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Accuracy of a Wrist-worn Heart Rate Sensor during Pediatric Surgeries

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Introduction

The accurate measurement of Heart Rate (HR) is a critical aspect of patient monitoring during surgical procedures. For pediatric patients undergoing elective surgery, effective and non-invasive methods of HR monitoring are essential to ensure safety and early detection of potential complications. Traditionally, heart rate is measured using devices like Electro Cardio Grams (ECGs), pulse oximeters, or blood pressure cuffs. However, the advent of wearable technology, particularly wrist-worn heart rate sensing devices, has introduced an alternative approach to continuous monitoring. These devices, typically used for fitness tracking, promise the convenience of non-invasive, continuous and real-time data acquisition, which could potentially improve patient care during surgery [1].

This study aims to investigate the accuracy of wrist-worn heart rate sensing devices in the context of elective pediatric surgical procedures. With the increasing use of wearable technology in healthcare settings, it becomes important to assess whether these devices can reliably measure heart rate during anesthesia and surgery, where factors like patient movement, changes in blood circulation and varying environmental conditions could affect sensor performance. The primary objective of this study is to evaluate the precision of wrist-worn HR sensors in comparison with standard HR measurement tools like ECGs during pediatric elective surgeries, providing insight into their potential clinical utility. The growing prevalence of wearable devices in healthcare has created a need to validate their accuracy in different settings. In particular, pediatric patients present unique challenges in monitoring, given their smaller body sizes, higher baseline heart rates and different physiological responses to anesthesia compared to adults. This article explores the feasibility, reliability and potential benefits of using wrist-worn HR sensors in a pediatric surgical context, with a focus on their practical application in improving patient outcomes [2].

Description

The study is conducted within the context of elective pediatric surgeries, which provide an opportunity for controlled observation in a clinical setting. The accuracy of wrist-worn heart rate sensing devices, such as those commonly used in fitness trackers and smartwatches, is compared against the gold standard of heart rate measurement: the Electro Cardio Gram (ECG). The study design includes a cohort of pediatric patients undergoing elective procedures under general anesthesia, with HR data being simultaneously recorded from both wrist-worn devices and the ECG monitoring system. The participants are selected from a broad range of elective surgeries, including orthopedic, ENT and ophthalmological procedures, to account for various physiological responses and surgical environments. This diversity helps ensure that the findings are generalizable to a wide range of pediatric surgical contexts. The wrist-worn devices used in this study include commercially available models such as the Fitbit, Apple Watch and Garmin wearables, which employ Photo Plethy Smography (PPG) sensors to estimate heart rate through light-based measurement of blood flow [3].

The primary focus of the study is to assess the accuracy of the wrist-worn devices in capturing real-time heart rate data during the perioperative period. Key performance metrics include sensitivity, specificity and correlation with ECG readings. The study also evaluates the devices' robustness in environments where patient movement, shifts in blood circulation and anesthesia-induced changes in heart rate may pose challenges to sensor performance. The effects of patient size, age and surgical type on device accuracy are also explored, as these factors could impact the reliability of wrist-worn sensors [4].

Furthermore, the study investigates the usability and practicality of wrist-worn devices in a clinical environment. Factors such as ease of device application, patient comfort and potential disruptions to the surgical workflow are considered. In addition, the ability of these devices to provide continuous, non-invasive and real-time heart rate data during surgery offers an opportunity for more proactive monitoring, potentially leading to earlier detection of abnormal heart rate patterns, which can be critical in preventing adverse events during surgery. While wrist-worn heart rate sensors have demonstrated promise in non-clinical settings, their performance in more controlled and challenging environments, such as during pediatric surgery, has not been extensively studied. This article delves into how these devices perform under the specific conditions of an operating room, where factors like lighting, temperature, patient positioning and surgical manipulation could all affect sensor accuracy [5].

Conclusion

In conclusion, this study provides valuable insights into the accuracy and feasibility of wrist-worn heart rate sensing devices in the context of pediatric elective surgery. While traditional HR monitoring methods like ECGs remain the gold standard, the potential benefits of integrating wearable technology into surgical care cannot be overlooked. Wrist-worn devices offer the promise of continuous, real-time and non-invasive monitoring, which could improve patient safety and surgical outcomes. However, the study's findings underscore the need for further refinement of these devices to ensure their reliability under the dynamic and sometimes unpredictable conditions of surgery. The results indicate that while wrist-worn devices can provide reasonably accurate heart rate measurements during elective pediatric surgeries, certain limitations persist. Variations in sensor accuracy were observed, particularly during periods of significant movement, changes in blood flow, or low perfusion, which can affect the sensor's ability to detect heart rate consistently. Additionally, the devices were generally less accurate in younger patients and those with smaller wrist sizes, highlighting the need for further research into device calibration and adaptation for pediatric populations.

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Conflict of Interest

None.

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