from anaesthesia, neostigmine is used together with an anti-cholinergic agent like atropine in advance (or simultaneously) in order to minimise possible side effects.¹

Although cardiac complications related to neostigmine administration have been reported earlier in literature,^{2,3} in our patient it was observed at usual doses and at the end of the operation, being different from others. Also, most of the cases reported in literature were related to patients undergoing cardiac transplantation.

The case of a 18-month-old male child weighing 12kg who suffered immediate cardiac arrest after neostigmine and atropine administration at the end of congenital glaucoma operation, is presented.

Case Report

After diagnosis of congenital glaucoma, trabeculectomy operation was planned for the 18-month-old, 12kg male child. Pre-operative complete blood count revealed WBC 9.72 K/UL, haemoglobin 10.8 g/dL, haematocrit 32.3%, platelet 417 K/UL. Blood biochemistry revealed glucose 95 mg/dL, albumin 3.7 g/dL, BUN 20 mg/dL, creatinine 0.41 mg/dL, sodium 136 mmol/L, potassium 4.4 mmol/dL, chloride 107 mmol/L, calcium 10.1 mg/dL, AST 38 U/L, ALT 16U/L. There were no abnormal lab results. History and physical examination were also normal without known cardiac anomaly. Thirty minutes before operation, 0.05 mg/kg oral midazolam was administered for sedation. In the operating room, standard monitorisation was performed with three lead electrocardiography (ECG), SpO₂ and non-invasive blood pressure. ECG was completely normal without any arrhythmia. Heart rate was 115 beats/minute, SpO₂ was 98%, and NIBP (Non Invasive Blood Pressure) was 85/42 mmHg. After two minutes of preoxygenation, anaesthetic induction was given with 30 mg propofol, 15 mg lidocaine, and 20 mcg fentanyl. In order to facilitate endotracheal intubation, 7.5 mg rocuronium bromide (IV bolus) was given. Intubation tube 4.5 number was inserted. Anaesthesia was maintained with 2% sevoflurane in 50-50% O₂-air gas mixture. During the operation, heart rate was between 103-125 beats/min, NIBP was between 75/37-92/45 mmHg, SpO₂ was between 97-99%, and etCO₂ was between 32-41 mmHg. No pathological changes were recorded. Surgical operation continued for 45 minutes. At the end of the operation, sevoflurane was terminated and the patient was ventilated with 100% O₂. After recovery of spontaneous ventilation, 0.015 mg/kg atropine IV was given to reverse

residual neuromuscular block. As heart rate increased, 0.04 mg/kg neostigmine IV was administered. At this stage, ECG heart rate was 122 beats/min, NIBP was 98/43 mmHg, SpO₂ was 97%, and etCO₂ was 40 mmHg. Without any other cardiac arrhythmias, immediate bradycardia and consequently asystolic arrest was observed. Chest compression was started and according to new resuscitation guidelines, 100 mcg adrenaline (IV) was given every 3 minutes. At the 15th minute of cardiopulmonary resuscitation, sinus rhythm (Figure) was recovered. Heart rate was 135 beats/min, blood pressure was 105/52 mmHg, SpO₂ was 98%, etCO₂ was 32 mmHg. Patient regained a haemodynamic stable status again. Spontaneous ventilation was sufficient, spontaneous eye opening was observed and he was moving the extremities freely. The patient was extubated. During the observation period, 20% mannitol was infused in 30 ml saline. The patient cried after extubation. Glasgow coma scale was 15, heart rate was 102 beats/min, NIBP was 95/48 mmHg, and SpO₂ was 98%. The patient was taken to the recovery room and was kept there for 2 hours. Then he was transferred to ophthalmology wards.

Discussion

Many drugs in anaesthetic practice (inhalational agents, anti-emetics, 5-OH-tryptamine antagonists) may lead to prolongation of Q-Tc interval and life-threatening arrhythmia.^{4,5} Morbid obesity, genetic predisposition and female gender are risky factors. Neuromuscular block can be reversed by glycopyrolate or neostigmine but these agents also prolong Q-Tc interval.⁴

Neuromuscular blockage is reversed by neostigmine 40-45 µg/kg and atropine 15-20 µg/kg doses. There is literature available suggesting that neostigmine and atropine

