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ORIGINAL ARTICLE

External validation of a pre-operative nomogram predicting peri-operative mortality risk after liver resections for malignancy

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Abstract

Aim: A pre-operative nomogram using a population-based database to predict peri-operative mortality risk after liver resections for malignancy has recently been developed. The aim of the present study was to perform an external validation of the nomogram using data from a high volume institution.

Methods: The National Inpatient Sample (NIS) database (2000–2004) was used initially to construct the nomogram. The dataset for external validation was obtained from a high volume centre specializing in hepatobiliary surgery. Validation was performed using calibration plots and concordance index.

Results: A total of 794 patients who underwent liver resection from the years 2000–2010 at the external institute were included in the validation set with an observed mortality rate of 1.6%. The mean total points for this sample of patients was 124.9 [standard error (SE) 1.8, range 0–383] which translates to a nomogram predicted mortality rate of 1.5%, similar to the actual observed overall mortality rate. The nomogram concordance index was 0.65 [95% confidence interval (CI) 0.46–0.82] and calibration plots stratified by quartiles revealed good agreement between the predicted and observed mortality rates.

Conclusions: The present study provides an external validation of the pre-operative nomogram to predict the risk of peri-operative mortality after liver resection for malignancy.

Keywords

nomogram, peri-operative mortality, liver malignancy

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Introduction

Hepatic resection is a well-accepted modality in the treatment algorithm of patients with primary and secondary malignancies involving the liver. Several previous studies have demonstrated that the number of hepatic resections being performed for malignancy have significantly increased over the past decade.[1,2] In spite of the increasing number of procedures being performed, hepatic resections are major operations that are associated with significant morbidity and mortality.[2–4] The majority of these operations are also performed in middle-aged to elderly individuals who have multiple pre-existing co-morbidities. The pre-operative counselling to discuss and determine the likely rate of peri-operative mortality associated with these high-risk procedures remains an important part of the management algorithm.

Several recent studies have proposed different tools to predict peri-operative outcomes after hepatic resections.[5–10] A nomogram was recently devised by our institute using easily available pre-operative variables to enable prediction of peri-operative mortality after hepatic resections for malignancy.[11] This nomogram was constructed from data derived from a national database comprising heterogenous institutions and low to high volume surgeons. It is not clear whether predictive tools developed from this database are reliable and accurate when applied

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to specific centres. The aim of the present study was, therefore, to undertake an external validation of a population-based dataset derived nomogram predicting mortality after liver resection for malignancy by utilizing data derived from a high volume single academic centre.

Methods

The National Inpatient Sample(NIS) database (2000–2004) was initially used to develop the nomogram which included age, race, gender, liver primary, coagulopathy, renal failure, congestive heart failure (CHF), cardiac arrhythmias and other major co-morbidities (Fig. 1).[11] The dataset for external validation was obtained from the University of Pittsburgh Liver Cancer Centre. Data were obtained from a prospectively maintained dataset of all patients undergoing liver resections for malignancy at this institute. Peri-operative mortality for both datasets was defined as the mortality during the same hospital admission.

Statistical methods

SAS software (SAS Institute Inc., Cary, NC, USA) was used for all statistical analysis. The nomogram was initially constructed using the previously described techniques, using the NIS dataset from 2000 to 2004.[12,13] Each variable was assigned points based the multivariate logistic regression. Depending on the number of variables/factors present in the case of an individual patient, the total number of points was calculated for each person in the NIS 2000 to 2004 dataset. The median total points for this dataset were 116 with a range of 0 to 469 which corresponds to a mor-

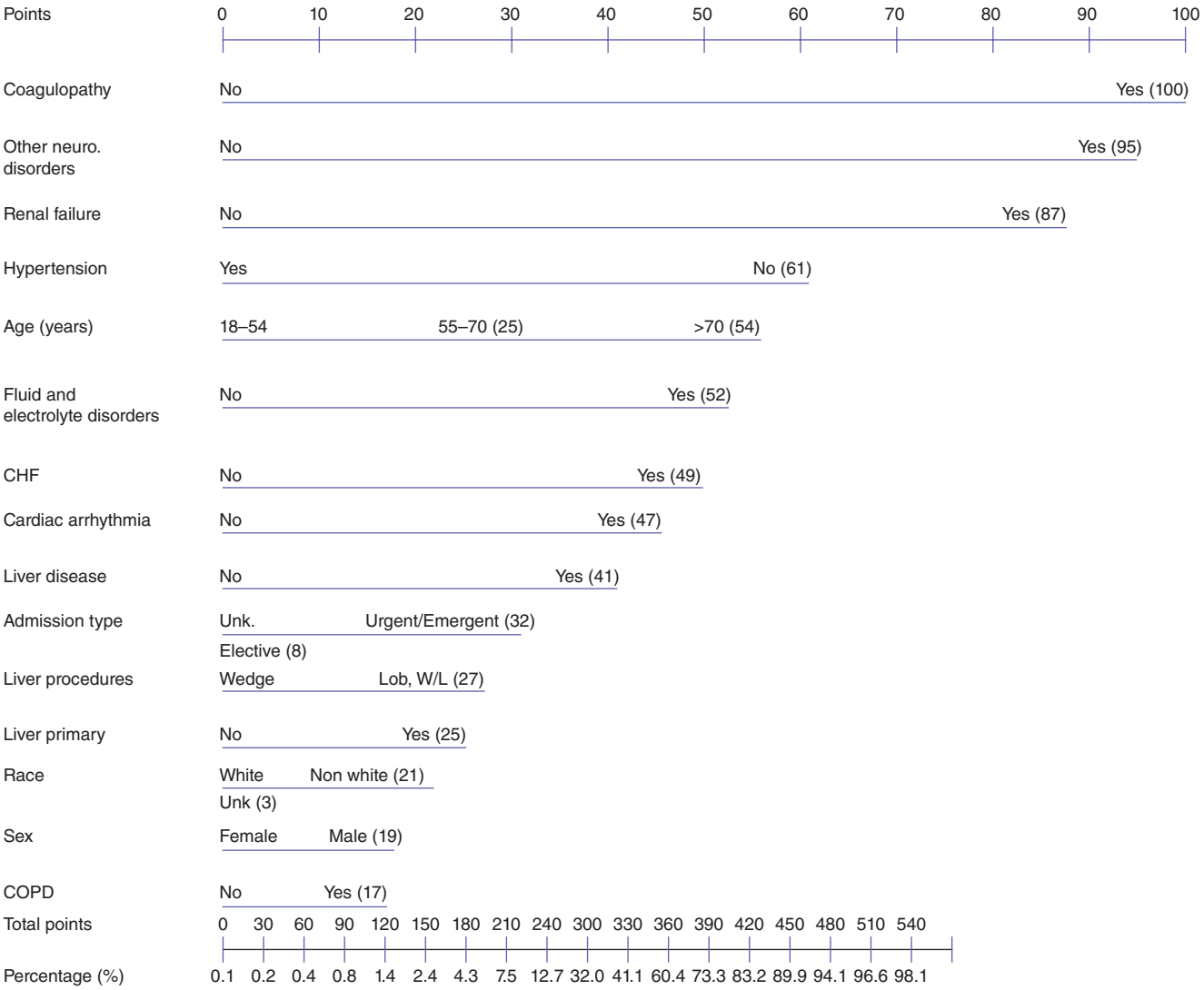

Figure 1 Representative figure of the nomgram (published with permission from Springerlink. Originally published in Dhir *et al*. *J Gastrointest Surg* 2010)[11]. CHF, Congestive heart failure; COPD, Chronic obstructive pulmonary disease; Unk, Unknown