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STRATIFICATION METHODS OF OPERATIONAL RISK IN CARDIOSURGICAL PATIENTS. LITERATURE REVIEW

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The authors declare that they have no conflicts of interest

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Abstract

The article discusses the issues of predicting the likelihood of a postoperative complication in cardiac surgery patients by stratifying the risks associated with surgical intervention. The author used the Aristotle Basic Score and EuroSCORE scales, the most common in the practice of a cardiac surgeon, showed the feasibility and effectiveness of their use, and an assessment of the results obtained.

Кардиохирургиялық науқастардың ота қауіпін стратификациялау әдістері. Әдебиет шолуы

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ота қауіп-қатері, кардиохирургия, жүрек ақаулары

Аңдатпа

Мақалада хирургиялық араласуға байланысты тәуекелдерді стратификациялау арқылы кардиохирургиялық науқастарда операциядан кейінгі асқынулардың ықтималдығын болжау мәселелері талқыланады. Автор кардиохирург тәжірибесінде жиі кездесетін Aristotle Basic Score және EuroSCORE шкаласын қолданып, оларды қолданудың орындылығын, тиімділігін және алынған нәтижелерді бағалауды көрсетті.

Методы стратификации операционного риска у каридохирургических пациентов. Обзор литературы

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Конфликт интересов
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Ключевые слова:
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Аннотация

В статье обсуждены вопросы прогнозирования вероятности послеоперационного осложненного течения у пациентов кардиохирургического профиля путем стратификации рисков, связанных с хирургическим вмешательством. Автор использовал шкалы Aristotle Basic Score и EuroSCORE, наиболее распространенные в практике кардиохирурга, показал целесообразность и эффективность их применения, оценку полученных результатов.

Introduction

As a rule, when assessing the risks associated with cardiac surgery, factors such as compensation, comorbidity, age, complexity of anatomy, time of artificial circulation, time of aortic compression, depth of hypothermia, methods of protection of ischemic myocardium, experience of the surgeon, category of complexity of surgery, hospital equipment and others are taken into account [21, 22, 36]. In this regard, it is obvious that cardiac surgeons need to use one or more unified operational risk assessment scales in order to have more information about the frequency and nature of possible complications in the early postoperative period. However, experience shows that in most cases there is an underestimation of the prognostic capabilities of stratification scales, which,

among other things, can lead to an undesirable outcome of the disease with an adequate treatment method [21, 22, 36]. This state of affairs at the present stage of development of cardiac surgery, including children's, is one of the urgent problems that requires a systematic approach and the adoption of appropriate recommendations in the near future.

The application of these developments and the analysis of the results obtained are the first on the territory of Kazakhstan. Based on the analysis of the experience of surgical operations in patients with a cardiac surgical profile, the modeling of operational risk was performed using various stratification techniques [22]. There are many publications devoted to this problem in the available literature. However, they are relevant only to the region or country where these studies were actually conducted, which limits their use to a certain extent [31, 32, 34]. From this point of view, these methodological recommendations represent a reasonable and unique opportunity to make an adequate prediction of possible operational risks in patients with a cardiac surgical profile based on the use of modern and proven stratification scales, such as EuroSCORE and Aristotle basic complexity score (ABC score), based on significant clinical material.

Risk stratification in cardiac surgery

There are numerous papers devoted to risk stratification in cardiac surgery using various scales ABC score, Aristotle Comprehensive Complexity score, EuroSCORE, EuroSCORE-II, GRACE, Mass-DAC Mortality Risk, PCI Risk score, RACHS-1, STS score, STS-EACTS Mortality score, CRUSADE, SYNTAX score and many others. The prognostic value of these scales is known, and it has been proven in patients with a large number of observations. The most popular in clinical practice among these stratification scales are EuroSCORE, EuroSCORE-II and SYNTAX score in patients with coronary heart disease and PPS, as well as ABC score, RACHS-1, STS-EACTS Mortality score in patients with CHD [1, 2, 4, 7, 10, 12, 13, 16, 20].

Taking into account the data we have obtained, in order to ensure the most favorable conditions for surgical intervention and the course of the hospital period in patients with high and significantly high operational risks, it is necessary to: attract additional safety technologies and other auxiliary methods of blood circulation; if necessary, divide operations into stages; if possible, use hybrid operations involving modern endovascular technologies; abandon anyor surgical intervention due to an unreasonably high risk of mortality.

