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The future of monitoring during general anesthesia in complex situations

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Abstract:

Unstable hemodynamics, and in particular hypotension, during general anesthesia increases the risk of cardiac, renal and brain dysfunction during the postoperative period and also increases the morbidity and mortality. Typical complications are myocardium infarct, heart failure, stroke, cognitive dysfunction (memory loss), acute renal injury and renal failure. This problem potentially affects any person undergoing general anesthesia (more than 300 million worldwide in 2020) but is much more prevalent in patients with preexisting medical conditions. Complications occur in about 25% of surgical operations involving general anesthesia and major complications occur in 17% of such operations. The occurrence of complications has a strong impact on the patient's health; it reduces the 10 years survival probability by 45%, and in fact has a greater impact on the survival rate than the preoperative condition in major surgical operations.

It has been demonstrated that monitoring the hemodynamics of patients and having treatment strategies with quantitative objectives based on the monitoring improves the patient's condition by reducing the rate of complications and the hospital length of stay.

Invasive measurements represent an existing solution for the monitoring of the heart. However, due to the very high associated risks, they cannot be used in routine operations and are therefore limited to use in only critical surgical operations. As a result, current standard monitoring solutions do not offer heart monitoring and are instead limited to arterial monitoring. These existing solutions have no predictive capabilities and thus only allow reactive therapeutic strategies.

The future of monitoring during general anesthesia in complex situations should enable a preventive approach capable to address the risk of hypotension before it occurs. Moreover, future devices should enable the anesthetist to distinguish between the different causes of hypotension. The standard procedure to determine the appropriate therapeutic response uses a trial-and-error approach and is time consuming, lasting several minutes. Since the patient's response to the treatment is not instantaneous, they remain in a hypotensive state during the decision process, which is detrimental to their condition since each minute spent in this state increases the risk of complications.

Predictive algorithm integrating usual recorded signals (pressure, flow, ECG …), combined with biophysical model and maching learning algorithms would be the ideal solution. Before integrating such solutions into our daily practice, such approaches should be evaluated through clinical studies which assessed the impact compared to usual care.