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PREDICTIVE VALUE OF GENERAL BLOOD ANALYSIS INDICATORS TO PREDICT MORTALITY IN ELDERLY PATIENTS

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Management of acute abdominal diseases at senile and elderly patients, prognosis of the outcomes is very important issue of surgery. The purpose of the study was to identify of mortality predictors among the parameters of periphery blood analyses and evaluate the prognostic value in elderly patients. We have analyzed the outcomes of the 216 elderly patients with acute abdomen, who underwent urgent surgical procedure. Results of our study, acquired by binary logistic regression, Pearson correlation and Area Under the Receiver Operating Characteristics analysis revealed that the hemoglobin and white blood count as good predictors. Survival depending of the cut off values for hemoglobin (11.04 g/dl) and white blood count ($14.05x10^{3}$/l) was statistically different. Thus, anemia positively, leukocytosis negatively correlates with outcomes. Hemoglobin values and leukocyte counts have a high predictive value for predicting mortality after emergency surgery in elderly and senile patients.

Key words: abdominal cavity, hemoglobin, leukocytes, surgical treatment

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ПРОГНОСТИЧНА ЦІННІСТЬ ПОКАЗНИКІВ ЗАГАЛЬНОГО АНАЛІЗУ КРОВІ ДЛЯ ПРОГНОЗУВАННЯ ЛЕТАЛЬНОСТІ У ХВОРИХ ПОХИЛОГО ВІКУ

Ведення гострих захворювань черевної порожнини у пацієнтів похилого віку, а також прогноз результатів оперативних втручань – одна з найважливіших проблем хірургії. Мета дослідження полягала у виявленні предикторів смертності серед параметрів аналізу периферичної крові та оцінці їхньої прогностичної цінності для пацієнтів похилого віку. Ми проаналізували результати 216 пацієнтів з гострим животом, яким у терміновому порядку було проведено хірургічне втручання. Результати нашого дослідження, отримані шляхом побудови бінарної логістичної регресії та обчислення кореляції Пірсона, показали, що такі параметри, як показники гемоглобіну та лейкоцитів, є хорошими предикторами виживання при оперативних втручаннях у осіб похилого віку. Виживання залежно від порогових значень гемоглобіну (11,04 г/дл) та кількості лейкоцитів (14,05х103/л) мало статистично достовірні відмінності. Таким чином, анемія позитивно, лейкоцитоз негативно корелює з постоперативними наслідками. Значення гемоглобіну та кількість лейкоцитів мають високу цінність для прогнозування смертності після екстрених операцій у пацієнтів похилого та старечого віку.

Ключові слова: черевна порожнина, гемоглобін, лейкоцити, хірургічне лікування.

The study is carried out within the framework of the dissertation on the subject "Surgical tactics for acute abdominal diseases in elderly and senile people".

According to the World Health Organization, the number of people in older age groups is increasing worldwide. Statistics show that 125 million people aged 80 and over live in different countries [1]. In connection with the increase in the number of elderly and senile people, the incidence of acute pathologies of the abdominal organs, requiring urgent surgical care, also increases [10, 12, 14].

Acute diseases of the abdominal organs in old age have a blurred clinical picture, which aggravates the diagnosis and planning of the surgical treatment regimen. The weakened body of elderly people with lost compensatory mechanisms very often leads to an unfavorable course of the postoperative period and unsatisfactory results of surgical treatment [4, 5, 8].

An important factor in the success of the treatment of elderly patients is, first of all, diagnosis and immediate course of action. There are publications in the literature with the results of various prognostic tests (ASA, APACHI, POSSUM, etc.) that can reliably predict mortality in a group of patients with indications for emergency surgery. But each of them has its own shortcomings and often requires special analyzes with the involvement of different computational functions [6, 7]. Almost all of these systems require the use of indicators during surgery or after surgery. From a practical point of view, all of the above does not satisfy surgeons [3, 9, 13].

Choosing the optimal scheme for preoperative preparation, recognizing risk factors, predicting complications is not a completely solved problem of surgical treatment of elderly patients with acute diseases of the abdominal organs, which requires deep research in this direction [2, 11].

