Early impact analysis of remote vital sign monitoring after esophagectomy: a multi-method study design

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Background

Surgical removal of the esophagus (esophagectomy) is associated with serious postoperative complications in 20-40% of the patients. Early recognition and treatment of these complications is critical to prevent secondary damage. To support medical professionals in the timely detection of clinical deterioration in patients admitted to the ward, it might be of interest to use wireless sensor technologies allowing unobtrusive continuous vital sign tracking. However, it is yet unclear under which circumstances and to what extent continuous vital sign monitoring can provide beneficial effects in this patient population.

Objectives

The study aims to evaluate the expected clinical effects of continuous vital sign monitoring in the postoperative ward trajectory of patients undergoing esophagectomy.

Study design

We designed a multi-method and multicenter study for early impact analysis of continuous vital sign monitoring during ward stay after esophagectomy. First, characteristics of the current population are collected, representing the baseline situation (I). Next, semi-structured interviews with nurses and surgeons are conducted to elicit the probability that continuous monitoring leads to earlier detection and earlier treatment of preselected postoperative complications (II). Correspondingly, experts will estimate the effects of earlier treatment on clinical outcome measures (30 day mortality, readmission to intensive care unit, and hospital stay length). To support valid estimations, the baseline population characteristics are presented to the experts. Last, decision tree analysis is performed to assess the relation between clinical outcome in the baseline situation and a situation with continuous monitoring of vital signs (III + IV).

I. Baseline population characteristics

Collection of characteristics of current population undergoing esophagectomy

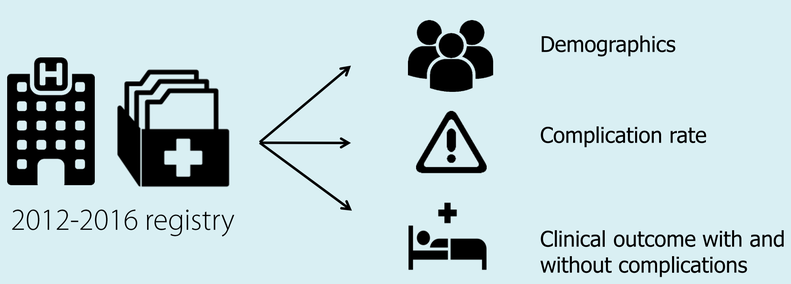

Fig 1. Illustration of baseline population characteristics colleded within the center

II. Effect size estimation by expert interviews

Semi-structured interviews

- 2 nurses and 2 surgeons per center
- Stepwise estimation of effects of continuous monitoring on clinical outcome
- Estimations supported by presentation of baseline population characteristics

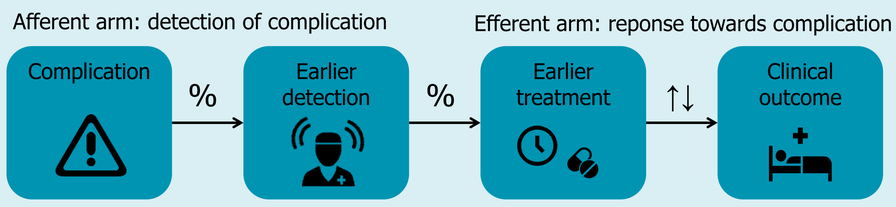

Fig 2. Illustration of the rationale of continuous vital sign monitoring for improving clinical outcome (%: probabilities and ↑↓: effect size estimated by experts)

III. Decision tree analysis

Decision tree model for each center

- Based on population characteristics and pooled expert estimations within center
- Joint probabilities for each decision tree branch

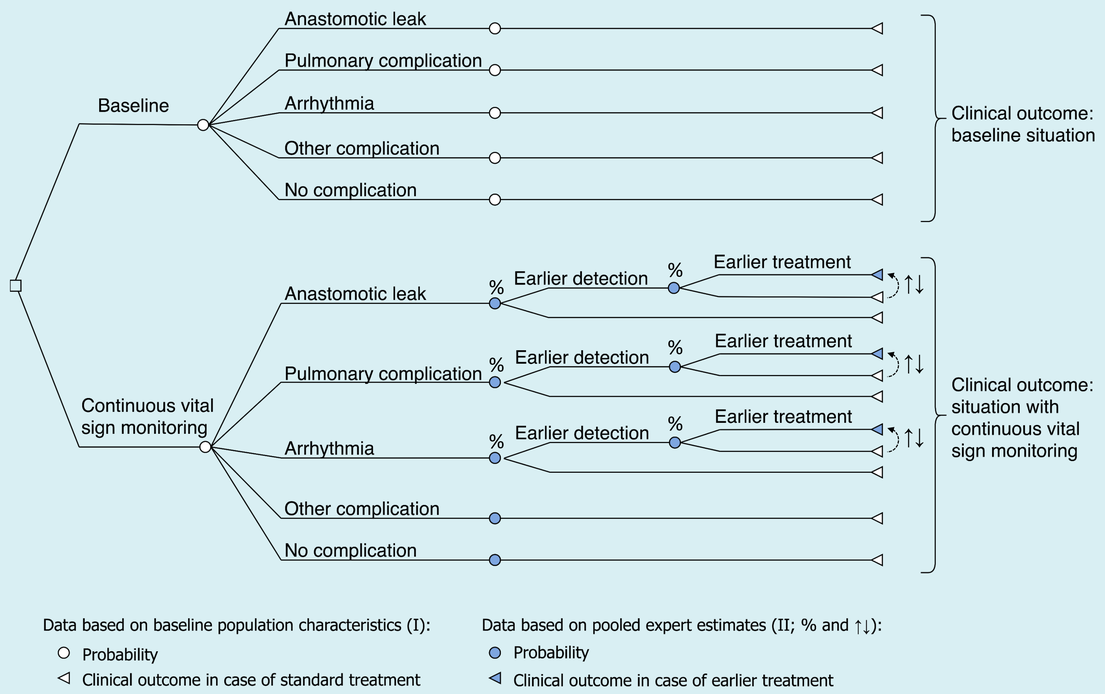

Fig 3. Decision tree

IV. Effect evaluation

Comparison of clinical outcome in the current situation and the expected situation

- Clustering of decision tree results of all participating centers
- Sensitivity analysis to assess the influence of different factors in the decision tree

Take home

Decision tree analysis combined with expert elicitation enables assessment of the afferent (i.e. monitoring chain) and efferent (i.e. response chain) arm of continuous vital sign monitoring, and facilitates impact analysis in an early stage. The results of this study can be used to optimize the strategy of remote vital sign monitoring in wards, to target situations where improvement in patient outcome and safety is expected.

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