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EFFECTIVENESS OF A MODEL FOR PREDICTING COMPLICATED COURSE OF SUPRAVESICAL OBSTRUCTION

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Introduction

Supravesical obstruction is a pathology often encountered in urological patients. By affecting the kidney tissue, it causes disturbances, including the cessation of kidney function and the development of complications that can result in death. The patient's treatment strategy depends on the nature of the disease, the results of laboratory tests, as well as the cause and location of the obstruction. The acute form of the disease can be manifested by pain in the lumbar region, elevated body temperature above 38 °C with chills, general weakness, nausea and vomiting, as well as urination problems. When examining a patient, special attention is paid to the results of an ultrasound examination of the kidneys and bladder (assessment of the degree of dilation of the ureter, pelvis and parenchyma thickness), blood tests (assessment of urea and creatinine levels, changes in the leukocyte formula, procalcitonin level), computed tomography and x-ray examination of the kidneys and pelvic organs (if necessary, using a contrast agent). Considering the results of these diagnostic methods, which reveal significant changes, the patient is recommended to use conservative or surgical treatment. Assessing the prognosis for this group of patients is difficult and definitive conclusions are difficult(1-3).

The outcome of the disease depends on several factors, including the cause, location, degree and duration of obstruction. An aggravating factor is the presence of infection, especially its presence. If there is satisfactory or good renal function, as well as the ability to eliminate obstruction and its causes, which, in turn, will eliminate the complicating infection, the prognosis is usually favorable. However, to establish a more accurate prognosis and evaluate results, it is necessary to take into account additional factors, such as the presence of concomitant diseases, the individual characteristics of the patient and the effectiveness of the chosen treatment tactics (4-6).

Purpose: development of models for predicting course of supravesical obstruction.

Materials and research methods:

We analyzed the data of 655 patients admitted with supravesical obstruction to the State Institution "RSSPMCU" from 2021 to 2023. The average age of the patients was 39.56+17.27 (4-86) years, of which 350 (53.4%) were men and 305 (46.6%) women. Patients were divided into groups according to the main diagnoses, such as urolithiasis (ULD) - 231 (35.3%), urinary tract infection (UTI) - 36 (5.5%), urinary tract stricture - 247 (37.7%) , ureteral stricture - 55 (8.4%), ureterocele - 30 (4.6%), ureteral obliteration - 56 8.5%). Table 1.

Table 1 Distribution of patients with supravesical obstruction by gender and underlying disease.

	Men n=350	**Women n=305**
Age	37,87+16,68 [4-74]	41,50+17,66 [4-86]
Diagnoses:		
ULD (n=231)	157 (68,0%)	74 (32,0%)
UTI (n=36)	6 (16,7%)	30 (83,3%)
UPJ stricture (n=247)	136 (55,1%)	111 (44,9%)
Ureteral stricture (n=55)	17 (30,9%)	38 (69,1%)
Ureterocele (n=30)	12 (40,0%)	18 (60,0%)
Obliteration of the ureter (n=56)	22 (39,3%)	34 (60,7%)

Note: A statistically significant difference were between men and women in terms of age, P=0.007. For nominal variables of diagnoses, $\chi 2$ value = 57.321 P<0.001.

All patients, according to indications, underwent conservative or surgical treatment. Conservative treatment was carried out in 36 (5.5%) patients, the vast majority of them had BMI - 24 (66.7%). The remaining patients underwent 640 surgical interventions, of which: drainage of the upper bladder - 90 (14.1%), reconstructive surgery - 260 (40.6%), stone removal - 231 (36.1%) and organ removal surgery - 59 (9.2%), Table 2.

Table 2 Distribution of patients with supravesical obstruction according to surgical intervention.

	Drainage of UUT	Reconstructive surgeries	Removing stones	Nephrectomy	Total
UTI n=36	6 (75,0%)	0 (0,0%)	0 (0,0%)	2 (25,0%)	8 (1,3%)
ULD n=231	14 (5,7%)	0 (0,0%)	231 (93,9%)	1 (0,4%)	246 (38,4%)
Obliteration of the ureter n=56	38 (73,1%)	12 (23,1%)	0 (0,0%)	2 (3,8%)	52 (8,1%)
UPJ stricture n=247	25 (9,7%)	182 (70,8%)	0 (0,0%)	50 (19,5%)	257 (40,2%)
Ureteral stricture n=55	7 (11,9%)	48 (81,4%)	0 (0,0%)	4 (6,7%)	59 (9,2%)
Ureterocele n=30	0 (0,0%)	18 (100,0%)	0 (0,0%)	0 (0,0%)	18 (2,8%)
Total:	90 (14,1%)	260 (40,6%)	231 (36,1%)	59 (9,2%)	640 (100,0%)

The construction of the forecasting model is justified taking into account 16 factors called from x1 to x16, which are dichotomous in nature. Variables: x1 – presence of pain in the lumbar region, x2 – hyperthermia (temperature above 38C), x3 – previous surgical interventions on the kidney or ureter, x4 – MDPL above 2.7 cm, x5 – thinning of the renal parenchyma (less than 6mm), x6 – presence of stones in the urinary tract, x7 – presence of stone(s) in the ureter, x9 – kidney function (iv urography), x10 – leukocyturia (above 25,000 in 1 ml), x11 – presence of bacteria in the urine, x12 – blood leukocytosis (above 11 ,6), x13 – increased urea level, x14 – increased creatinine level, x15 – unilateral kidney damage, x16 – kidney damage on both sides (single kidney). The state variable is defined as the conclusion of a complicated course, which is also dichotomous in nature, taking the values "yes" and "no". The discriminant analysis had the following parameters: a priori probabilities by equal groups, the covariance matrix was within groups.
Having received the specific weight of each factor, we obtained the number Z, which predicts the course of a given nature of supravesical obstruction as "complicated" or "not".

