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Evaluation of the Discrimination Ability of the Decision Rule Allowing to Predict the Probability of Death in Oncosurgical Patients with Comorbid Pathology

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Abstract. At the moment, there are many decision rules and mathematical models that reduce the risk of postoperative mortality and complications. A small part of such medical mathematical models (scales) is successfully used in practice, but there is also a part that eventually remains on the shelves and becomes morally obsolete. The purpose of this work is to evaluate the discrimination ability of the prognostic model underlying the decision rule that allows ranking patients into groups with favorable and unfavorable outcomes and into a group of patients subject to preoperative preparation to maintain the performance of the mathematical model Oncoprognosis 1.0. The discrimination ability carried out by constructing an area under the Receiver Operating Characteristic (ROC) curve. The investigation allowed conduct that any decision rule requires revision over time, its clarification and, if necessary, adjustments and updates.

Keywords. Prognostic score, validity of prognostic scores, prognosis of lethal outcome of oncosurgical patients

1. Introduction

At the moment, there are many decision rules and mathematical models used to reduce the risk of postoperative mortality and complications. Those prognostic models allowed assessing the severity of the patient's condition and predicting the probability of outcome of treatment [1, 2, 3]. A small part of such medical mathematical models scales is successfully used in practice, but there is also a part that eventually remains on the shelves and becomes morally obsolete. Researchers have shown that the effectiveness of the decision rule changes over time for a number of reasons. To successfully using any decision rule, it must be validated [3, 4, 5].

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Previously, the authors proposed specific model the Oncoprognosis 1.0 for predicting therapeutic measures (for example, surgical intervention) in elderly patients to rank patients according to the risk of death [5].

The purpose of this work is to evaluate the discrimination ability of the prognostic model underlying the decision rule that allows ranking patients into groups with favorable and unfavorable outcomes and into a group of patients subject to preoperative preparation.

2. Material and methods

The study included patients who received treatment in the Surgical Department in State Research Center - Burnasyan Federal Medical Biophysical Center of Federal Medical Biological Agency from January 2009 to July 2017 and January to December 2019. The study was conducted in 112 patients, 42 of whom (37.5 %) were men and 70 (62.5 %) women, aged 25 to 85 years (59.6 ± 13.2) and in 114 patients, 52 of whom (45.6 %) were men and 62 (54.4 %) women, aged 34 to 82 years (61.5 ± 11.2). At the end of hospitalization after surgical treatment in the first group 51 patients were discharged (45.5 %), and 61 (54.5 %) died and in the second group 100 patients were discharged (87.7 %), and 14 (12.3 %) died. In all patients, the parameters of the functioning of various organs and systems were collected, including taking into account the anamnestic data of oncological patients, with differentiation in the final outcome of surgical treatment (age, Body mass index (BMI), heart rhythm disorders in the history of an electrocardiogram, hemoglobin level (Hb, g / ml), presence of protein in the urine, international normalized ratio of coagulograms (INR), duration of the operation, hour) [5].

Table 1 Characteristics of data for all patients and in different groups. N -sample's size of group, m - average age in the group, δ - standard deviation of mean, M – man, F – female, Died – the number of deaths in the group of patients, Survived - number of surviving patients in the group.

Group	N	Age (m± δ)	M/F (%/%)	Died (%)	Survived (%)
1 Group of patients on whom the mathematical model was obtained	112	59.6±13.2	42/70 (37.5/62.5)	61(54.5)	51 (45.5)
2 Group of patients recruited separately for testing	114	61.5±11.2	52/62 (45.6/54.4)	14 (12.3)	100 (87.7)
3 Total group of patients of the previous two groups	226	60.4±12.3	94/132 (41.5/58.4)	75 (33.2)	151 (66.8)

Estimation of the discrimination ability of the prognostic model were in the group of patients on whom the mathematical model was obtained, in the group of patients recruited separately for testing and the total group of patients of the previous two groups. The discrimination ability of the model was determined by plotting the area under the receiver operating characteristic curve (ROC) curve [6, 7]. The data base statistical assessment and statistical description were done in Excel and SPSS programs version 17.

3. Results

The investigated prognostic model showed outstanding discrimination ability (0.926) for group of patients on whom the mathematical model was obtained (ROC curve 1). For Group of patients recruited separately for testing the analysis showed acceptable discrimination ability (0.786, ROC-curve 2). For Total Group of patients of the previous two groups the analysis showed acceptable discrimination ability (0.847, ROC-curve 3).

The analysis showed a decrease in the discrimination ability when using a predictive specific model the Oncoprognosis 1.0 for predicting therapeutic measures in elderly patients for Group of patients recruited separately for testing

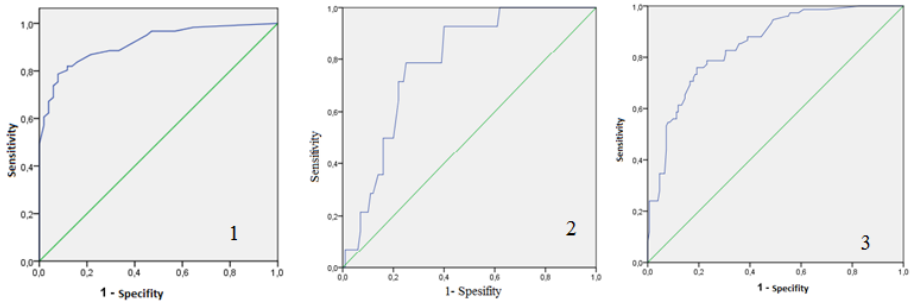

Figure 1. Area of the ROC-curve for the prognostic model for three investigated groups.

Table 2 Results of AUROC assessment. N -sample's size, AUROC- Area under ROC curve.

Group	N	AUROC
Group of patients on whom the mathematical model was obtained	112	0.926±0.026
Group of patients recruited separately for testing	114	0.786±0.051
Total group of patients of the previous two groups	226	0.847±0.026

Before making a final conclusion, it should be noted that the first two groups do not differ in gender and age, but have a difference in the number of died patients in the studied groups. Accordingly, the question arises about the impact of the sample size, about the proportion of favorable and unfavorable outcomes. There was also a data set place at different times and by different specialists. In the future, an additional set of data is expected, the determination of influencing factors on the validity of the predictive model, the expansion of methods for evaluating the decisive rule and its improvement by recalculating the coefficients of the mathematical model. So, we can conduct that any decision rule requires revision over time, its clarification and, if necessary, adjustments and updates.

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