

Detecting Postoperative Deterioration in Bariatric Patients Using Healthdot: Insights from the TRICA Study

Summary

Bariatric surgery is a low-risk procedure that may occasionally be followed by postoperative complications. Timely detection of such conditions is important to guide discharge plans. This study aimed to investigate how continuous cardiac pulse rate (PR) and breathing rate (BR) measurements provided by Healthdot can be used to generate alarms to detect patient deterioration after bariatric surgery in the hospital and at home. The occurred complications in the TRICA study consisted of bleeding and anastomotic leakage and were detected overall with 75% sensitivity. At home, the sensitivity was 67% with only 2% of the patients having more than one alarm per day. Healthdot provided PR and BR measurements that can be used with an Early warning scoring method to indicate postoperative deterioration in bariatric patients.

Introduction

Abnormal vital signs such as cardiac pulse rate (PR) and breathing rate (BR) may indicate deterioration in a patient's health status. Healthdot is a remote patient monitoring system that can be utilized both in the hospital and at home and provides unobtrusive and continuous measurements of PR and BR based on accelerometer measurements. Early warning scoring (EWS) systems are validated tools to predict upcoming patient deteriorations from attended spot-check vital signs measurements. The aim of this study is to investigate how, with aid of continuous Healthdot measurements, alarms can be generated to detect postoperative patient deterioration in bariatric patients.

Methods

Study Design and Description

The TRICA study is a retrospective observational study aimed to evaluate the performance for deterioration prediction after surgery using the data calculated based on accelerometer measurements. The study included patients with elective surgery that undergo transitions from hospital to home and was set-up in the Catharina Hospital in Eindhoven in 2019-2020. The study population (Table 1) consisted of 177 patients that were measured for PR and BR after bariatric surgery with Healthdot positioned on the lower-left rib. The measured data were averaged over 5-min intervals and transmitted wirelessly to a backend server via low-power wide-area network (LoRa).

Table 1. Patients' demographics.

Mean (SD)	Bariatric pat.
N* (Male %)	177 (28 %)
Age, years	46 (12)
BMI, kg/m ²	40 (4)
Surgery Duration, min	75 (18)
Monitoring Duration, d	11 (8)
Hospital Stay, d	1 (0)
Considered Deteriorations – Hospital/Home, n*	1/3

BMI, body mass index; Monitoring Duration, patient monitoring after surgery.
*Total number

Patient Deteriorations

According to the clinical records, patients experienced in total four severe deteriorations (Clavien-Dindo (CD) grade 2 or higher). One bleeding event occurred in the hospital and the remaining three at home resulting in readmissions. The latter deteriorations included one bleeding and two anastomotic leakages.

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Deterioration Detection

Deterioration detection was performed retrospectively from the collected data. Alarms indicating deterioration were generated by following Philips IntelliVue Guardian Software implementation. Existing EWS models require more clinical parameters than PR and BR, so a novel risk score model, called BARI-110-20, was developed by accounting for clinical knowledge and scientific literature on abnormal PR and BR values after bariatric surgery [1]. The BARI-110-20 EWS model is presented in Table 2. An alarm was generated when the score increased to 2 or 3 and continued to be constant for 15 min. For following alarms, the score needed to first decrease at least for 15 min and increase again or increase directly to a higher score. A complication leading to readmission was regarded as detected when one or multiple alarms were generated within the 24 h preceding the readmission.

Table 2. BARI-110-20 Early warning scoring model.

Individual score	0	+1	+2
Pulse Rate	≤ 110		> 110
Breathing Rate	≤ 20	> 20	

The sum of the individual scores was used to compute the risk score for alarms.

Results

Bleeding and anastomotic leakage were detected overall with 75% sensitivity (3/4 patients). For deteriorations occurring at home, sensitivity was 67% (2/3) while maintaining a low alarm rate. Figure 1 illustrates an alarm profile of one of the patients experiencing a deterioration leading to a readmission. The risk score lead to one alarm (red line) within 24 h preceding the readmission.

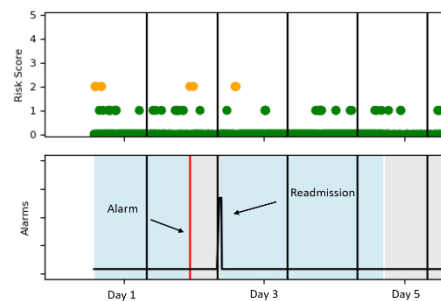


Figure 1. Example of an alarm at home preceding a readmission when risk score reaches 2 for a sufficiently long period (above) and the timing of the alarm and readmission (below). Blue background refers to hospital and grey to home.

During the home measurement period 70% (123/177) of the patients did not have any alarms and only 2% (3/177) had more than one alarm per day. In the hospital, the respective proportions of patients were 91% (161/177) and 3% (5/177).

Conclusion

The TRICA study provides first evidence that continuous PR and BR measurements from Healthdot can be used in combination with a novel EWS model (BARI-110-20) to alarm for postoperative deterioration in bariatric patients with a relatively low alarm rate.

References

[1] Bellorin et al., Understanding the Significance, Reasons and Patterns of Abnormal Vital Signs after Gastric Bypass for Morbid Obesity, *Obes. Surg.*, vol. 21, pp. 707–713, June 2011.