Severe Burns from a Pulse Oximeter

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Pulse oximeters are widely used in hospitals and since January 1, 1990 have been recommended by the American Society of Anesthesiology as standard equipment in anesthesia practice.§ Reports of major complications from the use of these devices are rare.⁴ More than 20 manufacturers produce pulse oximeters and a recent article listed “a guide for determining which pulse oximeter will be best for one’s own, specific purposes.”⁵ Frequently, institutions use pulse oximeters from several different manufacturers based on the needs of individual departments, cost factors, or changing technology. Some companies use connectors on their sensors that easily insert into oximeters from other companies, but the wiring is incompatible and, as will be shown here, dangerous. The following report documents second- and third-degree burns that developed in a neonate when pulse oximeter sensors from one manufacturer (Physio-Control) were used inadvertently with a different manufacturer’s (Ohmeda) pulse oximeter.

CASE REPORT

A 4.4-kg full-term infant was born by vaginal delivery with the aid of vacuum extraction. A subgaleal occipital hematoma developed and the patient was transferred to the newborn nursery. All the nursery’s pulse oximeters (Physio-Control 1600) were in use and one (Ohmeda 3700) was borrowed from the Anesthesia Department. The nursery personnel connected the infant to the Ohmeda machine via the sensor that they used routinely with the Physio-Control 1600 machine. Initially, a wrap-around finger sensor was applied to the right ring finger, but no saturation (SpO₂) reading was obtained. The problem was assumed to be a faulty sensor. This sensor was removed after approximately 1 min and noted to be “a little warm.” A second type of Physio-Control sensor (clip-on type) was then applied to the superior aspect of the right ear pinna. After approximately 3 min without obtaining any SpO₂ or pulse rate readings, the tip of the ear was noted to be acquiring a red color, the sensor was removed, and further attempts to monitor SpO₂ were abandoned. Over the next several hours, it became apparent that the infant had been burned in two locations (Figs. 1 and 2) suffering from a second-degree burn to the right ring (and adjacent middle) finger and a third-degree burn to the tip of the right ear. The infant subsequently recovered uneventfully from the occipital hematoma. The burns were initially treated with topical therapy and the patient was seen in consultation by a surgeon prior to discharge. Reconstructive surgery will likely be required at some time in the future for repair of the right ear.

Subsequently, we measured the temperature at the tip of the clip-on Physio-Control sensor while connected to the Ohmeda machine used in this incident (table 1). Within 2 min, the temperature at the tip of the sensor was 200° F. This information was reported to the manufacturers and the Food and Drug Administration. A similar incident resulting in first- and second-degree burns was subsequently found to have had occurred but was only briefly described in an Air Force publication.⁶

DISCUSSION

Two pulse oximeter sensors intended for use with the Physio-Control 1600 pulse oximeter were connected to an Ohmeda 3700 pulse oximeter and resulted in serious burns. The Physio-Control sensor’s electrical connector fit securely into the Ohmeda machine’s receptacle without being forced or jammed in any way. When the sensor’s electrical connector fit into the borrowed Ohmeda oximeter, everything apparently was ready to begin obtaining SpO₂ measurements.

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Mixing sensors and machines from different manufacturers is not uncommon and is possible with equipment from other companies as well. This is because sensors manufactured by many companies (not just Physio-Control and Ohmeda) use common electrical connectors. A recent advertisement in ANESTHESIOLOGY even appeared to encourage this practice by stating "There's one thing Hewlett-Packard, MDE, Mennen, Ivy, Drager, and Siemens all agree on . . . Nellcor Sensors." ** This may not present any difficulties if the oximeters from different companies are all derived from a common source, but whether or not this is the case is generally not known by practicing anesthesiologists. Whether such problems can occur by mixing sensors and devices from manufacturers other than reported in this case is unknown. Many manufacturers' user's manual or packaging instructions caution against mixing sensors and machines from companies other than their own (including Ohmeda and Physio-

Table 1. Temperatures at Tip of Physio-Control Sensor after Attachment of an Ohmeda Machine

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00:00</td>
<td>78</td>
</tr>
<tr>
<td>00:30</td>
<td>108</td>
</tr>
<tr>
<td>01:00</td>
<td>148</td>
</tr>
<tr>
<td>01:30</td>
<td>178</td>
</tr>
<tr>
<td>02:00</td>
<td>200</td>
</tr>
<tr>
<td>02:30</td>
<td>223</td>
</tr>
<tr>
<td>03:00</td>
<td>254</td>
</tr>
</tbody>
</table>

Control), but rarely are warning labels displayed directly on the sensors and/or machines. Evaluation of the Physio-Control and Ohmeda schematics shows that when the sensor is plugged into certain Ohmeda units, 5 V DC is connected to the detector diode in the sensor. This causes excessive current to go through the detector diode and its temperature increases. Tests conducted by both companies†† showed significant heating does occur with all Physio-Control sensors when used with Ohmeda 3700/3701 oximeters (revision “P” or later). The revision designation is noted on the face of the machine’s readout display immediately after turning on the power. The one used in this case was revision “P.” We have since labelled these oximeters at our institution with a note “Use Ohmeda Sensor Only” or “Use Physio-Control Sensor Only.”

In conclusion, Physio-Control sensors will not function with some Ohmeda pulse oximeters and if connected to an Ohmeda pulse oximeter can result in significant overheating. Caution should be used if pulse oximeter sensors and machines from different manufacturers are used together, even if their electrical connectors are mechanically compatible. Mixing of equipment, as this case illustrates, can produce significant burns to the patient. If sensors and oximeters from different companies are used together, they should be checked for functional (not just mechanical) compatibility. Manufacturers should label their equipment carefully and develop devices that display a warning when incompatibility occurs or prevent incompatibility altogether by design changes. All institutions using oximeters and sensors from more than one company should check their equipment to determine whether inaccurate or dangerous incompatibilities can occur.

References


†† Unpublished data, courtesy of Kevin Morningstar (Ohmeda) and Bill Garthe (Physio-Control).