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Clinical application of the Melbourne risk prediction tool in a high-risk upper abdominal surgical population: an observational cohort study

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Abstract

Objectives (1) To determine the ability of the Melbourne risk prediction tool to predict a pulmonary complication as defined by the Melbourne Group Scale in a medically defined high-risk upper abdominal surgery population during the postoperative period; (2) to identify the incidence of postoperative pulmonary complications; and (3) to examine the risk factors for postoperative pulmonary complications in this high-risk population.

Design Observational cohort study.

Setting Tertiary Australian referral centre.

Participants and methods 50 individuals who underwent medically defined high-risk upper abdominal surgery. Presence of postoperative pulmonary complications was screened daily for seven days using the Melbourne Group Scale (Version 2). Postoperative pulmonary risk prediction was calculated according to the Melbourne risk prediction tool.

Outcome measures (1) Melbourne risk prediction tool; and (2) the incidence of postoperative pulmonary complications.

Results Sixty-six percent (33/50) underwent hepatobiliary or upper gastrointestinal surgery. Mean (SD) anaesthetic duration was 377.8 (165.5) minutes. The risk prediction tool classified 84% (42/50) as high risk. Overall postoperative pulmonary complication incidence was 42% (21/50). The tool was 91% sensitive and 21% specific with a 50% chance of correct classification.

Conclusion This is the first study to externally validate the Melbourne risk prediction tool in an independent medically defined high-risk population. There was a higher incidence of pulmonary complications postoperatively observed compared to that previously reported. Results demonstrated poor validity of the tool in a population already defined medically as high risk and when applied postoperatively. This observational study has identified several important points to consider in future trials.

Keywords: Abdominal surgery; Postoperative care; Risk prediction; Pulmonary complications; Physiotherapy

Introduction

Pulmonary complications are a significant cause of morbidity, mortality [1,2] and prolonged hospitalization in surgical populations [3,4], particularly following upper abdominal surgery (UAS). The reported postoperative pulmonary complication (PPC) incidence post UAS is variable (9–70%) depending on the definition adopted, patient population, postoperative time frame studied, type of postoperative care provided and outcomes measures utilized [2,4,5]. Respiratory physiotherapy may be unnecessary in patients at low PPC risk [6], leading to interest in risk prediction to target physiotherapy resources towards individuals identified at high PPC risk.

Numerous independent PPC risk factors have been identified [5,7,8] and several risk prediction models have been described within the literature [1,5,9–12]. There is great

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variability in PPC definition, risk factors and outcome measures, as well as poor methodological reporting, limiting the ability to draw inferences for clinical practice [13]. Past studies have had sub-optimal study designs with deficient description of the methodological steps in the development of the risk prediction model to enable external model validation in independent cohorts [14]. Clinical applicability of risk prediction models has also been limited by inclusion of risk factors not consistently measured in clinical practice such as lung function testing [15] as well as the reliance on complex calculations to identify "at-risk" patients. The general applicability of these studies have been further limited by model evaluation at single centres, limited evaluation of UAS as a single population, and failure to determine external model validity in independent patient populations after initial model derivation.

Scholes *et al.* developed a risk prediction tool, the Melbourne risk prediction tool (MRPT) for elective UAS based on five risk factors [14]. (Please refer to Scholes *et al*. paper Box 2 for the scoring method and cut-off values). The tool was designed to be administered in the pre- and peri-operative period to predict individuals' risk for PPC development. Unpublished work conducted by Scholes *et al*. found almost perfect inter-rater reliability (ICC 1.0) regardless of clinical expertise for utilization in clinical practice. Validation of the MRPT in an independent patient population has not previously been published. A recent unpublished survey by Browning and colleagues highlighted that only 5% of Australian hospitals provide pre-operative physiotherapy whereas currently in clinical practice a physiotherapist first sees most patients in the postoperative period. This in conjunction with a twofold increase over the last decade in same-day admissions for abdominal surgical procedures [16] limits the ability for risk prediction tools to be utilized in the pre-operative period. Therefore it is critical to determine the external validity of the MRPT in identifying high-risk individuals in the postoperative period rather than pre-operatively. This study was a nested cohort observational study within a recent pilot trial involving a postoperative surveillance team (POST) who provided medical co-management of a "medically determined" high-risk surgical patient population [17] at our institution.

Objectives

The primary objectives of this sub-study were:

(1) To determine the ability of the MRPT to predict a PPC as defined by the MGS-2 in a medically defined high-risk UAS population during the postoperative period;
(2) To identify the incidence of PPCs in this population;
(3) To examine the risk factors for PPCs in this high-risk population.

Methods

Study design: Prospective nested observational cohort study within a larger pilot observational trial (described elsewhere) [17] conducted from March to June 2010.

Setting: Tertiary referral teaching hospital in Melbourne, Australia

Participants

Eligibility criteria: Participants were included if they were in the POST pilot trial [17] and fulfilled the following additional criteria: (1) underwent UAS defined as an incision above or extending above the umbilicus [18]; and (2) seen by the physiotherapist on the first postoperative day. The flow of participants throughout the study is shown in Fig. 1 (see supplementary online material). The study was granted local institutional ethical approval. Individual written consent from each participant was not required.

Procedure

All participants received usual medical and nursing care as well as additional monitoring from a specialized postoperative surveillance team consisting of medical registrars and specialized ICU nursing staff during the first five days postoperatively (if directly admitted to the ward) or following ICU discharge. No pre-operative physiotherapy was provided and participants received usual care physiotherapy beginning on the first postoperative day. This commonly included early mobilization and education regarding performance of deep breathing exercises (DBE) and supportive coughing hourly. Respiratory physiotherapy such as airway clearance or continuous positive airway pressure was provided if required as determined by the treating physiotherapist. To minimize expectation bias all outcome decisions regarding presence or absence of a PPC were made by the chief investigator (SP) after the participant was discharged from hospital. This information was not communicated with the treating physiotherapist and thus did not influence decisions regarding physiotherapy treatment.

Outcome measures

Primary outcomes of the study were (1) MRPT Prediction Score and (2) PPC incidence.

Risk prediction

Risk prediction using the five-factor MRPT was assessed on the first postoperative day by the primary investigator (SP) using data obtained from the surgical and medical histories. VO_{2max} was predicted based on the SAQ [14], which was administered by the primary investigator (SP). (Please refer to Scholes *et al*. paper for the MRPT scoring method Box 2).