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Results

The discriminant analysis function for the group of patients with BMI (n=36) showed the following canonical formula: x1 - 0.302; x2 – 1.171; x3 - 0.728; x4 - 2.212; x5 - 0.939; x6 - 0.308; x7 - 0.487; x8 - 1.222; x9 - 1.291; x10 - 0.718; x11 - 0.427; x12 - 0.903; x13 - 0.034; x14 - 0.449; x15 - 0.501; x16 - 1.449; The Z number value for the BMI group averaged 4.743+4.509 (min - 0.302 – max 13.141). The cut-off point is 5.061 according to ROC curve analysis. The area under the curve is 0.891

The discriminant analysis function for the group of ULD patients (n=231) showed the following canonical formula: x1 - 0.043; x2 - 0.882; x3 - 0.062; x4 - 1.114; x5 - 0.305; x6 - 0.643; x7 - 0.077; x8 - 1.049; x9 - 0.230; x10 - 0.415; x11 - 0.508; x12 - 0.091; x13 - 0.309; x14 - 0.148; x15 - 0.644; x16 - 0.157; The Z number value for the ULD group averaged 2.407+2.235 (min -0.043 – max – 6.677). The cut-off point is 1.526 according to the ROC curve analysis. The area under the curve is 0.89

The discriminant analysis function for the group of patients with ureteral obliteration (n=56) showed the following canonical formula: x1 - 0.705; x2 - 0.244; x3 - 0.478; x4 - 0.111; x5 - 0.490; x6 - 0.158; x7 - 0.004; x8 - -0.433; x9 - 0.893; x10 - 0.222; x11 - 0.802; x12 - 1.592; x13 - 0.659; x14 - 1.089; x15 - 0.117; x16 - 0.395; The Z number value for the group with ureteral obliteration averaged 6.095+2.246 (min - 0.893 - max - 8.392). The cut-off point is 4.975 according to ROC curve analysis. The area under the curve is 0.889

The discriminant analysis function for the group of patients with ureteral stricture (n=55) showed the following canonical formula: x1 - 0.260; x2 - 0.053; x3 - 0.118; x4 - 0.353; x5 - 0.007; x6 - 0.107; x7 - 0.116; x8 - 0.381; x9 - 0.041; x10 - 0.365; x11 - 0.577; x12 - 0.364; x13 - 0.364; x14 - 0.032; x15 - 0.169; x16 - 0.089. The Z number for the group with ureteral stricture averaged 1.224+0.945 (min – 0.053– max – 3.396). The cut-off point is 1.325 according to the ROC curve analysis. The area under the curve is 0.959

The discriminant analysis function for the group of patients with ureterocele (n=30) showed the following canonical formula: x1 - 0.194; x2 - 0.239; x3 - 0.079; x4 - 0.683; x5 - 0.092; x6 - 0.191; x7 - 0.534; x8 - 0.633; x9 - 0.604; x10 - 0.593; x11 - 0.383; x12 - 0.437; x13 - 0.525; x14 - 0.822; x15 - 0.640; x16 - 0.716; The Z number for the ureterocele group averaged 2.813+2.346 (min – 0.092 – max – 7.365). The cut-off point is 5.435 according to ROC curve analysis. The area under the curve is 0.714

Discussion

Today, discriminant forecasting models are widely used in medicine (7). Such models provide a tool for determining probabilities and predicting various clinical situations and their outcomes based on a set of input variables. They use discriminant analysis to determine differences between groups of patients or pathological conditions and create a predictive model (8, 9).

For example, a study by Ahmed A. Shokeir evaluated various urinary biomarkers in the diagnosis of congenital supravesical obstruction. Findings from this study indicate significant progress in identifying biomarkers to diagnose and assess prognosis in children with congenital obstructive uropathy. Various cytokines, peptides, enzymes, and microproteins have been identified as important contributors or consequences of obstruction causing renal fibrosis and apoptosis. The most promising biomarkers are the growth factor transforming growth factor-β1 (TGFβ1), epidermal growth factor (EGF), endothelin-1 (ET-1), and a panel of tubular enzymes(10). These biomarkers demonstrate high sensitivity, specificity, and overall accuracy in the diagnosis of congenital obstructive uropathy in children. In addition, they can help differentiate between dilated kidneys without obstruction that require conservative treatment and obstructed kidneys that require surgical correction. However, some limitations of previous studies include the lack of different types of controls and small sample size. Larger studies with diverse control groups are required to confirm the clinical utility of biomarkers in the diagnosis and monitoring of children with congenital obstructive uropathy (11).

Satoshi Washino et al. other risk factors indicating renal damage from supravesical obstruction were assessed. The publication describes that the role of risk factors (or biomarkers) for renal injury in patients with upper urinary tract obstruction is in diagnosis, risk stratification, clinical decision making and monitoring. Although a variety of urinary and serum biomarkers have been studied in children and adults with UUTO, MCP-1 and NGAL are the most studied and probably the optimal biomarkers. Recently discovered new biomarkers such as vanin-1 and α-GST have shown superior performance in assessing supravesical obstruction compared with

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traditional biomarkers. The assessment of only one risk factor is not sensitive and specific enough, so panel assessment of several biomarkers makes it possible to compensate for their interaction and increases predictive capabilities. Thus, building a discriminant model to evaluate multiple biomarkers is very important in the treatment of supravesical obstruction (12).

Conclusion:

The discriminant model for "predicting supravesical obstruction" according to the underlying disease has high sensitivity and specificity, as well as diagnostic accuracy in predicting the complicated course of supravesical obstruction.

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