

A Preliminary Study of the Pulse Oximetry for Early Breast Cancer Detection

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ABSTRACT

Breast cancer is a critical health issue globally, with a high incidence rate especially in the Netherlands, where around one of eight women develop the disease during the lifetime. Early detection could enhance the survival rate. However, current methodologies like the mammography have the problems of low accessibility, high cost, and less reliability. This study proposed a novel screening method using an array of pulse oximeters, a potentially low-cost but highly accessible strategy, to detect the early signs of breast cancer through the hypoxia measurement. This approach used the phenomenon that the early-stage breast cancer cells consume increased amounts of oxygen for growth, thereby changing the oxygen levels in the blood.

In this study, a simple setup including six pulse oximetry sensors was developed. It was compared with a commercial finger pulse oximeter on the wrist for basic operational verification. Next, a phantom model was created to simulate breast tissues. This was used to test whether the pulse oximetry sensors could detect the low oxygen levels caused by breast cancer. The experimental design tested various sensor configurations and performed comparative analyses to establish a baseline of the accuracy and reliability for the sensors under different oxygen-level conditions.

The results showed that the pulse oximetry setup could detect variations of oxygen saturation, which might correlate with the hypoxic conditions from the breast tumours. However, effectively using it for breast screening is still challenging due to the deep location and specific nature of low oxygen levels of breast cancer, which differ from the surface-level measurements typically using this technology. Future research will adapt the proposed design to directly measure the oxygen level from the breast tissues. In addition, the next step will also focus on enhancing sensor sensitivity and specificity for the breast tissue hypoxia and validating in a clinical setting.

This study explored an innovative use of pulse oximetry for early breast cancer detection. It paved the way for developing more accessible and less invasive breast cancer screening methods, potentially increasing the early detection rates and survival rates.