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Case report

Methemoglobinemia due to local anesthesia: a rare cause of cyanosis and chest pain after placement of implantable cardioverter defibrillator

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Abstract

Although methemoglobinemia is rare in adulthood, it may have fatal consequences if unnoticed. We planned to implant an implantable cardioverter defibrillator ICD in a 50-year-old male patient for primary prevention. Following sterile draping, prilocaine 5 mg/kg (400 mg) was injected subcutaneously for local anesthesia. We injected an additional dose of 200 mg due to pain during subclavian vein puncture. A DDD-R ICD was placed successfully within approximately 40 minutes. The patient complained of sudden chest pain and dyspnea 15 minutes after bed rest and was transferred to the coronary care unit due to cyanosis and deterioration of general status. Physical examination revealed blood pressure of 110/80 mmHg, pulse rate of 110 bpm, and otherwise unremarkable signs. Peripheral oxygen saturation was determined as 83% by pulse oximeter. Possible pneumothorax and cardiac perforation were excluded by emergency chest radiograph and echocardiography. Blood gas analyses was performed to assess for methemoglobinemia, which revealed pH 7.41, pCO_2 40 mmHg, oxygen saturation 98.2%, and methemoglobin 7.9% that peaked to 12.3%. Methylene blue (1%) was slowly injected over 10 minutes at a dose of 1 mg/kg. Cyanosis waned and methemoglobin values decreased to 4.1%, 2.1%, and 1.1% at 2, 8, and 16 hours following the administration, respectively. The patient was safely discharged 2 days after implantation of pacemaker. Methemoglobinemia should be considered in cases presenting with cyanosis, non-diagnostic ECG, and a discrepancy in oxygen saturation between pulse oximetry and blood gas analyses.

Key words: prilocaine, methemoglobinemia, ICD, pacemaker

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Introduction

Local anesthetic agents are used for various cardiovascular procedures, including coronary angiography, transesophageal echocardiography, and permanent pacemaker implantation. Although methemoglobinemia following administration of a local anesthetic agent is rare, toxicity can be dangerous and potentially fatal[1]. Therefore, practicing cardiologists should be aware of this rare but important complication of local anesthetics. To the best of our knowledge, there are only two studies in current medical literature reporting methemoglobinemia after administration of high dose (1,400 and 800 mg) of prilocaine during implantation of permanent pacemaker[2, 3].

We report the case of a patient who developed dyspnea, chest pain, and cyanosis soon after placement of an ICD and was diagnosed with methemoglobinemia due to prilocaine injection.

Case report

We planned to place an ICD in a 50-year-old male patient for primary prevention following the finding of low ejection fraction (25%) on echocardiography. The patient had a surgical history of primary percutaneous coronary intervention due to acute anterior myocardial infarction before two years, and was on optimal medical treatment. Following sterile draping, midazolam 2 mg (Dormicum; F. Hoffmann- La Roche AG, Basel, Switzerland) was administered intravenously, and prilocaine 5 mg/kg (400 mg, Priloc 2%, Vem İlaç Sanayive Ticaret Ltd. Şti, Tekirdağ) was injected subcutaneously for local anesthesia. We injected an additional dose of prilocaine

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200 mg due to pain during subclavian vein puncture A DDD-R ICD was placed successfully in approximately 40 minutes.

The patient complained of sudden chest pain and dyspnea 15 minutes after bed-rest, and was transferred to the coronary care unit due to cyanosis and deterioration of general status. Physical examination revealed blood pressure of 110/80 mmHg, pulse rate of 110 bpm, and otherwise unremarkable signs. Peripheral oxygen saturation was determined as 83% by pulse oximeter. Possible pneumothorax and cardiac perforation were excluded by emergency chest radiograph and echocardiography. Blood gas analyses was performed to assess for methemoglobinemia, which revealed pH 7.41, pCO_2 40 mmHg, oxygen saturation 98.2%, and methemoglobin 7.9% that peaked to 12.3%. Methylene blue (1%) was slowly injected over 10 minutes at a dose of 1 mg/kg. Cyanosis waned, and methemoglobin values decreased to 4.1%, 2.1%, and 1.1% at 2, 8, and 16 hours following the administration, respectively. The patient was discharged 2 days after implantation of pacemaker.

Discussion

Methemoglobinemia is more frequently encountered in newborns and infants following injection of local anesthetic agents for procedures such as circumcision, due to low methemoglobin reductase activity. Under normal conditions, iron is present in ferrous oxide (Fe2+) form in hemoglobin. Methemoglobinemia occurs due to oxidation of ferrous oxide (Fe2+) to ferric oxide (Fe3+), which results in decreased oxygen binding capacity of hemoglobin due leftward shift of the hemoglobin-oxygen dissociation curve. In healthy individuals, oxidative substances (drugs, nutrients, chemical substances, among others) produce methemoglobin; however, the concentration is maintained below 1% by the intra-erythrocyte methemoglobin reductive system (cytochrome b5 reductase enzyme system)[4]. Cyanosis develops when blood methemoglobin level exceeds 10–15%. Symptoms such as fatigue, tachycardia, respiratory distress, nausea, and vomiting develop when the level of methemoglobin increases to 35%, while lethargy, stupor, and syncope develop in cases over 55%. Methemoglobin concentration above 70% is usually fatal if left untreated[5]. Prilocaine is one of the local anesthetic agents associated with methemoglobinemia[6]. Prilocaine is metabolized to o-toluidine in liver, which oxidizes hemoglobin[7, 8]. The half-life of prilocaine is approximately 55 minutes, and methemoglobinemia occurs 20–60 minutes after administration of the agent[9].

Treatment of the methemoglobinemia includes removal of the offending agent, aggressive oxygen supplementation, and treatment with the first-line antidote, methylene blue. Methylene blue activates methemoglobin reductase, which reduces methylene blue to methylene leucoblue, and subsequently transforms methemoglobin to deoxyhemoglobin through a non-enzymatic mechanism. Exchange transfusion and hyperbaric oxygen are the second-line therapeutic options for patients with severe methemoglobinemia, who do not respond to methylene blue or in whom methylene blue is contraindicated (for example, patients with glucose-6-phosphate dehydrogenase deficiency). Intravenous ascorbic acid can also be used for treatment of methemoglobinemia.

In the event of cyanosis following cardiac interventions under local anesthesia with normal oxygen pressure on blood gas analyses and normal or low saturation by pulse oximeter, methemoglobinemia should be considered in addition to mechanical complications such as pneumothorax, hemothorax, cardiac or venous perforation. In patients with history of coronary artery disease and low ejection fraction combined with the symptom of chest pain, ischemic events should commonly be considered. However, in cases with cyanosis, non-diagnostic ECG, low peripheral oxygen saturation, and normal oxygen saturation on blood gas analyses, methemoglobinemia should be suspected.

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