

Role of apple smart watch in post-operative monitoring

Kavya Shree Mallesh¹, Ravi Kumar Chittoria^{2*}, Imran Pathan³, Padmalakshmi Bharathi Mohan⁴, Shijina Koliyath⁵, Neljo Thomas⁶, Nishad Kerakada⁷

¹Junior Resident, ²Professor, ³⁻⁷Senior Resident, Dept. of General Surgery, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Pondicherry, India

Corresponding Author: Ravi Kumar Chittoria

Email: drchittoria@yahoo.com

Abstract

Health care is advancing rapidly due to increasing integration with technology and Smart watches are newer technology in the aspect. There is increasing health consciousness among general public and these wrist worn devices which have many sensors are serving them as exercise tracking devices and can also which can calculate various health parameters like heart rate, oxygen saturation and even ECG monitoring. Recently it has been found useful in identification of atrial fibrillation also. In this study, we have examined the feasibility of Apple watch as a monitoring device in the post-operative period.

Keywords: Apple, Smart watch, Post-operative, Monitoring.

Introduction

We are living in an era of Digital India where Technology is more advanced, affordable and accessible than ever before. With technological advancement, their innovations are in our palms and are represented by Smart phones and Smart watches. With development of micro-sensors and microprocessors the devices are becoming miniature yet powerful. Technological advancement has wide application in all categories including health sector. Technological development in health care is rapidly expanding. Smart watches are growing in popularity amongst general public and among health professionals. Smart watch being a latest mobile integrated technology illustrates the potential to health care providers to monitor patients remotely. Apart from Apple, other companies that provide smart watches are Fitbit, Garmin, Samsung, etc.¹ Apple smart watch series 6 is capable of recording heart rate, oxygen saturation, single lead ECG.²

There is paucity in studies comparing usage of smart watches in monitoring of patients in a hospital set up in comparison to routine multi parameter vitals monitor. Apple smart watch as a medical device has not been proven for usage but its accuracy in measuring heart rate, oxygen saturation and ECG recording can be utilized as a simple device in monitoring of patients in the hospital setup. Post-operative patients make the large number of patients in hospital who require close monitoring. In this article, we make an attempt to describe the usage of the Apple smart watch in post-operative monitoring of patients.

Materials and Methods

This is a prospective study conducted in the department of plastic surgery in a tertiary care center. This study was conducted during March 2021. In this study, total of 20 patients in plastic surgery during the post-operative period were included. Informed written consent was taken from the patient's attenders and doctors regarding publication and use of clinical photographs.

Table-1 Physician and their experience on scale of 1 to 5 rating, the higher the score the more was the satisfaction level

A smart watch (Apple, series 6) was used as a monitoring device (Fig. 1 and 2). The smart watch was tied around the hand of the patient. Then heart rate and oxygen saturation was measured by tapping the display icons (Fig. 3). For recording ECG, the patient's opposite hand index finger was kept over the crown of the watch for 30 seconds (Figure-4). The reading and interpretation of ECG were noted.

Doctors were asked to rate their experience of usage of the device on a scale of 1 to 5 rating, the higher the score the more was the satisfaction level. Feedback statement was also taken from doctors and from nursing staff in ICU. For doctors, the experience was rated based on – the experience of learning a new tool, reliability in post-operative monitoring, ease of using the instrument.

Result

Total 10 doctors participated in the study and total 20 patients were included in the study. All doctors found it easy to use, reliable and had a good overall experience (4 or more rating). The reliability of the device had average score of 3.6 as some time device showed error in heart beat and in oxygen saturation. 7 out of 10 doctors stated that they would recommend use of this device in post-operative monitoring.



Fig. 1: Apple watch with its display

Physician	Ease of usage	Reliability	Over all experience with this new device	recommend other for usage of this device
Physician -1	4	3	4	no
Physician -2	4	4	5	yes
Physician -3	5	4	4	yes
Physician -4	4	4	5	yes
Physician -5	4	3	5	yes
Physician -6	5	3	4	no
Physician -7	4	3	5	yes
Physician -8	4	4	5	yes
Physician-9	5	3	4	no
Physician-10	4	4	4	yes
Average	4.3	3.5	4.5	Yes= 7/10



Fig. 2: Apple watch with its sensors



Fig. 3: Use of Apple watch in post operative monitoring of a patient showing heart rate



Fig. 4: Display showing ecg monitoring

Discussion

Health sector is emerging with rapid technological integration. Smartphones have become ubiquitous and with increasing popularity of smart watches among youth and middle aged people especially apple smart watches rapidly trending in watch industry. These devices have multitude of sensors including barometry, accelerators and photoplethysmography. This has given a new dimension to people who are health conscious. These can be used to monitor distance walked, walking steps and estimated energy expenditure. The most under explored part of which is heart rate monitoring. With Apple smart watches even rhythm of heart rate with heart rate variability can be recorded. This can be used in old age patients with atrial fibrillation for monitoring. With smart watches integrated with Smart phones through built-in health app can also help in self-monitoring blood pressure among hypertensive patients.

