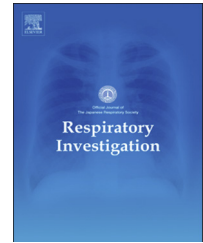


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Original article

Superiority of respiratory failure risk index in prediction of postoperative pulmonary complications after digestive surgery in Japanese patients



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ABSTRACT

Background: Several multifactorial risk indexes have been proposed by Western countries for identifying patients at a high risk of developing postoperative pulmonary complications (PPC). However, there is no consensus on how to evaluate the risk of PPC and what multifactorial risk index should be adapted for Japanese patients. This study aimed at clarifying the utility of risk indexes to predict PPC following digestive surgeries in Japanese patients.

Methods: We retrospectively analyzed 892 patients who underwent digestive surgeries under general anesthesia in Niigata University Medical and Dental Hospital between January 2009 and March 2011. PPC was defined as postoperative respiratory failure and postoperative pneumonia. We calculated three risk indexes (respiratory failure risk index (RFRI), postoperative pneumonia risk index, and PPC risk score), and compared them between the PPC group and the non-PPC group. A receiver operating characteristic (ROC) curve analysis was employed to compare the usefulness of each index.

Results: PPC developed in 55 patients (6.2%). All risk indexes were significantly higher in the PPC group than the non-PPC group. The category classification of the risk scores demonstrated a significant tendency to increase the incidence rate of PPC. In the ROC analysis, the area under the curve for RFRI was 0.762 (95% CI 0.697–0.826), which was the highest value observed among these indexes.

Conclusions: Multifactorial risk indexes are useful tools for identifying Japanese patients at a high risk of developing PPC following digestive surgeries. Of the risk indexes evaluated in this study, RFRI is potentially the most accurate in predicting PPC.

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1. Introduction

Postoperative pulmonary complications (PPC) are associated with postoperative morbidity, mortality, longer hospital stays, and higher medical costs following a variety of surgeries [1–4]. Therefore, the prevention of PPC is one of the most important issues in perioperative management. Although it has previously been reported that pulmonary rehabilitation (PR) such as preoperative exercise therapy or lung physiotherapy has a beneficial effect on preventing PPC in lung resection [5] and coronary artery bypass graft surgery [6], there is little evidence to support the usefulness of PR and its use is not routinely recommended in noncardiothoracic surgery [7,8]. The identification of high-risk patients is therefore needed in order to achieve efficient perioperative intervention [9].

The incidence of PPC is known to be affected by multiple factors. The risk factors of PPC include patient-related factors such as age, functional status, and history of chronic obstructive pulmonary disease (COPD), and surgery-related factors such as surgical site and time [10,11]. Several multifactorial risk indexes, based on prospective large cohort studies, have been proposed almost exclusively from Western countries in order to identify high-risk patients [12–14]. In Japan, the scoring system for evaluating cardiac complications after noncardiac surgeries has already been developed [15], along with guidelines for perioperative cardiovascular management [16]. However, there is no guideline available on how to evaluate the risks for PPC and no available comparison between multifactorial risk indexes. In addition, since race and health-care settings differ between Caucasian countries and the Japanese, it is still unknown whether these scores are applicable to Japanese patients or not.

There are few studies in which comparisons of usefulness among multifactorial risk indexes are reported. Arozullah et al. proposed two indices, respiratory failure risk index (RFRI) and postoperative pulmonary risk index (PPRI), on the basis of a multivariable analysis of a large cohort of male veterans undergoing major noncardiac surgery [13,14]. RFRI included seven factors: type of surgery, emergency surgery, albumin level less than 30 g/L, blood urea nitrogen level greater than 30 mg/dL, partially or fully dependent functional status, COPD, and age, in which surgery-related factors were dominant (see Table S1 in the supplement material). On the other hand, PPRI factors included weight loss, general anesthesia, impaired sensorium, history of cerebrovascular accident, transfusion of more than 4 units, steroid use for chronic condition, current smoker within 1 year, and alcohol intake of more than 2 drinks per day in the past 2 weeks in addition to some of the values of RFRI (see Table S2 in the supplement material). Recently, Canet et al. reported a PPC

risk score by a prospective, multicenter study in a large, heterogeneous population [12]. This score consisted of seven factors: low preoperative arterial oxygen saturation, acute respiratory infection during the previous month, age, preoperative anemia, surgical incision, surgical duration of at least 2 h, and emergency surgery (see Table S3 in the supplement material). We previously reported that RFRI was useful for predicting PPC in a small number of patients with respiratory impairment [17]. Ideally, the validity of RFRI should be examined in a larger, population-based Japanese cohort.

The present study was designed to investigate the utility of multifactorial risk indexes as a predictor of PPC following digestive surgeries, including cases with normal preoperative pulmonary function. We also compared the predictive power in these indexes.

2. Material and methods

2.1. Study design and patient population

Adult patients (aged 18 years and older) who underwent digestive surgery under general anesthesia at Niigata University Medical and Dental Hospital from January 2009 to March 2011 were included in this retrospective cohort study. The patients who were ventilator dependent before surgery, performed PR for prevention of PPC, or had preoperative pneumonia, were excluded from the analysis. The patients who underwent multiple surgeries during their hospitalization were also excluded. Owing to the invasiveness of the procedure, those who underwent organ transplantations were also exempt from the analysis.

Ethical considerations concerning this study were reviewed and approved by the Ethical Committee at Niigata University (Approval date: April 28, 2014; Approved #: 1891). We obtained consent from attending physicians for this analysis and took attention to the anonymity of patient data.

2.2. Definition of terms

We defined PPC as postoperative respiratory failure (PRF) and postoperative pneumonia. In a previous report by Arozullah et al. [14], PRF was defined as the need for mechanical ventilation more than 48 h after surgery, or reintubation followed by mechanical ventilation after postoperative extubation. Postoperative pneumonia was defined as a disease that required antibiotic treatment for a suspected respiratory infection, accompanied by the development of a fever and the appearance of new opacities on a chest X-ray. PRF and

Abbreviations: BUN, blood urea nitrogen; COPD, chronic obstructive pulmonary disease; CVD, cerebrovascular disease; FEV₁, forced expiratory volume in 1 s; %FEV_{1.0}, forced expiratory volume in 1 s as a percentage of that predicted; FVC, forced vital capacity; PFT, pulmonary function test; PPC, postoperative pulmonary complications; PPRI, postoperative pneumonia risk index; PR, pulmonary rehabilitation; PRF, postoperative respiratory failure; RFRI, respiratory failure risk index; ROC, receiver operating characteristic; SpO₂, oxyhemoglobin saturation by pulse oximetry; %VC, vital capacity as a percentage of that predicted

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