Tomas
Janušauskas

# The results of surgical treatment of abdominal aortic aneurysm: influence and evaluation of comorbidities, demographic and surgical risk factors

SUMMARY OF DOCTORAL DISSERTATION

Biomedical sciences, Medicine (06 B)

VILNIUS 2011

Vilnius University

Tomas Janušauskas

# THE RESULTS OF SURGICAL TREATMENT OF ABDOMINAL AORTIC ANEURYSM: INFLUENCE AND EVALUATION OF COMORBIDITIES, DEMOGRAPHIC AND SURGICAL RISK FACTORS

Summary of doctorial dissertation
Biomedical sciences, Medicine (06 B)

Vilnius, 2011

The Study was carried out at Vilnius University during 2007 – 2011.

Scientific Advisor:
Prof. habil. dr. Vytautas Jonas Triponis (Vilnius University, Biomedical sciences, Medicine – 06B)

**Doctorate Committee:**

Chairman:

Prof. dr. Janina Tutkuvienė (Vilnius University, Biomedical sciences, Medicine – 06B)

Members:
Prof. habil. dr. Vytautas Jonas Sirvydis (Vilnius University, Biomedical sciences, Medicine – 06B)
Prof. dr. Žaneta Petrulionienė (Vilnius University, Biomedical sciences, Medicine – 06B)
Prof. dr. Šarūnas Kinduris (Lithuanian University of Health Sciences, Biomedical sciences, Medicine – 06B)
Prof. dr. Edgaras Stankevičius (Lithuanian University of Health Sciences, Biomedical sciences, Medicine – 06B)

Oponents:
Prof. habil. dr. Aleksandras Antuševas (Lithuanian University of Health Sciences, Biomedical sciences, Medicine – 06B)
Assoc. prof. dr. Arimantas Grebelis (Vilnius University, Biomedical sciences, Medicine – 06B)

Maintaining of the Dissertation is scheduled at the open Doctorate Committee Meeting on September 27, 2011 at 2 p.m. at the Conference Hall of Vilnius University City Hospital.

Address: Antakalnio str. 57, LT-10207, Vilnius, Lithuania

tel. (+370) 5 2344519

fax. (+370) 5 2346966

The Summary of the Doctorial Dissertation was mailed on August 27, 2011.

One can get acquainted with the Dissertation at Library of Vilnius University.

VILNIAUS UNIVERSITETAS

Tomas Janušauskas

# PILVINĖS AORTOS ANEURIZMŲ CHIRURGINIO GYDYMO REZULTATAI: GRETUTINIŲ LIGŲ IR DEMOGRAFINIŲ BEI CHIRURGINIŲ VEIKSNIŲ ĮTAKA IR VERTINIMAS

Daktaro disertacijos santrauka
Biomedicinos mokslai, medicina (06 B)

Vilnius, 2011

Disertacija rengta 2007 – 2011 metai Vilniaus universitete

Mokslinis vadovas:

Prof. habil. dr. Vytautas Jonas Triponis (Vilniaus universitetas, biomedicinos mokslai, medicina – 06 B)

**Disertacija ginama Vilniaus universiteto medicinos mokslo krypties taryboje:**

Pirmininkė:
Prof. dr. Janina Tutkuvienė (Vilniaus universitetas, biomedicinos mokslai, medicina 06B).
Nariai:
Prof. habil. dr. Vytautas Jonas Sirvydis (Vilniaus universitetas, biomedicinos mokslai, medicina – 06B)
Prof. dr. Žaneta Petrulionienė (Vilniaus universitetas, biomedicinos mokslai, medicina – 06B)
Prof. dr. Šarūnas Kinduris (Lietuvos sveikatos mokslų universitetas, biomedicinos mokslai, medicina – 06B)
Prof. dr. Edgaras Stankevičius (Lietuvos sveikatos mokslų universitetas, biomedicinos mokslai, medicina – 06B)

Oponentai:
Prof. habil. dr. Aleksandras Antuševas (Lietuvos sveikatos mokslų universitetas, biomedicinos mokslai, medicina – 06B)
Doc. dr. Arimantas Grebelis (Vilniaus universitetas, biomedicinos mokslai, medicina – 06B)

Disertacijos gynimas numatomas viešame disertacijos gynimo tarybos posėdyje, kuris įvyks 2011 m. rugsėjo mėn. 27 d. 14 val., Vilniaus miesto universitetinės ligoninės Didžiojoje auditorijoje.

