Abstract

Pilot Development of BP-Glass for Unobtrusive Ambulatory Blood Pressure Monitoring

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Abstract

Background: Cardiovascular disease (CVD) is the leading cause of death and lower life expectancy worldwide, and is a heavy financial burden both to individuals and to the health system. Blood pressure (BP) control is one of the key strategies to prevent CVDs such as heart attacks and strokes; unfortunately, the proportion of patients with controlled BP has not improved in recent years, despite the increased intensity of therapy. Efforts are being made to improve this situation, including early identification of at-risk individuals using connected health concepts, individualized therapies, adoption of more sensitive clinical indices, and home BP monitoring. The existing BP methods each demonstrate different limitations, including their obtrusiveness, inability to provide continuous monitoring, difficulty integrating into Electronic Health Records, human error concerns, or high cost. New technologies for unobtrusive ambulatory blood pressure monitoring (ABPM) remain to be developed to combine the latest sensor and information technologies and to support the coming connected health strategies.

Objective: The objective of this pilot study is to develop a novel, unobtrusive ABPM technology that features beat-to-beat continuous BP monitoring, seamless automatic integration with electronic health records (EHR) and/or internet, low cost to meet today's need of BP control and CVD prevention.

Methods: In this paper, we describe the pilot development of a novel wearable ABP monitoring device, BP-Glass. BP-Glass integrates three noninvasive, cuffless and continuous BP sensing technologies into a pair of eyeglasses: tonometry, pulse transit time (PTT) and hemodynamics-based technologies. In the BP-Glass prototype, a superficial temporal artery (STA) tonometry sensor is integrated into a pair of eyeglasses for unobtrusive sensing of ABP; together with a battery powered wearable recording system, the BP-Glass system is capable of recording ABP, electrocardiogram (ECG), respiration, cerebral hemodynamics, systemic hemodynamics and subjects' motion for up to 24 hours at 250Hz sampling rate, and the total weight of the whole multi-modality monitoring system is less than 350 grams. The system's performance is demonstrated by ambulatory tests during subject's normal activity; ABP fluctuations during micturition and Valsalva maneuvers are discussed in detail.

Results: Successful ambulatory BP monitoring using BP-Glass during people's daily activities were conducted. Interesting spontaneous or introduced blood pressure fluctuations were captured during the ambulatory recording, including Micturition response and Valsalva Maneuver response.

Conclusions: These preliminary results demonstrate the feasibility of our BP-Glass design for ABP monitoring, and suggest that system has significant potential in the diagnosis and management of cardiovascular and cerebrovascular disease, especially

powerful in catching ABP fluctuations during transient symptoms, such as syncope, with unpredictable onsets. To the best of our knowledge, this is the first report of multi-modality ABP monitoring and simultaneous blood pressure and hemodynamics recording during events in peoples' daily activity.

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KEYWORDS

ambulatory blood pressure monitoring; wearable technology; connected health

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Multimedia Appendix 1

Extended abstract.

[PDF File (Adobe PDF File), 884KB - iproc_v1i1e8_app1.pdf]

References

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