CASE REPORT

Piezoelectric Electrocardiographic Artifact in a Patient after Surgery with Bradycardia and Hypotension

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A 64-year-old man was evaluated by a rapid response team for altered mental status shortly after an uncomplicated surgery. He was found to be hypotensive and bradycardic, and an emergent electrocardiogram showed extra "P" wave complexes, ultimately found to be piezoelectric artifacts from a fluid infusion pump. Equipment-related artifacts have been known to mimic arrhythmias prompting unnecessary therapeutic interventions including antiarrhythmics and direct current shocks. Timely recognition of the unusual properties of the complexes resulted in the avoidance of atropine, epinephrine, or transcutaneous pacing in a rapid response team scenario.

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equipment-related ECG artifact; piezoelectric; bradycardia

Equipment-related electrocardiographic artifacts have been known to mimic arrhythmias and could prompt unnecessary therapeutic interventions including antiarrhythmics and synchronized direct current shocks. Piezoelectric intravenous fluid pumps are uncommonly implicated and have not been shown to mimic a bradyarrhythmia in a patient with hypotension after surgery.

CASE PRESENTATION

A 64-year-old man was evaluated by a rapid response team for dizziness and diaphoresis on the general medicine floor shortly after transfer from the postanesthesia care unit. He had undergone an uncomplicated total hip replacement for degenerative disease a few hours prior, where estimated blood lost was reported at 100 mL. His medical history is significant for well-controlled hypertension on losartan and hydrochlorothiazide. On examination, the patient appeared lethargic with a blood pressure of 72/47 mmHg and had a regular heart rate of 49 beats per minute. An emergent 12-lead electrocardiogram (ECG) was obtained (Fig. 1).

Figure 1, the emergent ECG, shows a rate of 53 beats per minute. At first glance, the rhythm

appears to be sinus bradycardia with nonconducted premature atrial contractions (PACs) causing an increased refractory period. Could this be the cause of the patient's hypotension? However, the pacing of the of the sinoatrial (SA) node is regular and appears independent of, and not reset by a PAC, as would be expected. The ST-segment elevations in the anterior leads appear to have J-point morphologies suggestive of early repolarization. There are no T-wave inversions or reciprocal ST-segment depressions. The etiology of hypotension for this postoperative patient includes myocardial infarction, bradyarrhythmia, hypovolemia due to diuretic medications and poor oral intake, hemorrhage, and excessive vasodilatation due to perioperative analgesia. The highly unusual morphology of the extra "P" waves and its independence from the SA node are highly suspicious for artifact.

The ECG findings were highly suspicious for artifact. Electrodes and leads were checked. Ancillary equipment was switched off and on as safety allowed. The intravenous maintenance fluid infusion pump was turned off and a repeat ECG showed resolution of the artifact (Fig. 2).

The patient was given a liter of normal saline as a pressure bag bolus. His blood pressure

Figure 1. An emergent 12-lead electrocardiogram (ECG).

Figure 2. A 12-lead electrocardiogram (ECG) after discontinuation of the intravenous pump.

responded, improving from 72/47 to 122/72 mmHg. The patient's heart rate also steadily returned to normal, from 53 beats per minute to 69 beats per minute. The patient's complete blood count did

not reveal a new anemia. His electrolytes, blood urea nitrogen, and creatinine were unremarkable. Serial troponin I tests were negative. On closer history, the patient had received intravenous

hydromorphone in the post-anesthesia care unit before transfer, and had a history of increased sensitivity to opiate-class medications. The patient was placed on telemetry. The patient's diuretic medications were held and oral diet restarted. Opiate medications were minimized. He had no further events and was discharged home after a short hospitalization.

DISCUSSION

Equipment-related ECG artifacts have been reported in the past and have been known to mimic arrhythmias and pacemaker spikes, prompting not only physician alarm but also unnecessary therapeutic interventions including antiarrhythmics and synchronized direct current shocks.¹ Intravenous pumps have been shown to cause ECG artifacts including nonspecific waves and pseudo-QRS waves interpreted most commonly as ventricular premature contractions, and could have a frequency as high as 300 beats per minute which could be frightening to the clinician.² Largely, static and piezoelectric effects of crystalloid fluid running through the tubing with improper grounding of the equipment are implicated;²⁻⁵ however, leakage of current from the equipment has been found in some instances for intravenous pumps^{6,7} and for intravenous fluid warmers.^{8,9} In two cases, lidocaine was given erroneously for the pseudoarrhythmias.^{5,6} To the best of our knowledge, this is the first case of an intravenous pump artifact inadvertently mimicking PACs in a patient with hypotension and bradycardia. In our patient, the recognition of the unusual properties of the artifact resulted in prompt turning off of the infusion pump leading to resolution of the

artifact and the avoidance of antiarrhythmics or synchronized direct current shocks in a rapid response team scenario. This management is in line with a proposed ECG analysis algorithm when equipment-related artifacts are suspected.¹

CONCLUSIONS

Intravenous pumps and fluid warmers have been shown to cause ECG artifacts due to static and piezoelectric effects as well as leakage of current. When equipment-related artifacts are suspected, electrodes and leads should be checked, and the safe switching off and on of ancillary equipment should be considered.

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