Adresas: Antakalnio g. 57, LT-10207, Vilnius

tel. (+370) 5 2344519

faks. (+370) 5 2346966

Disertacijos santrauka išsiųsta 2011 m. rugpjūčio 27 d.

Disertaciją galima peržiūrėti Vilniaus universiteto bibliotekoje.

**CONTENTS**

**Abbreviations**

AAA – abdominal aortic aneurysm

AH – arterial hypertension

BP – blood pressure

CI - confidence interval

COPD – chronic obstructive pulmonary disease

CT – computed tomography

DM – diabetes mellitus

ECG – electrocardiogram

ICD-10 – The International Statistical Classification of Diseases and Related Health Problems, 10th Revision

Hb - hemoglobin

MI – myocardial infarction

OD – odds ratio

RAAA – ruptured abdominal aortic aneurysm

SD – standart deviation

US - ultrasound

VUCH – Vilnius University City Hospital

## 1. Introduction

The most important feature of abdominal aortic aneurysm (AAA) is to expand gradually. The rupture occurs when it becomes sufficiently large. Ruptured abdominal aortic aneurysm (RAAA) remains among the leading causes of death in Western countries and Lithuania (Carrioccio A 2004, Heather LH 2004, Triponis V 2001, Urbonavičius S 2002). Postoperative mortality rate of patients operated for ruptured abdominal aortic aneurysm is 30-80%. Mortality rate after elective aortic repair as presented in the reports from the larger vascular centers over the world doesn't go beyond 3-5 per cent. It is quite clear that AAA should be operated before it ruptures. Nevertheless the elective AAA surgery confronts with a series of problems. When to operate these patients, when to wait or not operate at all – is a question which should be discussed by both clinicians and scientists. It is important to clarify the criteria which could determine the indications for this operation. The most important criteria to be considered are patient's risk factors constituting age, comorbidities, the size of the aneurysm and its anatomy. Surgical factors such as tactics and technique, as well as intraoperative and postoperative complications are also of great importance for the results of operations. As the literature shows the research in the area of risk factors conditioning the outcome of open AAA repair is far from completion (Bown MJ 2002, Hoornweg LL 2008, Kniemeyer HW 2000, Noel AA 2001, Peppelenbosch AG 2010).

The review of the literature, especially from countries with strong economies showed that improving diagnostics, operation techniques, advances in anesthesia and postoperative care, did not influence significantly the ratio between operations for ruptured and unruptured aneurysms. In some countries targeted health screening programs of certain age groups have been carried out. These programs were aimed at finding out the aneurysms on purpose to treat them electively. Two large studies of this kind were completed in 2003. They were "Aneurysm Detection and Treatment Study" performed in the USA and "Small Aneurysm Study" accomplished in Great Britain. After summarizing their results the recommendations on abdominal aortic aneurysm treatment were elaborated (Brewster DC 2003). However these and other programs in pursuit of safer aneurysm surgery by rupture prevention had only a minor impact on

ruptured and unruptured AAA operation ratio. The decrease of mortality in patients operated for aneurysm rupture was also insignificant.

During the last decade the question whether all patients with hemorrhagic shock caused by aortic rupture should be operated was raised. Vascular surgeons are still discussing whether there are patients who could be excluded from operative treatment as hopeless? Is it possible on the background of certain clinical signs to deprive a patient of the last chance to survive? Could any criteria be clarified to support the decision? Is the verdict not to operate on such patient compatible with medical ethics more as this question emerges in relation with encouragements to save medical budged? Undoubtedly, most patients with ruptured aneurysms die after surgery and their treatment cost considerable money. Literature does not reveal which factors constitute the greatest threat and predict the RAAA's postoperative complications and mortality (Carrioccio A 2004, Acosta S 2006, Hardman DT 1996).

