Continuous Non-invasive Blood Pressure Monitoring during General Anesthesia Induction

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Automated brachial cuffs are used to monitor arterial pressure (AP) in most anesthetized patients. Commonly inflating at regular intervals of 3–5 minutes, these devices only provide an intermittent monitoring, and may miss rapid hypotensive or hypertensive events. We investigated the ability of our oBPM® algorithm in detecting such changes in AP in 40 patients undergoing general anesthesia from pulse oximeter photoplethysmographic signals. The results demonstrated good trending ability in detecting rapid changes for both systolic and mean AP. Implemented in clinical settings, this solution may help in decreasing the duration of intraoperative hypo-/hypertensive events, thereby improving clinical outcome.

Arterial pressure (AP) is routinely monitored by means of automated brachial cuffs in most anesthetized patients. These devices only provide intermittent measurements, typically at intervals of 3 to 5 minutes. Thus, rapid intraoperative hypotensive events – associated with postoperative complications[1] – may go unnoticed. We investigated the ability of our oBPM® algorithm[2] in detecting such rapid changes in AP by pulse wave analysis of photoplethysmographic (PPG) signals acquired at the fingertip.

In a clinical study[3] (ClinicalTrials.gov ID: NCT02651558) in 40 patients scheduled for an elective surgery necessitating invasive AP monitoring, we evaluated the trending ability (ability to track AP changes) of our oBPM® algorithm applied to pulse oximeter PPG signals compared to the invasive method. Significant AP changes – commonly defined as changes of at least ±20 %[4] – were automatically identified in the invasive data. In particular, changes occurring of various durations, from 30 seconds up to 5 minutes, by increments of 30 seconds, were identified. The trending ability was assessed through four-quadrant plots and polar plots, using the concordance rate (CR), the angular CR at ±30°, and the angular bias as trending performance metrics.

Figure 1 shows the results for mean AP (MAP). The upper panel (four-quadrant plot) depicts excellent concordance (CR = 100 %). The lower panel (polar plot)[5] confirms this concordance (angular CR at ±30° of 100 %), with an angular bias of −3°. By analogy with non-invasive cardiac output monitoring techniques[5], good trending ability can be claimed with CR > 90–95 %, angular CR at ±30° > 90–95 %, and angular bias < ±5°. The results shown in Figure 1 are for rapid changes occurring over a time span of 60 seconds. Similar performance was obtained for faster (30 seconds) and slower (90 seconds) changes, complying with the aforementioned criteria. With changes of 120 seconds and more – of lesser clinical importance as they are less likely to be missed by a cuff – the criteria were not met anymore. Nevertheless, the CR, the angular CR at ±30°, and the angular bias remained respectively > 97 %, > 89 %, and < ±8° for changes of all durations, up to 5 minutes. Results for systolic AP showed comparable behavior, complying with the criteria for changes ≤ 90 seconds as well.

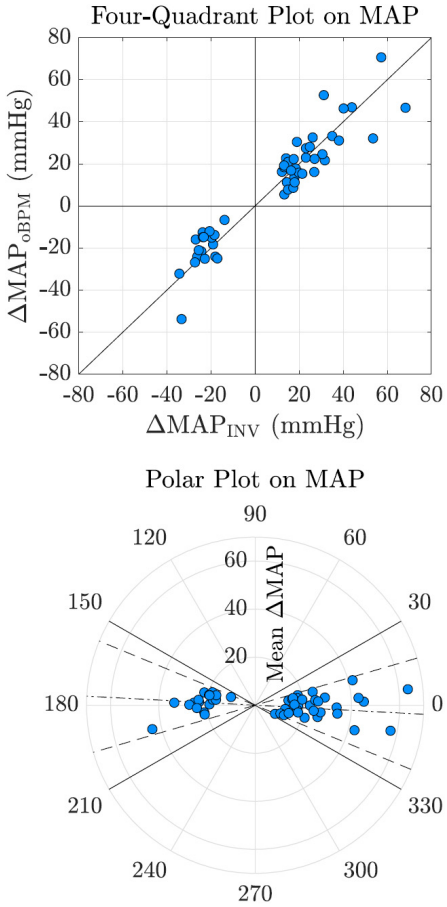

Figure 1: Four-quadrant plot and polar plot demonstrating the trending ability of the oBPM® algorithm for mean AP (MAP). The dash-dotted line in the polar plot depicts the angular bias, and the two dashed lines the 95 % confidence interval.

Rapid and possibly deleterious changes in AP may be missed by the current non-invasive monitoring solutions (brachial cuffs). Without requiring any additional equipment in the operating room – pulse oximeters being already part of standard equipment – our solution has shown to be able to detect rapid changes both in systolic and mean AP with good accuracy. Implemented clinically, this solution may be used for the "intelligent" triggering of cuff measurements, thus decreasing the duration of hypo- and hypertensive events, thereby improving clinical outcome.

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