Apple smart watch uses optical heart sensor known as photoplethysmography. It has light sensitive diodes which are paired with green LED lights and infra-red rays. These detect the amount of blood flowing through person’s wrist anytime. With this principle it supports a wide range in heart rate from 30 to 210 .The optical heart sensor can also use infrared light. Built-in electrodes are present in the Crown and the back of Apple Watch. When finger is placed on the crown, it creates a closed circuit between heart and both arms, capturing the electrical impulses.³

Multiple studies have been conducted including cohort studies on usage of smartphones in rapid detection and alarming of life threatening situations.⁴ These studies have shown that the vital monitoring done using smart watches when was compared to routine monitoring devices were almost similar with heart rate being shown 95% accurately and oxygen saturation being shown with 97% accuracy.^{5,6} A study was done by tison et al which showed that Smart watches could passively detect atrial fibrillation when integrated with deep neural network and could accurately discriminate atrial fibrillation from sinus rhythm with more than 98% sensitivity and 90.2% specificity compared with the 12 lead ECG.⁷

Postoperatively, patient needs close monitoring and to be assessed closely for any deterioration in condition. They are

at risk of clinical deterioration and their vitals needs to be monitored during this period. The basic parameters which need to be monitored in the post-operative period are pulse rate, oxygen saturation, systolic blood pressure, temperature, respiratory rate and level of consciousness. There is an increasing burden among health professionals to discharge patients early to reduce the length of hospital stay and patients during the post-operative period can be discharged only when their vital parameters are normal and no complications noted. Smart watches can bridge this gap and reduce the burden of health personnel by close and continuous monitoring of patients and also with extended monitoring after discharge at home for continued care.

Apart from issue of availability and associated high cost, these wrist worn devices have certain other limitations also. Predictors of increased error in HR measurement include darker skin tone, larger wrist circumference and higher BMI. Their reading can be affected by low temperature, darker skin tone, larger wrist circumference and higher Basal Metabolic index.⁸ sweating or wet skin may also affects the reading.^{7,8} Measurement by watch is also not possible or is inaccurate when the patient is ambulating, hence not useful for small children or in uncooperative patients. It is not suitable to detect cardiac arrhythmia other than atrial fibrillation.^{9, 10}

Conclusion

Apple smart watch is a simple and easy tool and can be reliable in terms of monitoring,^{11, 12} though it might not be capable of diagnosing any disease condition and may have a valuable role in monitoring of patients during post-operative period. But since it is a small study, definite conclusion cannot be made. Multiple large randomized control trials are required to confirm the efficacy of these devices as monitoring devices during post-operative period.

Conflicts of Interest

All contributing authors declare no conflicts of interest.

Source of Funding

None.

References

1. Karmen CL, Reisfeld MA, McIntyre MK, Timmermans R, Frishman W. The Clinical Value of Heart Rate Monitoring Using an Apple Watch. *Cardiol Rev.* 2019;27(2):60-2
2. Massoomi MR, Handberg EM. Increasing and Evolving Role of Smart Devices in Modern Medicine. *Eur Cardiol.* 2019;14(3):181-6.
3. Apple Support. Monitor your heart rate with Apple Watch. January 26, 2019. <https://support.apple.com/en-in/HT204666>
4. Hahnen, Christina et al. "Accuracy of Vital Signs Measurements by a Smartwatch and a Portable Health Device: Validation Study." *JMIR mHealth and uHealth* . 2020;8(2):e16811. doi:10.2196/16811
5. Raja, Joel M. "Apple Watch, Wearables, and Heart Rhythm: where do we stand?." *Ann Translational Med.* 2019;7(17):417. doi:10.21037/atm.2019.06.79
6. Khushhal, A. "Validity and Reliability of the Apple Watch for Measuring Heart Rate During Exercise." *Sports Medicine International Open.* 2017;1(6):E206-E211. doi:10.1055/s-0043-120195
7. Tison GH, Sanchez JM, Ballinger B, Passive detection of atrial fibrillation using a commercially available smartwatch. *JAMA Cardiol.* 2018;3:409–16
8. Fallow BA, Tarumi T, Tanaka H. Influence of skin type and wavelength on light wave reflectance. *J Clin Monit Comput.* 2013;27: 313–7.
9. Parak J, Korhonen I. Evaluation of wearable consumer heart rate monitors based on photoplethysmography. *IEEE.* 2014: 3670–3673
10. Apple Support. Taking an ECG with the ECG app on Apple Watch Series 4. November 18, 2019. <https://support.apple.com/en-us/HT208955>
11. Wallen MP, Gomersall SR, Keating SE, Wisløff U, Coombes JS. Accuracy of Heart Rate Watches: Implications for Weight Management. *PLoS One.* 2016;11(5):e0154420. doi: 10.1371/journal.pone.0154420. PMID: 27232714; PMCID: PMC4883747.
12. Wang R, Blackburn G, Desai M, Phelan D, Gillinov L, Houghtaling P et al. Accuracy of Wrist-Worn Heart Rate Monitors. *JAMA Cardiol.* 2017;2(1):104-6. doi: 10.1001/jamacardio.2016.3340. PMID: 27732703.

How to cite: Mallesh KS, Chittoria RK, Pathan I, Mohan PB, Koliyath S, Thomas N, Kerakada N. Role of apple smart watch in post-operative monitoring. *IP Int J Aesthet Health Rejuvenation* 2021;4(1):1-3.