## 2. General Aim of The Thesis

The general aim of the thesis was to evaluate the influence of risk factors on outcome of abdominal aortic aneurysm operations.

### Specific Aims

1. Assessment of the influence of patient age on mortality rate after elective non-ruptured abdominal aortic aneurysm operations.
2. Assessment of the influence of concomitant heart pathology on mortality rate after elective non-ruptured abdominal aortic aneurysm operations.
3. Evaluation of the influence of chronic obstructive pulmonary disease on mortality rate after elective non-ruptured abdominal aortic aneurysm operations.
4. Assessment of the influence of operation technique on the results of abdominal aortic aneurysm operations.

5. Evaluation of the influence of shock, blood volume deficiency and chronic concomitant pathology on mortality rate after ruptured abdominal aortic aneurysm operations.
6. Establishment of the most specific risk factors predetermining the lowest probability of survival after ruptured abdominal aortic aneurysm operations.
7. Evaluation of the influence of gender, age and concomitant pathology on the results of ruptured abdominal aortic aneurysm operations.
8. Determine most important risk factors decreasing long-term survival rate after abdominal aortic aneurysm operations.
9. Determine five year survival rate and the most frequent causes of death of the patients after abdominal aortic aneurysm operations.

## 3. Work Originality and Significance

Prevalence, early complications and mortality of cardiovascular disease depend on the socio – economic and cultural conditions of the society. On assessment of cardiovascular disease risk factors it has been observed, that in Lithuania and other post-communist countries, they are diagnosed in younger age than in the developed Western countries. We have little data on prevalence of peripheral artery disease in Lithuania, and the importance of risk factors to these diseases. Results of abdominal aortic aneurysm treatment and impact of various risk factors on them has yet not been analyzed. Such studies have not yet been performed in the neighboring countries as well – Latvia, Estonia and Poland. Also we have not found in the literature any evidence of similar studies carried out in Russia and Belorus.

## 4. Material and methods

The study has been carried out in the Center of vascular surgery of Clinic of Heart and Vascular Diseases (Faculty of Medicine, Vilnius University) at Vilnius University City Hospital (VUCH).

The study was carried out in patients who were operated for ruptured and unruptured subrenal abdominal aortic and/or the common iliac artery aneurysms in 1$^{st}$

and 2nd vascular surgery departments of Vilnius University City Hospital from 01-01-1997 to 31-12-2006.

The study was carried out in the Center of Vascular Surgery at Vilnius City University Hospital and in the Clinic of Heart and Vascular Medicine (Faculty of Medicine, Vilnius University).

The study comprised patients who were operated for ruptured and unruptured subrenal abdominal aortic and/or the common iliac artery aneurysms at the Vilnius City University Hospital from 01-01-1997 to 31-12-2006.

***Patients***

The first step of this study was to collect data from medical records of patients and to perform a retrospective analysis of all available data.

Patient demographics, risk factors, arterial blood flow of the lower limbs, concomitant pathology, blood tests, electrocardiograms, ultrasound and computed tomography of the abdominal aorta and the iliac arteries, surgical technique and type of vascular prosthesis, intraoperative and postoperative complications, results of operations and causes of death were analyzed.

The study included all patients who were operated for ruptured and unruptured abdominal aortic and/or iliac artery aneurysms. Patients who died during the operation due to the abdominal aortic aneurysm rupture at the beginning of surgical procedure were also included. We excluded the patients who were examined or treated in the Center of Vascular surgery but did not underwent the aortic repair.

The study included 373 patients. Eighty-four (22.5%) of them were operated for ruptured abdominal aortic and/or iliac artery aneurysms. Three hundred and two (81,0%) patients recovered.

The short-term results were evaluated analyzing the clinical investigation, laboratory and imaging data obtained in the near postoperative period covering the time from admission to the discharge or death of a patient.