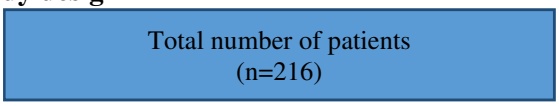
Purpose of the study was to identify the correlation between indicators of the general blood test and the outcome of treatment, as well as to determine the predictive abilities of markers in elderly and senile patients with acute diseases of the abdominal organs.

Materials and Methods: The results of studies of 216 elderly and senile patients with acute diseases of the abdominal organs, who received treatment on the basis of the [1]Azerbaijan State Institute for Advanced Training of Doctors in the clinical city hospital No. 3 in the period from 2010 to 2020, were analyzed. The average age of patients is 70.71±0.46 years, from 62 to 91 years. There were 150 men out of 216 (69.4 % and 66 out of 216 women (30.6 %). Patients were divided by age into 4 subgroups: 62–65 years old (n=40); 66–75 years old (n=71); 76–85 years old (n=35); ≥86 years (n=4). The ratio of men / women in age subgroups did not differ significantly (p>0.05).

More than half of the total study material consisted of patients with strangulated hernias of the anterior abdominal wall: 127 out of 216 (58.8 %). The second place was taken by patients with perforated gastric and duodenal ulcers: 39 out of 216 (18.1 %). Further on the list were patients with acute calculous cholecystitis: 29 out of 216 (13.4%); with intestinal obstruction: 11 of 216 (5.1 %) and with acute appendicitis: 10 of 216 (4.6 %).

Immediately after admission, all patients underwent general and biochemical blood tests, urine and feces analysis, radiological and additional testing as indicated. After preoperative preparation, all patients underwent surgical intervention according to indications. The average duration of surgical interventions was 129.9±46.8 minutes, and the duration of anesthesia was 178.2±65.1 minutes. After the operation, the patients received intensive therapy, and then were transferred to the general regime wards. In-hospital mortality after surgery was 11.1 % (24/216). The correlation between the indicators of the general blood test and the outcome of treatment was studied; these indicators were also comparatively studied in the survivors and the deceased.

Study design



Stage 1 – clinical examination, general and biochemical blood analysis, urine and feces analysis, radiological and additional studies according to indications.

Stage 2 – surgery

Stage 3 – the study of the correlation between indicators of the general blood test and the outcome of treatment.

The study was conducted in compliance with international ethical principles (Declaration of Helsinki, 1964). Informed consent was obtained from patients.

Data processing: All parameters and data were collected in an Excel table and then transferred for processing using the IBM SPSS-20 program. Continuous variables were expressed as mean ± median (M ± m). Categorical variables are expressed as actual numbers and percentages. Statistical analysis was performed using the nonparametric Mann-Whitney U-test and Student's t-test. Values were considered statistically significant at p<0.05. Correlation relations between the parameters were found out by the method of pair correlation. ROC (Receiver Operating Characteristic) curves were used to assess various cut-off values. Values were considered statistically significant at p<0.05.

Kaplan-Meier curves were used to illustrate survival data, and log rank tests were used to test for statistically significant survival.

Results of the study and their discussion. Of the 216 elderly and senile patients operated on for acute diseases of the abdominal organs, 192 (88.9 %) patients were safely discharged from the hospital. The average number of bed-days was 6.95±0.32 days, postoperative complications occurred in 57.4 % (124/216) of cases. Within 30 days after surgery, 24 patients out of 216 under observation died, the overall mortality rate was 11.1 %. Among the causes of death, the main place was occupied by acute heart failure – in 10 cases; for other reasons: pulmonary embolism – in 3 cases; acute respiratory failure – in 3 cases; sepsis, severe intoxication – in 6 cases; acute renal-hepatic failure – in 2 cases. The age of the deceased did not statistically differ from the age of the survived (71.3±1.5 and 70.6±0.5, respectively, p>0.05). There were twice as many men among patients with a fatal outcome as women (16 men and 8 women). But in terms of percentage in subgroups divided by sex, there was no statistical difference in mortality rates (men 11 %, women 12 %, p>0.05). The highest mortality was observed on admission between 3 and 7 days after the onset of symptoms. In our study, among this contingent of patients, the deceased were 6 patients out of 24 (23 %). The lowest mortality was observed in patients admitted more than 14 days after the onset of symptoms.