Scales used in patients with congenital heart defects

Risk adjustment for congenital heart surgery (RACHS-1)

The RACHS-1 method was developed by a team of researchers from Boston Children's Hospital (USA) and 11 national representatives from pediatric cardiologists and cardiac surgeons [7, 8]. Initially using a clinical assessment, with further refinement based on 2 national databases, 207 surgical interventions were identified in 6 different categories with a similar risk of hospital mortality.

Three additional clinical factors, such as age, prematurity and non-cardiac congenital structural abnormalities, complement the model. Risk stratification was performed based on the observation of 889 children under the age of 15 who underwent 1019 operations (Table 1).

STS-EACTS (STAT) mortality score

The STS-EACTS (STAT) mortality score, published in 2008, was developed using objective data with minimal subjective probability [24, 25]. Mortality risk was assessed for 148 types of surgical interventions using real data of 77294 patients (including 33360 patients from EACTS and 43934 patients from STS) for the period from 2002 to 2007.

Each operation received a score from 0,1 to 5,0, depending on the estimated lethality. Then the operations were distributed according to the increasing risk and grouped into 5 categories (Table 2). The effectiveness of this model was subsequently evaluated on an independent sample of 27700 patients and compared with previous methods (RACHS-1 and ABC score).

The STS-EACTS (STAT) mortality score represents a stage of evolution in this matter, including previously proposed stratification models that had a certain degree of subjectivity. This scale stratifies mortality according to real data for each surgical intervention taken from the multicenter database STS-EACTS.

Aristotle basic complexity score

In 1999 Lacour-Gayet F. and a committee of experts created a tool for stratification of complexity and called it the ABC score, referring to Aristotle's philosophy (Rhetoric, Book I, 350 BC): "Where there is no available scientific answer, an opinion that is perceived and accepted by the majority has true value" [3, 10, 11].

A group of 50 surgeons from 23 countries, representatives of the four largest international societies for pediatric cardiac surgery (STS, EACTS, CHSS and ECHSA), suggested that the complexity of the operation consists of three factors: surgical mortality, surgical intervention and its technical complexity (Table 2).

Each surgical operation received a score for each of the three factors in the range from 0.5 to 5, forming a score in the range from 1.5 (0,5+0,5+0,5) up to 15 (5+5+5). Surgical interventions were divided into categories (similar to RACHS-1) according to scores: 1st level (from 1,5 to 5,9), 2nd level (from 6,0 to 7,9), 3rd level (from 8,0 to 9,9) and 4th level (from 10,0 to 15,0). According to the required analysis, both the score and the level (categories) can be used.

Table 1.
Risk categories in patients with CHD according to various stratification scales [2]

RACHS-1	STS-EACTS (STAT) mortality score	Aristotlebasicscore
Category 1 PDA>30d, OS ASD, sinus venosus septal defect, aortic coarctation>30d, PAPVC	Category 1 ASD, VSD, Fontan (lateral tunnel, fenestrated), aortic coarctation repair (end to end), TOF repair (no TAP)	Category 1 ASD repair, AVSD repair (intermediate and partial), PDA, PAPVC repair
Category 2 VSD, TOF, Glenn, OP ASD, aortic coarctation at age<30d, ASD and VSD, repair of total anomalous pulmonary veins at age >30d	Category 2 PDA, mitral plasty, Glenn, TOF (TAP), Fon-tan (external conduit, fenestrated)	Category2 VSD, Glenn, Systemic to pulmonary shunt (MTBS and central), TOF (ventriculotomy, non-TAP)
Category 3 Fontan procedure, Systemic to pulmonary artery shunt, mitral valvotomy or valvuloplasty, MVR, PA banding	Category 3 Arterial switch operation, coarctation repair (patch aortoplasty), AVSD repair (complete), coarctation repair + VSD repair, Rastelli	Category 3 TOF (TAP), Fontan, TAPVC repair, mitral valvuloplasty, MVR
Category 4 Arterial switch operation with VSD closure, atrial septectomy, repair of total anomalous pulmonary veins at age <30d	Category 4 Arterial switch operation and VSD repair, Arterial switch procedure + aortic arch repair, PA banding, systemic-pulmonary shunt (MBTS or central), MVR, TOF-AVSD repair	Category 4 Senning, ASO, ASO and VSD, DORV (intraventricular tunnel repair), Rastelli, Norwood
Category 5 Repair of truncusarteriosus and interrupted arch, tricuspid valve repositioning for neonatal Ebstein anomaly at age <30d	Category 5 Norwood procedure, Damus-Kaye-Stansel procedure	-
Category 6 Norwood operation, Damus-Kaye-Stansel procedure	-	-