For investigation of long-term outcome the letters have been sent to all discharged patients or their families asking for information about the fate of patients or inviting them to visit a vascular surgeon at VUCH. In case of patient's death the information on

the cause of death was received. In total, the data of 153 (50.7%) patients were available. The condition of all patients who presented for examination at the Center was evaluated by one specialist. One hundred and six patients (69.7%) had died at various periods after they were discharged from the hospital. In 47(30.3%) patients who presented for examination at the Center of Vascular Surgery the clinical evaluation was performed by history, symptoms and signs, measurement of the peripheral arterial blood flow, ultrasound of the abdominal aorta and the iliac arteries, electrocardiogram and the consultation of a cardiologist. Comorbidities and other localizations of atherosclerotic occlusive arterial disease were assessed. The causes of death were ascertained on the background of the information provided by the Department of Statistics using ICD-10. The cause of death of certain patients was available from the documents presented by relatives.

The data on vascular operations performed in the late postoperative period because of lower limb ischemia were obtained from electronic database of the Center of Vascular Surgery.

While analyzing the data in the short-term postoperative period, patients were divided into two groups of patients: 1. patients operated for ruptured AAA and/ or common iliac artery aneurysms, 2. patients operated for unruptured AAA and/or common iliac artery aneurysms.

An overall patients' condition was evaluated according to a history, physical examination findings and test results and concomitant pathology such as diabetes, renal disorders and arterial hypertension. Smoking habit was clarified from the history.

Concomitant cardiac pathology and postoperative complications were evaluated in scores according to Detsky modified cardiac risk index. Detsky score is designed for operative risk assessment. The sum of the scores shows the degree of postoperative complications' risk (Table 1).

According to the criteria of World Health Organization arterial hypertension is diagnosed if the systolic blood pressure (BP) is ≥140 mm Hg and the diastolic blood pressure equals ≥90 mm Hg.

The renal function was assessed by $K^+$ (3.5 to 5.1 mmol/l), urea (up to 65 years – 1.73-8.3 mmol/l, and > 65 years of age - <11.9 mmol/l) and creatinine (women 44-80 μmol/l, men 62-106 μmol/l) levels in the blood.

Diagnosis of diabetes mellitus was established on the background of history. In all patients diabetes had been diagnosed previously. All patients had type II diabetes mellitus.

In all patients the size of the abdominal aortic and the iliac artery aneurysm was assessed by ultrasound examination. From 2006 it was accomplished also by CT scan.

| Risk factors | Points |
|---|---|
| 1. Age older than 70 years | 5 |
| 2. Prior myocardial infarction: | |
| Last infarction within 6 month | 10 |
| Last infarction more than 6 month ago | 5 |
| 3. Unstable angina within last 6 month | 10 |
| 4. Angina pectoris: | |
| Canadian angina class 3 | 10 |
| Canadian angina class 4 | 20 |
| 5. Alveolar pulmonary edema: | |
| Pulmonary edema within one week | 10 |
| Pulmonary edema at any time | 5 |
| 6. Suspected critical aortic stenosis | 20 |
| 7. Arrhythmia | 5 |
| 8. Emergency surgery | 10 |
| **Data interpretation** | |
| 0-15 points – Class 1, low risk<br>20-30 points – Class 2, moderate risk<br>>30 points – Class 3, high risk | |

**Table 1.** Modified Destky cardiac risk index factors, their values and interpretation.

General condition and the risk of postoperative complications in patients treated for ruptured abdominal aortic aneurysm was evaluated also by Hardman index. This index is a total of scores of five factors, one for each: age > 76 y., loss of consciousness after admission, plasma creatinine level > 190 μmol/l, Hb <90 g/l, acute myocardial ischemia, electrocardiogram (ECG) represented by ST-segment depression > 1 mm and/or T-wave changes. So, Hardman index could range from 0 to 5. According to literature, three and more scores may result in 100% mortality after surgery.

Hemorrhagic shock in patients treated for ruptured PAA was determined immediately upon arrival to the clinic by evaluation of heart rate, systolic blood pressure, respiratory rate, renal function, level of consciousness, hemoglobin (Hb) and hematocrit levels. These patients were divided into two groups: 1 – admitted in shock and 2 – no signs of shock on admission. If free fluid in the abdominal cavity was found with US and patient's systolic blood pressure was <90 mm Hg, these patients were immediately transported to the operating room and additional tests were not carried out.

Blood volume deficit was assessed by comparing the amount of the blood loss during surgery and transfused blood components and crystalloids solutions during surgery and after it.

