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Case Report | OMICS International

Oximeter Behavior While Using a Tourniquet

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Case Report

This letter is a case report presenting the behavior of an approved for marketing oximeter device under tourniquet test, while comparing it with another approved for marketing device, the Cnoga TensorTip MTX (this letter is not a clinical trial report). Pulse oximetry is used for measuring the peripheral pulse and arterial oxygen saturation (SpO_2) in the blood. The TensorTip MTX can measure over 15 bio-parameters, among them the peripheral pulse and oxygen saturation.

Pulse oximetry is a noninvasive technique widely used. It was developed during the 1970's and its main use is to measure the oxygen saturation level of arterial peripheral blood, an indicator of oxygen supply [1]. Conventionally, a pulse oximeter has both a coherent light source, such as a LED, emitting red (660 nm) and infrared (940 nm) light, and a photodiode detector to measure the absorption of light. The probe is typically attached to a patient's finger or toe. For a finger, the probe is configured so that the emitters project light through the tissue. The photodiode is positioned opposite the LED in order to detect the transmitted light as it emerges from the finger tissues [2-5]. The pulse oximetry monitor determines oxygen saturation by analyzing the differential ratio absorption of the two wavelengths emitted by the probe. It alternately activates the probe LED emitters and reads the resulting current generated by the photodiode detector. The pulse oximeter calculates a ratio of detected red and infrared intensities, and then an oxygen saturation value is empirically determined based on the ratio obtained, using standard tables empirically obtained by the manufacturers, which are based on the Beer Lambert law [3,6-8].

The TensorTip MTX is a new device developed by Cnoga. This device can measure multiple bio-parameters, among them oxygen saturation in peripheral blood which is the main focus of this letter. The device is small, portable and light-weight. It is designed for use at home as well as in health care settings. The device contains a finger compartment, four monochromatic light sources in the visual to IR spectrum (~600 nm to ~1000 nm) and a color image sensor which is sensitive to a continuous spectrum in the range of ~380 nm-~1000 nm. The technology, developed by Cnoga, is based on a color image sensor and follows the usage of real time color image sensor providing the ability to analyze tissue pigmentation over the spatial-temporal-color domain using the light that traverses the tissue, such as fingertip or earlobe. The usage of the color array sensor provides far richer information compared to a standard pulse oximetry [2-4,6]. The device and the algorithms used are based on a number of patents issued by the company [9-12]. Figure 1 compares a normal scenario between the TensorTip MTX device and a regular oximeter and shows the similar measurements.

Figure 1: Comparison between the TensorTip MTX and an oximeter at a normal scenario.

The pulse oximeter is mostly a reliable device, simple to use and gives accurate results when used appropriately. Nevertheless, one of the main drawbacks of pulse oximetry is its inability to measure the oxygen saturation at low perfusion, since it has difficulties detecting the waveform of the arterial pulse at low perfusion [6,13]. However, there are also some cases in which the pulse oximeter will fail to measure the oxygen saturation due to the lack of a strong pulsating signal, even if the perfusion is sufficient and the tissue is viable. Therefore, during those situations, such as an injury that requires using a tourniquet or other cases where blood flow is compromised partially, the use of pulse oximetry may not identify the peripheral pulse and therefore may not present an accurate SpO_2, sometimes not even providing a reading at all. As can be seen in Figure 2a and Figure 2b, using the pulse oximeter to measure a finger of a tourniquet-constricted arm provides no results on the screen, whereas the TensorTip MTX can successfully measure oxygen saturation in this same situation. The TensorTip MTX attached to the finger of a tourniquet-constricted arm continues to show accurate, real-time measurements; SpO_2 dropped from 98% to 89% and blood pressure fell from 118/76 to 91/64 mmHg.

This difference between the two devices derives from the fact that the TensorTip MTX does not rely on the pulse of the injured organ, which may be low or even absent while using tourniquet. Consequently, the pulse oximeter fails in this situation whereas the TensorTip MTX can still measure reliably.

Moreover, while the arm is in a tourniquet, not only does the TensorTip MTX continue to give a SpO_2 reading while the pulse oximeter doesn't, the TensorTip MTX device is able to measure

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additional parameters. Figure 2c shows continuous measurements of pCO_2 rising from 35 to 68 mmHg, pO_2 dropping from 98 to 53 mmHg and pH levels dropping from 7.42 to 7.33. The measurements were taken uninterruptedly while the arm was tourniquet-constricted for few minutes.

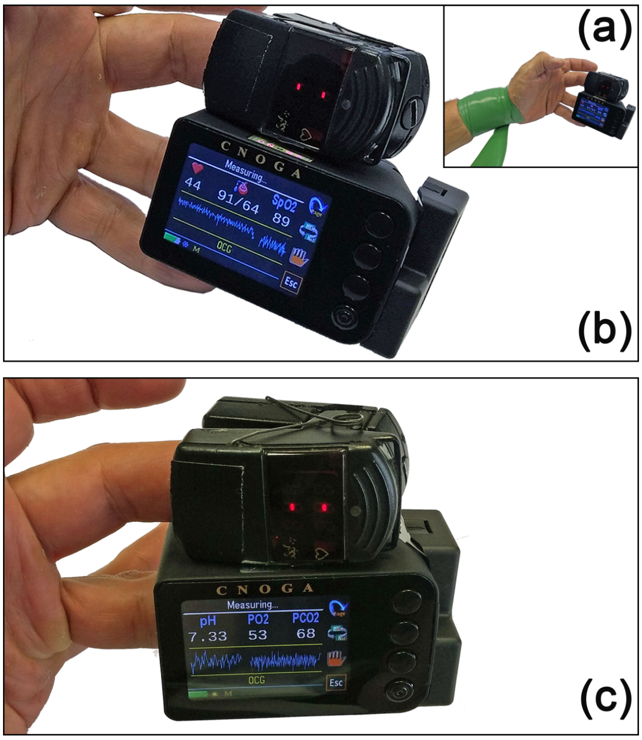

Figure 2: (a) Measurement of a tourniquet-constricted arm with the TensorTip MTX and an oximeter device; (b) Enlargement of the screens presented in (a), showing heart-rate, blood pressure and SpO_2 measurements; (c) pH, pO_2 and pCO_2 values while using a tourniquet.

Conclusion

In conclusion, in this letter we present our new device, TensorTip MTX, and its ability to measure oxygen saturation in the blood even when a tourniquet is being applied on the arm, while a regular pulse oximeter device fails in this situation.

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