A general blood test was performed in all patients immediately after admission. The indicators of the general analysis of blood in all patients, as well as comparatively in the groups of deceased and survived patients, are shown in Table 1.

Table 1

Complete blood count in elderly and senile patients

	Hb	Leukocytes	Erythrocytes	Lympho-cytes	Monocytes	Eosino-phils	Neutro-phils	Platelets	ESR
General	12.05±0.67	12.35±0.16	3.8±0.87	1.51±0.03	5.48±004	1.58±0.45	7.05±0.27	228±6.84	47.6±1.6
Survivors	12.29±0.64	11.9±0.14	3.86±0.97	1.53±0.22	5.4±0.036	1.57±0.45	6.92±0.27	234.5±7.52	46.1±1.67
Deceased	10.62±0.09	15.9±0.44	3.54±0.07	1.35±0.16	6.08±0.13	1.59±0.44	8.08±1.15	175.3±7.02	59.5±4.66
P	<0.001	<0.001	<0.01	<0.001	<0,001	>0.05	<0.001	<0.001	<0.01

Note: Hb – hemoglobin (g/dl); Leukocytes ($x10^3$); Erythrocytes ($x10^3$); Lymphocytes (/μL); Monocytes (/μL); Neutrophils (/μL); Platelets ($x10^3$); ESR – Erythrocyte sedimentation rate (mm/hour). P – the difference between the indicators, the difference is considered significant at p<0.05

As can be seen from the table, there is a statistically significant difference between all indicators of a general blood test in surviving and deceased patients. In our study, the highest degree of reliability was observed in relation to most indicators of the general blood test: hemoglobin level, the number of leukocytes, lymphocytes, monocytes, neutrophils and platelets. At the same time, the average values of the number of leukocytes, lymphocytes, monocytes and neutrophils in the group of deceased patients were higher, and the average values of erythrocytes and platelets were lower than in the group of patients who survived after abdominal surgery. In addition, the smallest degree of intergroup differences took place in the number of eosinophils; this indicator did not show pronounced differences in survived and deceased patients.

The erythrocyte sedimentation rate also statistically significantly differed in deceased and survived patients: the mean values of this indicator were 59.5±4.66 mm/h in deceased patients versus 46.1±1.67 mm/h in survivors.

However, for a more reliable analysis of the prognostic significance of various indicators of a complete blood count, we analyzed the dependence of the outcome of the disease (alive or dead) on independent variables, such as the concentration of hemoglobin, the number of blood cells (leukocytes, lymphocytes, monocytes, neutrophils, platelets, eosinophils) and ESR. Regression analysis showed that among all the studied indicators, the hemoglobin concentration and the number of leukocytes in the blood have the best chances of predicting the outcome of the disease (sensitivity 76.5 %; specificity 94.5 %)

The next step of statistical processing was to clarify the correlations between the outcome of the disease and the studied indicators of the general blood test.

According to the results obtained, the hemoglobin concentration (r=0.521; p=0.000), the number of lymphocytes (r=0.145; p=0.034) and platelets (r=0.186; p=0.006) have positive, and the leukocytes (r= 0.536; p=0.000), monocytes (r=-0.387; p=0.000) and ESR (r=-0.180; p=0.008) – negative correlation with the disease outcome. In all other cases, except erythrocytes and neutrophils, the correlation was statistically significant.

For indicators with positive (Fig. 1a) and negative (Fig. 1b) correlation, a ROC curve was constructed.