***Statistics***

Discrete nominal variables were analyzed in 2xk and 2x2 tables, the difference between variables in table rows and columns was assessed using Pearson's $\chi^2$ test or Fisher's exact test. For independent groups analysis of quantitative data Student's t test was used. The chosen level of significance was $\alpha = 0.05$, the statistical significance of differences was considered when error possibility was $p<0.05$.

All averages were represented with standard deviation (SD).

Multivariate analysis with binary logistic regression was performed. The overall pattern of statistical significance was assessed with reference to coefficient of determination (Nagelkerke R Square).

In logistic regression models the impact of various factors is assessed in the odds ratio (OR), its statistical significance is assessed using the OR 95 % confidence intervals (CI).

For evaluation of the influence on survival of individual risk factors Kaplan-Meier method was used. The results were compared by Log Rank test. Statistical significance was accepted at level of $p<0.05$.

The data were processed using Microsoft Office Excel 2007, and statistical data processing programs WinPepi v11.4 (2011) and SPSS 17.0 (2008).

## 5. Results

Between January 1997 and December 2006 373 patients with abdominal aortic aneurysm in VUCH were operated, 289 (77.5%) of them were operated for unruptured AAA, and the remaining 84 (22.5%) patients were treated for ruptured AAA. The ratio of operations for unruptured and ruptured abdominal aortic aneurysm was 3.47:1.

### 5.1. Unruptured abdominal aortic aneurysms

***Patients***

There were 289 (77.5%) operations made – 238 (82.4%) for males and 51 (17.6%) for females for patients with unruptured abdominal aortic aneurysm. Male and female ratio was 4.6:1. Distribution of operated men and women by year is shown in Figure 1.

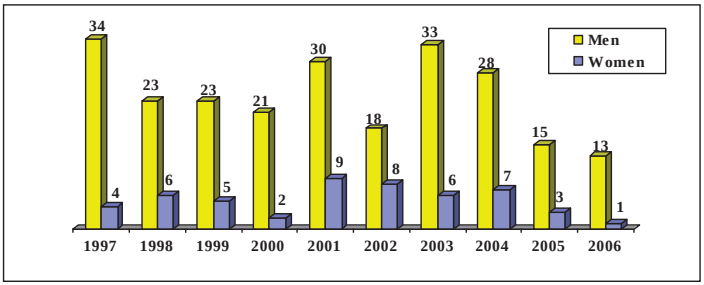


**Figure 1**. Operated women and men by year.

Mean age of women was 72.1 ± 8.1, whereas men age was 67.6 ± 8.5 ($p<0.0001$).

Most of the patients (74.4%) were in age groups of 60 to 79 years. Although in the group of 60-69 there were more men, in the 70-79 age group there were more women, this difference was statistically insignificant ($p>0.05$). Significant differences were obtained when comparing marginal age groups. In age group <60 years there were significantly more men ($p<0.05$, OR 3.33 95% CI 1.01-11.2), and the age group >80 years was made by women ($p<0.05$, OR 2.66 95% CI 1.2-6.1) (Fig. 2).

***Mortality***

In total, 28 (9.7%) patients died – 21 (8.8%) were men and 7 (13.7%) women. The overall mortality rate for men and women groups did not differ (p> 0.05). The number of operations and mortality by year is shown in Figure 3. Men and women post-operative mortality by year is shown in Figure 4.

The comparison of mortality rates by age groups showed no significant difference between men and women, but the overall mortality of younger than 60 years patients was significantly lower than in the group ≥ 80 years (p<0.05, OR 6.39 95% CI 1.2-33.4). Mortality difference of 60 – 69 and 70 – 79 years group was insignificant (p>0.05) (Table 2).