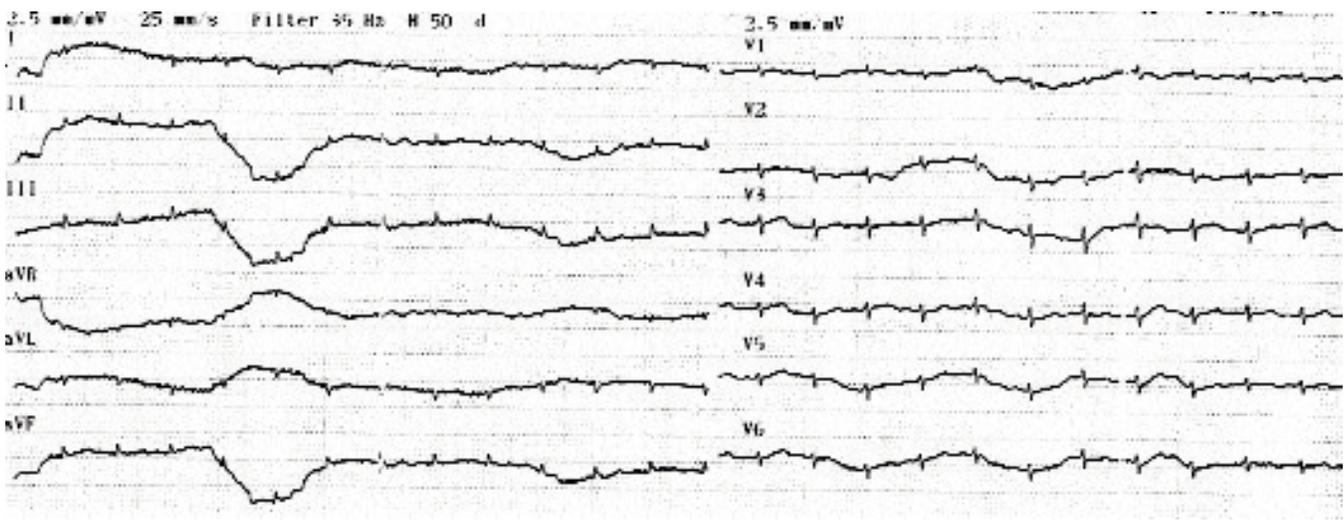


Figure: ECG recorded after cardiopulmonary resuscitation.

administration may be associated with arrhythmias and cardiac arrest. If neostigmine and atropine are administered simultaneously, cardiac baroreceptor sensitivity is disrupted at least for 2 hours. As such, cardiac arrhythmia probability increases.^{4,6} No arrhythmia was observed in the patient but bradycardia and asystole was noticed. Atropine provides maximum vagal inhibition at 20 µg/kg dose, and this is the recommended dose together with neostigmine. If atropine and neostigmine are injected together, atropine has biphasic effect which results first in bradycardia followed by tachycardia. If they are given as a combination, atropine may lead to unexpected and abrupt bradycardia at small dose, and may lead to arrhythmia at larger dose. Thus, neostigmine must be given after increased heart rate is observed with atropine. Accordingly, patient received atropine and his heart rate increased. Thereafter, neostigmine was given. In patients with first-degree heart block, neostigmine may cause further blocks. Therefore, neostigmine must be very cautiously administered in patients with atrioventricular-conduction-defects.⁴ However, our patient had no history of cardiac pathology or systemic disease. Also, no drug use was reported. Hypoxia and hypercarbia may also increase the incidence of cardiac dysrhythmia in patients receiving neostigmine and atropine as a mixture (in the same injector). No hypoxia was reported in our patient. Besides, the patient was otherwise a healthy child. He had no known cardiovascular disease. Therefore, dysrhythmia was totally unexpected. No hypoxic moment or situation was observed either.

Neostigmine prolongs Q-Tc interval with sevoflurane and other volatile agents. This effect may be more increased with desflurane.⁷ In a study with fentanyl, Q-Tc interval is also prolonged.⁸ We used 20 µg fentanyl with sevoflurane which causes less dysrhythmia than desflurane.

Sawasdiwipachai et al. have reported cardiac arrest in a 13-month-old girl during heart transplantation after administration of glycopyrolate together with neostigmine.⁹ Similar case reports have concluded that cardiac arrest might have occurred because of immaturity of parasympathetic system reinnervation in children.^{2,10}

Infants have dominance of sympathetic system in their conduction pathways. However, vagal innervations

provide electrical stability of ventricle. Vagal system is not fully mature in infants which makes ventricular electrical system less stable.¹¹ Therefore, infant heart rate is more than that of any other age. In accordance with increased age, parasympathetic system gradually takes dominance from the sympathetic system. Parasympathetic system protects heart from dysrhythmia. Anti-cholinergic drugs block parasympathetic dominance, which may lead to increased susceptibility to cardiovascular complications.⁶ This feature might be the cause of cardiac arrest in our patient's case; neostigmine plus atropine might have caused arrest in an 18-month-old otherwise healthy child.

Conclusion

Neostigmine must be cautiously administered in order to reverse neuromuscular blockage; especially in children whose parasympathetic system is not fully developed. Furthermore, especially in paediatric cases, atropine must be administered first to increase the heart rate, after which neostigmine can be administered more safely.

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