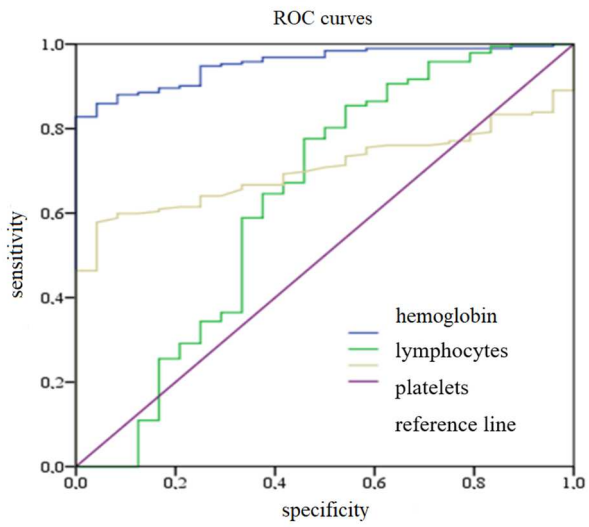


Fig. 1a. ROC analysis for hemoglobin, lymphocytes and platelets;

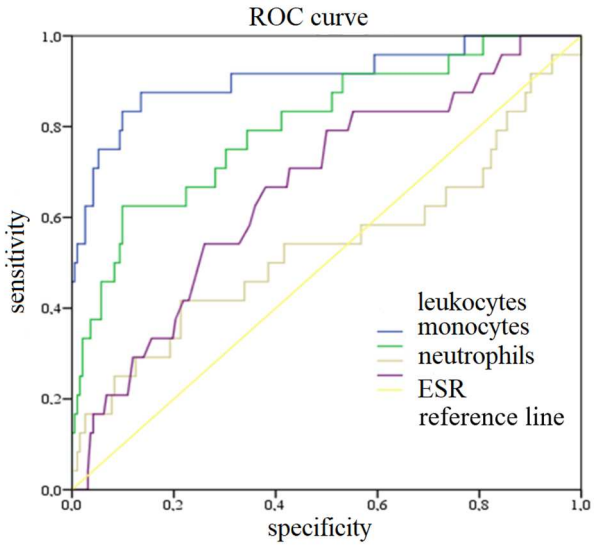


Fig. 1b. ROC analysis for leukocytes, monocytes, neutrophils and ESR.

Using the data, the cut off values, area under the curve, sensitivity and specificity of the predictors were determined (Table 2).

□□bl□2

Results of ROC analysis with threshold values of indicators

Indicator	Cut off	AUROC	Sensitivity %	Specificity %
Hemoglobin	11.08	0.954	88	87.5
Leukocytes	14.05	0.908	87.5	86.5
Erythrocytes	1.45	0.637	64.6	62.5
Monocytes	5.6	0.802	70.8	70.3
Neutrophils	1.45	0.536	54.2	53.6
Platelets	190	0.706	67	67
ESR	53	0.666	67	62

As can be seen from table 2, indicators of the general blood test had different significance for predicting the outcome of the disease. Thus, the values of hemoglobin (Hb)=0.954 and leukocytes=0.908 showed a fairly high efficiency as a predictor, while monocytes and platelets – good efficiency at AUROC (Area Under the Receiver Operating Characteristics) values of 0.802 and 0.706, respectively. For lymphocytes and ESR, AUROC values were consistent with the average efficacy as a test for predicting disease outcome. It should be noted that the highest sensitivity and specificity was shown by the hemoglobin concentration (88 % and 87.5 %, respectively) and the number of leukocytes (87.5 % and 86.5 %, respectively). The corresponding indicators for monocytes were somewhat inferior to these values (sensitivity 70.8 %, specificity 70.3 %).

In contrast to the above, AUROC of neutrophils (0.536, between 5 and 6) indicates that, as a prognostic test, this indicator is unsatisfactory, having 53.6 % specificity and 54.2 % sensitivity.

Survival was determined using the Kaplan-Meier method depending on the threshold values of the indicators of the general blood test. The results obtained for hemoglobin and leukocytes are shown in Fig.2a and Fig.2b.

When analyzing nosocomial survival and its relationship with indicators of a general blood test, it was found that nosocomial survival in patients with hemoglobin levels greater than the threshold value (>11.02 g/dl) was 97.7 %, while in the group with a threshold value of Hb<11.02 g/dL dropped to 52.4 %. Among other indicators, a similar trend was observed with the cut off of the number of leukocytes: at>14.05, the survival rate was 55.3 %; and at <14.05, the survival rate is 98.2 %. Log Rank, Breslow, Tarone-Ware tests have shown a statistically significant difference between survival rates.