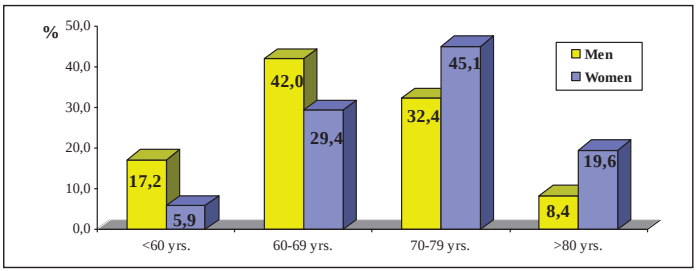


**Figure 2**. Distribution of men and women in age groups.

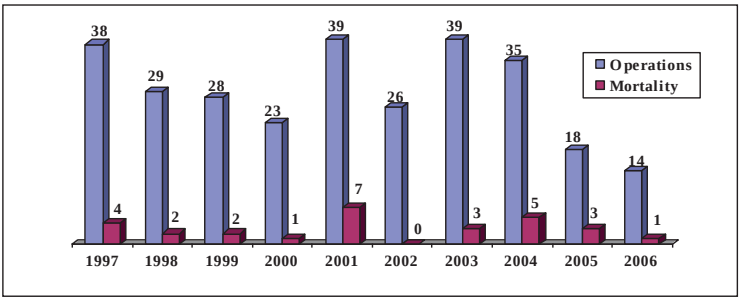


**Figure 3**. The number of operations and mortality by year.

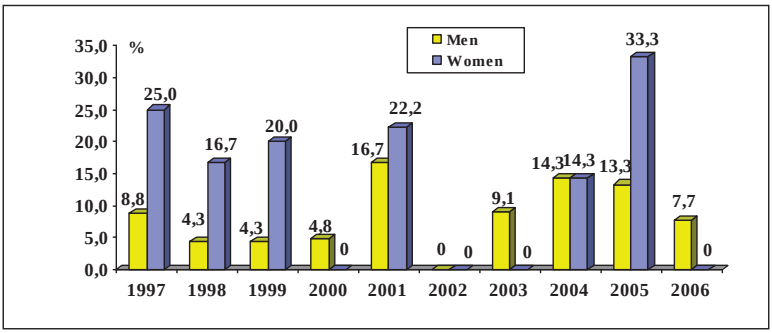


**Figure 4**. Men and women mortality rate by year.

| | Age group | | | |
|---|---|---|---|---|
| | **<60 yrs.** | **60-69 yrs.** | **70-79 yrs.** | **≥80 yrs,** |
| **Men, n (%)** | 2 (4.9) | 9 (9.0) | 7 (9.1) | 3 (15) |
| **Women, n (%)** | 0 (0) | 1 (6.7) | 2 (8.7) | 4 (40.0) |
| p | >0.05 | >0.05 | >0.05 | >0.05 |
| **Total, n (%)** | 2 (4.5) | 10 (8.7) | 9 (9.0) | 7 (23.3) |

**Table 2**. Mortality rate in the age groups for men and women.

It was found that in the group of < 70 years there were significantly more men as compared with group of ≥ 70 years, while women' part in the first group was lesser than in the second group. This difference was statistically significant ($p<0.05$, OR 2.67 95% CI 1.4-5.0). However, the comparison of mortality in both age groups together, as well as in men and women groups separately in the same or in the different age groups, showed no significant difference ($p>0.05$) (Table 3).

***Patient assessment by Detsky***

The evaluation of risk by Detsky showed that the difference on average risk score between women and men was insignificant (Table 4). Male non-survivors as compared

with male survivors had more comorbidities ($p<0.05$). The same significant difference was found when comparing the rate of comorbidities in survivors and non-survivors patients. Mean Detsky score in non-survivors was significantly higher. Meanwhile, for female survivors mean Detsky score was lower than in the female patients who died postoperatively, the difference was insignificant ($p = 0.061$).

| **Age < 70 yr.** | **Total, n (%)** | **Non-survivors n (%)** |
|---|---|---|
| **Men** | 141 (59.2) | 11 (7.8) |
| **Women** | 18 (35.3) | 1 (5.6) |
| **Total** | 159 (55.0) | 12 (7.5) |
| **Age ≥ 70 yr.** | **Total, n (%)** | **Non-survivors n (%)** |
| **Men** | 97 (40.8) | 10 (10.3) |
| **Women** | 33 (64.7) | 6 (18.2) |
| **Total** | 130 (45.0) | 16 (12.3) |

