Ultrasound-guided probe-generated artifacts stimulating ventricular tachycardia: A rare phenomenon

ABSTRACT
Electrocardiographic (ECG) artifacts may arise due to interference, faulty earthing, and current leakages in biomedical equipment which might create clinical dilemmas in the perioperative settings. Piezoelectric signals generated by ultrasonography probe are another uncommon source which might be sensed by the ECG electrodes and produce tracings similar to pathological arrhythmias triggering false alarms and avoidable therapies. Anesthesiologists should be familiar with these uncommon sources which might produce these artifacts and they should be identified swiftly.

Key words: Artifacts; electrocardiography; heart rate; tachycardia; ventricular

Introduction
Real-time electrocardiography (ECG) monitoring is an indispensable monitoring modality in patients undergoing diagnostic/therapeutic procedures inside the radiological suite under anesthesia. Interference in the monitored ECG has been reported from artifactual signals arising from physiological or external nonphysiological sources. Common physiological reasons include muscular activity and patient’s movement. Nonphysiological causes include insufficient electrode gels, electrode contamination with cleaning fluids, faulty earthing, current leakage, or noise from electronic apparatus. Radiological suite is an area where varieties of electronically controlled equipment operate simultaneously in proximity. Consequently, a potential of electronic interference of the ECG tracings exists which can mimic pathological arrhythmias. We encountered a similar event where interference was caused presumably piezoelectric signals arising from the probe of ultrasonography (USG) machine and desire to report it.

Case Report
An 8-year-old female child (American Society of Anesthesiologists-I) was posted for transjugular liver biopsy under general anesthesia. After attachment of standard monitors (ECG, pulse oximetry, and noninvasive blood pressure [NIBP]), general anesthesia was induced. Following sterile preparation, the right neck was approached for internal jugular venous access under ultrasound guidance. As soon as the probe (8 MHz, linear transducer) of the USG machine was placed over the patient's neck, ECG tracing started demonstrating ventricular tachycardia (VT) [Figure 1].

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Vital parameters, however, remained stable at that point (NIBP of 112/69 mmHg, heart rate 88/min, SpO₂ of 100%). Immediate manual palpation of the right radial pulse revealed a regular, rhythmic, and normovolemic pulse consistent with the pulse oximetry waveform. ECG leads’ placement was reevaluated and was found to be in order. Since VT persisted, radiologists were requested to cease all interventions. As the probe was removed from the skin, normal sinus rhythm restored immediately. After approximately a minute’s wait, wherein hemodynamic stability and proper functioning of monitoring equipment were ensured, and radiologists were requested to proceed. As the probe was again placed over the skin, a rhythm resembling VT instantly reappeared. As earlier, there was no hemodynamic compromise. Contact termination between probe and skin led to disappearance of the abnormal rhythm. To exclude equipment-related causes, a new probe was connected to the machine and scanning began. ECG abnormalities did not appear in this instance. The previous probe was then reattached to another machine, and as soon as scanning began, arrhythmias resurfaced. Thus, identification of the probe as the source of artifact generation source was substantiated. The radiologists were now requested to use the second probe during the rest of the procedure. Thereafter, the procedure ensued smoothly and had an uneventful completion in approximately 40 min.

Discussion

Uninterrupted ECG monitoring of patients under anesthesia is a basic standard of care, and the attending anesthesiologists should remain attentive of any distortion of the normal sinus rhythm. VT is an aberrant cardiac rhythm with ventricular rate >100 beats/min and with 3 or more irregular beats. Artifacts are noncardiac electrical activities on the ECG resulting from patient tremor, movement, current leakage, grounding failure, or interference by capacitance. Occurrence of artifacts simulating VT has also been described during use of different biomedical equipment and in diverse scenarios such as intraoperative high-field magnetic resonance imaging, pressure-controlled irrigation pump (during arthroscopy), high-frequency oscillatory ventilation, digital urine output monitor, core temperature monitor, and sinus microdebrider. Technical faults such as current leakage, grounding failure, break in insulated lines, or interference by capacitance have been implicated for the development of artifacts. A related case described ECG artifact on placement of transthoracic echocardiographic probe over the chest due to earthing defect.

ECG artifacts generated from static and piezoelectric effects from infusion pumps, blood warming sets, and dialysis pumps have been reported previously. The cyclic pinching and release of the polyvinyl chloride tubings were responsible for electricity generation which flowed into tubing through the fluids and was picked up by the ECG electrodes. USG probes work on similar principle where a piezoelectric element oscillates across an applied voltage which generates sound waves and electrical charge by deformation of polymeric crystals. In our case, in the absence of any other equipment-related defect, we believe that the piezoelectric signals generated by the probe were being sensed by the ECG monitor whenever it was being used in its vicinity. Subtle manufacturing variations might have existed in the piezoelectric element of that particular probe which caused artifact development and rhythm simulating VT.

ECG artifacts with adequate amplitude and duration can resemble VT triggering false alarms, misdiagnosis, and inappropriate interventions and therapies (medications such as lignocaine/nitroglycerine, chest compressions, cardiac catheterization, pacing, or intensive care unit admission for close monitoring). Thus, the financial and manpower burden on health care resources are increased. Certain indicators which can differentiate artifacts from VT include:
- Absence of hemodynamic deterioration during the event
- Sinus sign: The sinus rhythm and normal P, QRS, and T-wave are observed in a single limb lead (leads I, II, III) within the artifact
- Spike sign: A regular or irregular tiny spike is observed on the QRS complex
- Notch sign: Where a notch is observed on the QRS-like complex with sinus rhythm cycle
- An unstable baseline on the ECG before the event, after the event, or both
- An association with body movement.

Figure 1: Appearance of artifacts simulating ventricular tachycardia after contact with ultrasonography probe

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In our case, since spike sign, notch sign [Figure 1], hemodynamic stability, and persistent SpO\textsubscript{2} waveform were present, we reasonably suspected the artifactual genesis of the abnormal rhythm (VT) and avoided needless treatment.

To conclude, attending anesthesiologists should be cognizant that rarely, piezoelectric signals arising from the USG probe can be a potential source of ECG artifacts. Arrhythmias such as VT are potentially fatal events and their appearance on ECG monitor should prompt their expeditious termination through pharmacological or nonpharmacological means. However, prior to initiation of remedial measures in a mechanical manner, bizarre waveforms should be interpreted with caution and evidence such as the pulse oximeter and ECG waveforms, hemodynamic compromise, tactile evaluation of the peripheral pulses, and the overall clinical scenario at the time of the event should be taken into account.

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**Conflicts of interest**
There are no conflicts of interest.

**References**

1. Patel SI, Souter MJ. Equipment-related electrocardiographic artifacts: Causes, characteristics, consequences, and correction. Anesthesiology 2008;108:138-48.
2. Selvan RB, Rao PB, Ramachandran TR, Veliath DG. Earthing defect: A cause for unstable hemodynamics. Ann Card Anaesth 2012;15:47-9.
3. User Experience Network. ECG artifact in the OR. Health Devices 1991;20:140-1.
4. Huang CY, Shan DE, Lai CH, Fong MC, Huang PS, Huang HH, et al. An accurate electrocardiographic algorithm for differentiation of tremor-induced pseudo-ventricular tachycardia and true ventricular tachycardia. Int J Cardiol 2006;111:163-5.