Anemia is one of the most important risk factors in patients undergoing emergency surgery, since it contributes to anastomotic insufficiency and other postoperative complications. [3]. In our study, anemia and leukocytosis showed a high predictive value, which is consistent with the data of some authors who found that postoperative 30-day mortality after non-cardiac surgery was higher in patients with anemia than in patients without anemia [11]. Similar data was obtained by other researchers using a multivariate logistic regression model to assess the impact of preoperative anemia on postoperative outcomes with

hepatectomy [15]. In all probability, such results are a consequence of hypoxia and low adaptive capabilities that accompany anemia and create an unfavorable background in the postoperative period.

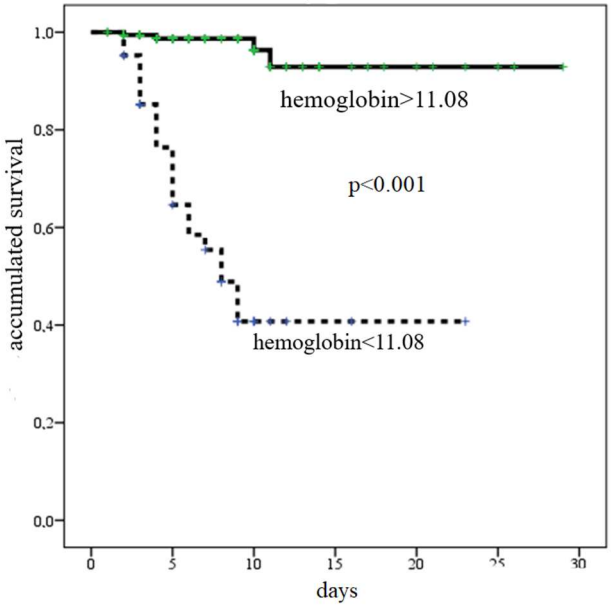


Fig. 2a. Survival depending on cut off hemoglobin.

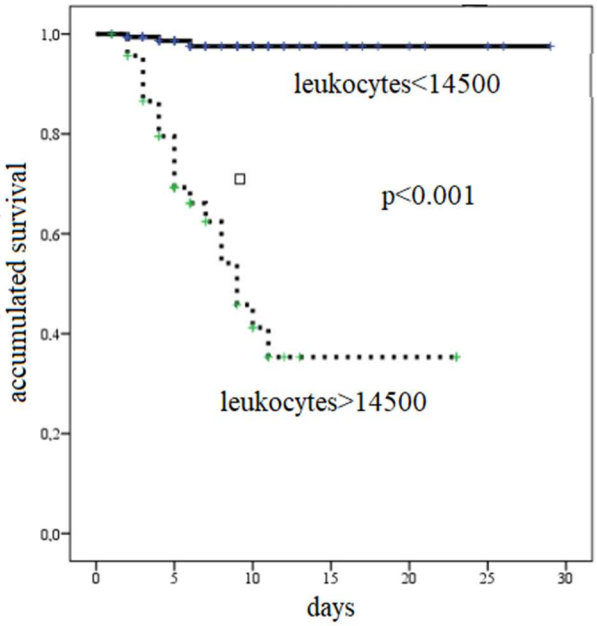


Fig. 2b. Survival depending on cut off leukocytes.

Survival rates were significantly different depending on the cut-off values. In the course of the study, we found the optimal threshold values for each indicator of the complete blood count. The results obtained indicate the possibility of using data more accessible for analysis than the risk assessment models proposed by other authors, where it is necessary to take into account a larger number of parameters (for example, preoperative diseases, wound classification, the nature of the intervention, etc. [2, 6, 7]). Using the proposed indicators, we can predict with sufficient reliability the risk of mortality in elderly and senile patients who have undergone surgery.

Conclusions

1. The concentration of hemoglobin (r=0.521; p=0.000), the number of lymphocytes (r=0.145; p=0.034) and platelets (r=0.186; p=0.006) have positive, and the number of leukocytes (r=-0.536; p=0.000), monocytes (r=-0.387; p=0.000) and ESR (r=-0.180; p=0.008) – negative correlation with the treatment outcome, which indicates the possibility of using these indicators to predict the outcome of surgery.