**Table 3**. The distribution of patients and mortality in age groups <70 years and ≥70 years

| | **Total** | **Survivors** | **Non-survivors** | **p** |
|---|---|---|---|---|
| **Men** | 13.6 ± 9.5 | 13.1 ± 9.4 | 19.3 ± 9.5 | <0.05 |
| **Women** | 14.2 ± 10.2 | 13.2 ± 10.1 | 20.7 ± 8.4 | 0.061 |
| **Total** | 13.7 ± 9.6 | 13.1 ± 9.5 | 19.6 ± 9.1 | <0.05 |
| **p** | >0.05 | >0.05 | >0.05 | |

**Table 4**. Detsky score in men and women.

Total Detsky score for all patients in the age group of < 70 years was 10.6 ± 9.3 points, and in group of ≥ 70 years the the sum of points was much higher – 17.6 ± 8.6 ($p<0.05$). The detailed comparison of these two age groups is in Table 5. The concomitant disease rate in age group ≥ 70 years for male and female survivors and all patients who recovered was higher as compared with the younger group (p,0.05).

Average Detsky score for older women who died after surgery was significantly higher than that in younger female non-survivors ($p<0.05$). Average score in older male non-survivors and in all patients who died postoperatively did not differ significantly from those younger male non-survivors and all younger patients who died after surgery ($p>0.05$) (Table 5).

In age group < 70 years there were more concomitant pathology in male non-survivors and all non-survivors than in male survivors and all survivors ($p<0.05$). Meanwhile, mean scores in recovered and deceased women was similar ($p>0.05$) (Table 5).

Analysis of Detsky score showed that the role of comorbidities in women in the age group ≥ 70 years and in non-survivors was higher than in patients who recovered ($p<0.05$), but the results for comorbidities in men who died and all non-survivors in this age group were similar to those who recovered($p>0.05$) (Table 5).

| | **Age < 70 yr.** | | | **Age ≥70 yr.** | | |
|---|---|---|---|---|---|---|
| | **Survivors** | **Non-survivors** | **p** | **Survivors** | **Non-survivors** | **p** |
| **Men** | 10.3 ± 9.0 | 18.6 ± 10.5 | 0.044 | 17.2 ± 8.3 | 20.0 ± 8.8 | >0.05 |
| **Women** | 7.6 ± 8.3 | 7.5 ± 3.5 | >0.05 | 16.7 ± 9.7 | 23.3 ± 5.2 | 0.033 |
| **p** | >0.05 | 0.037 | | >0.05 | >0.05 | |
| **Total** | 10.0 ± 9.0 | 17.5 ± 10.8 | 0.036 | 17.1 ± 8.6 | 21.3 ± 7.6 | 0.092 |

**Table 5**. Age group scores according to Detsky

We compared two groups of patients: one group of patients who had scores from 0 to 15 points and the other group of patients who scored 20 points and more (Table 6). We found that patients with more points by Detsky had a significantly higher mortality ($p<0.05$, OR 4.0 95% CI 1.8-9.1) (Table 6).

| **Detsky risk group** | **Total, n (%)** | **Survivors, n (%)** | **Non-survivors, n (%)** |
|---|---|---|---|
| **0 - 15** | 190 (65.7) | 180 (94.7) | 10 (5.3) |
| **≥20** | 99 (34.3) | 81 (81.8) | 18 (18.2) |

**Table 6.** Detsky risk impact on mortality ($p<0.05$).

***The assessment of comorbidities***

The prevalence of concomitant pathology among patients and its impact on mortality is shown in Table 7. History of myocardial infarction (p=0.048, OR 2.19 95% CI 1.0-4.8) or the presence of at least one risk factor according to Detsky (p=0.002, OR 7.3 95% CI 1.7-31.6 were significant for patient's mortality. Chronic renal insufficiency was diagnosed two cases; these patients needed no dialysis. The significance of this factor for mortality is very close to the statistical reliability. The reason of death in one of the two patients who had this risk factor was a complete failure of renal function. Diabetes mellitus had no significant effect on mortality, but the prevalence of this factor in the non-survivors group was higher than in the group of patients who recovered. Arterial hypertension and COPD did not significantly influenced mortality rate (p>0.05).