Note: PDA = patent ductusarteriosus; OS ASD = ostiumsecundum atrial septal defect; PAPVC = partial anomalous pulmonal veins connection

Scales used in patients with acquired heart defects and coronary heart disease

EuroSCORE and EuroSCORE-II

EuroSCORE is a cardiac risk model for predicting mortality after cardiac surgery. The scale was published in 1999 and is based on an international European database of patients who underwent cardiac surgery by the end of 1995.

The EuroSCORE-II scale was developed based on the analysis of data from 22 381 patients from 154 clinics in 43 countries who underwent heart surgery: 45% – coronary bypass surgery, 45% – valve surgery, 10% – other cardiac surgery. EuroSCORE-II was first proposed at the annual conference of the European Association of Cardiothoracic Surgeons (EACTS) in Lisbon in 2011 [29].

In the improved EuroSCORE-II, all the disadvantages of EuroSCORE and the logistics version of EuroSCOREwere eliminated, such as the low prevalence of age-related patients (80-year-olds), combinations of valve surgery, and a gradation of the functional ability of the kidneys was added (Table 2). Unlike the previous version, EuroSCORE-II allows stratification of operational risk, including the following factors: insulin-dependent diabetes mellitus; 1-, 2-, 3-, 4- 1st FC according to NYHA; angina pectoris of the 4th FC according to CCS; function of the left ventricle, including the left ventricle <20%; pulmonary hypertension, including the average pressure in the pulmonary artery of 31-55 mmHg; the volume of surgical intervention: isolated aorto-coronary bypass surgery, one operation without aorto-coronary bypass surgery, two or three operations [29].

Risk stratification according to the model of the Society of Thoracic Surgeons STS Score (The Society of Thoracic Surgeons) (ESC/EACTS) [2, 30] in both 2010 and 2014 has the highest class of evidence and is confirmed for the best prognosis in a more severe contingent of patients who underwent cardiac surgery, or with a combination of coronary bypass surgery and prosthetics of heart valves. This model includes both demographic and clinical variables. Studies by Sedaghat A. et al. and Yamaoka H. et al. show an excellent ability to calibrate the EuroSCORE-II scale and excessive risk assessment calculated using the STS Score model [26, 36].

Table 2.
Basic characteristics of the EuroSCORE-II and EuroSCORE scales

Risk factors	EuroSCORE-II	EuroSCORE
Patient-related factors	Age	
	Gender	
	Extracardiacarteriopathy	
	Chronic pulmonary disease	
	Insulin-dependent diabetes mellitus	-
	Poor mobility	Neurological dysfunction
	Renal dysfunction Dialysis Creatinine Clearance<50 ml/min Creatinine Clearance>50 ml/min	Serum creatinine>200μmol/L
Cardiac-related factors	Active endocarditis	
	Recent MI	
	Class ofNYHA II III IV	-
	CCS angina class 4	Unstable angina
	LV function,%	
	>50 31-50 21-30 <20	>50 31-50 <30
	Pulmonary hypertension	
	31–55 mmHg >55 mmHg	>60 mmHg
Urgency	Elective Urgent Emergency Salvage	Emergency
Surgicalintervention	CABG Valve placement Aortic root replacement Prosthetics structural defect Maze procedure Resection of a cardiac tumor	CABG VSD after MI

Conclusion

Stratification of operational risk in patients with cardiac surgery is a daily necessity in the practice of a modern hospital, which allows monitoring the course of the postoperative period and helps to reduce the incidence of serious complications and mortality. According to the data obtained, reliable effectiveness of the EuroSCORE and ABC score stratification scales, respectively, was noted in all groups of patients, which dictates their use in clinical practice with a high degree of confidence.

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