2. Among the hematological parameters, the concentration of hemoglobin (nosocomial survival in patients with hemoglobin levels above the threshold value (>11.02 g/dL) was 97.7 %, while in the group with Hb<11.02 g/dL it decreased to 52.4 %) and the number of leukocytes (at>14.05, the survival rate was 55.3 %; and at<14.05, the survival rate was -98.2 %) have a high predictive value for predicting mortality after emergency operations in elderly and senile patients.

3. Conducting further studies to identify predictors of various outcomes of surgical intervention in elderly and senile patients will allow for a more complete and reliable prediction in this contingent.

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TELERADIOGRAPHIC PARAMETERS IN YOUNG MEN AND YOUNG WOMEN WITH ORTHOGNATHIC OCCLUSION, DETERMINED BY JARABAK METHOD

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Ukrainian young men and young women with orthognathic occlusion have pronounced sex differences for most of the basic teleradiographic characteristics of the skull and almost half of the indicators that can be used to change the parameters of the upper and lower jaws according to Jarabak method (young men have greater values of distances N-S, S-Ar, Ar-Go, Go_Me, N-Go, S-Gn, S-Go, N-Me and S-Go:N-Me ratio; and in young women – larger values of angles Sum and SN-GoGn). The established differences of teleradiographic indicators according to the Jarabak method with normative data for residents of European origin confirm (in young men have greater values of distances S-Ar, Ar-Go, Go_Me and S-Go, angles N-S-Ar, S-N-Pog, Mand1-GoMe and S-Go:N-Me ratio and smaller values of angles Ar-Go-Gn, Sum, N-S-Gn and distance N-Me; in young women have greater values of angles Max1-SN, Mand1-GoMe, distance Ar-Go and S-Go:N-Me ratio and smaller values of distances N-S, N-Me and angles Ar-Go-Gn, Sum) the need to determine regional standards for the correct use of this method in Ukraine.

Keywords: teleradiography, cephalometry according to Jarabak method, young men and young women with orthognathic occlusion.

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ОСОБЛИВОСТІ ТЕЛЕРЕНГЕНОГРАФІЧНІХ ПОКАЗНИКІВ У ЮНАКІВ І ДІВЧАТ ІЗ ОРТОГНАТИЧНИМ ПРИКУСОМ, ЩО ВИЗНАЧАЮТЬСЯ ЗА МЕТОДОМ JARABAK

В українських юнаків і дівчат із ортогнатичним прикусом для більшості базових телерентгенографічних характеристик черепа та майже половини показників, яким за допомогою хірургії можливо змінювати параметри верхньої й нижньої щелеп за методом Jarabak встановлені виражені статеві відмінності (в юнаків більші значення відстаней N-S, S-Ar, Ar-Go, Go_Me, N-Go, S-Gn, S-Go, N-Me та співвідношення S-Go:N-Me; а у дівчат – більші значення кутів Sum і SN-GoGn). Встановлені відмінності телерентгенографічних показників за методом Jarabak з нормативними даними для мешканців європейського походження (в юнаків більші значення відстаней S-Ar, Ar-Go, Go_Me і S-Go, кутів N-S-Ar, S-N-Pog, Mand1-GoMe і співвідношення S-Go:N-Me та менші значення кутів Ar-Go-Gn, Sum, N-S-Gn і відстані N-Me; у дівчат більші значення кутів Max1-SN, Mand1-GoMe, відстані Ar-Go і співвідношення S-Go:N-Me та менші значення відстаней N-S, N-Me і кутів Ar-Go-Gn, Sum) підтверджують необхідність визначення регіональних нормативів для коректного використання даного методу в Україні.

Ключові слова: телерентгенографія, цефалометрія за методом Jarabak, юнаки та дівчата з ортогнатичним прикусом.

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Teleradiographic method of research together with cephalometric analysis has become an indispensable method of planning orthodontic treatment for dentists around the world [4].

The use of different anatomical landmarks and the interpretation of the obtained data led to the emergence of different methods of cephalometric analysis of lateral teleradiograms. Thus, the methods of Steiner, Downs, Ricketts, Sassouni and Jarabak are known and widespread among dentists [3, 9, 13]. In