| | **Total, n (%)** | **Survivors, n (%)** | **Non-survivors, n (%)** | **p** |
|---|---|---|---|---|
| **Arterial hypertension** | 186 (64.4) | 166 (63.6) | 20 (71.2) | 0.411 |
| **Diabetes** | 13 (4.5) | 10 (3.8) | 3 (10.7) | 0.095 |
| **COPD** | 101 (34.9) | 90 (34.5) | 11 (39.3) | 0.612 |
| **History of MI** | 87 (30.1) | 74 (28.4) | 13 (46.4) | 0.048 |
| **Renal insufficiency** | 2 (0.7) | 1 (0.4) | 1 (3.6) | 0.053 |
| **Detsky cardiac risk factors** | 193 (66.8) | 167 (64.0) | 26 (92.2) | 0.002 |

**Table 7**. The concomitant pathology and its impact on mortality.

| | **Total** | | **Non - survivors** | | **p** |
|---|---|---|---|---|---|
| | **Men, n (%)** | **Women, n (%)** | **Men, n (%)** | **Women, n (%)** | |
| **Arterial hypertension** | 146 (61.3) | 40 (78.4) | 16 (72.4) | 4 (57.1) | >0.05 |
| **Diabetes** | 11 (4.6) | 2 (3.9) | 1 (4.8) | 2 (28.6) | >0.05 |
| **COPD** | 95 (39.9) | 6 (11.8) | 11 (52.4) | 0 (0) | <0.05 |
| **History of MI** | 74 (31.1) | 13 (25.5) | 10 (47.6) | 3 (42.9) | >0.05 |
| **Renal insufficiecy** | 1 (0.4) | 1 (2.0) | 0 (0) | 1 (14.3) | 0.08 |
| **Detsky cardiac risk factors** | 156 (65.5) | 37 (72.5) | 19 (90.5) | 7 (100) | >0.05 |

**Table 8**. The influence of concomitant pathology on mortality in men and women groups.

The prevalence of COPD was significantly higher in male non-survivors group as compared to female non-survivors (p<0.05, OR 8.0 95% CI 1.0-78.0) (Table 8).

***Smoking***

The assessment of smoking prevalence among patients showed that this risk factor had no effect on mortality of men and women separately or of men and women together (p>0.05). We found that in smoking male patients complication rate was significantly higher than in smoking female patients (p=0.001, OR 10.2 95% CI 2.0-51.8). There was no difference in complication rates in the group of smoking patients and nonsmoking patients (p=0.099) (Table 9).

| | **Total, n (%)** | **Survivors, n (%)** | **Complications, n (%)** | **Non-survivors, n (%)** | **p** |
|---|---|---|---|---|---|
| **Men** | 142 (59.7) | 129 (59.4) | 43 (69.4) | 13 (61.9) | 0.826 |
| **Women** | 5 (9.8) | 5 (11.4) | 2 (18.2) | 0 (0) | 0.097 |
| **p** | | >0.05 | **0.001** | >0.05 | |
| **Total** | 147 (50.9) | 134 (51.3) | 45 (61.6) | 13 (46.4) | 0.621 |
| | | | **p = 0.099** | | |

**Table 9**. Smoking prevalence and impact on mortality.

***Technique of operations***

The number of operations and prosthesis used for abdominal aortic aneurysm resection are shown in Table 10. The comparison of two operation techniques and mortality did not show any significant difference (p>0.05). However, by the comparison of tube and bifurcated graft groups it was found that there was difference in the incidence of complications (Table 11). There were significantly more peripheral arterial thromboembolic complications in bifurcated graft group (p=0.035, OR 4.5 95% CI 1.0-20.4). The frequency of separately compared complications was not significant. The

comparison of total number of complications showed that the complication rate was significantly higher in bifurcated graft group (p=0.024, OR 1.88 95% CI 1.1-3.3).

| | Total, n (%) | Survivors, n (%) | Non-survivors, n (%) |
|---|---|---|---|
| **Tube graft** | 113 (39.1) | 104 (92.0) | 9 (8.0) |
| **Bifurcated graft** | 161 (55.7) | 145 (90.1) | 16 (9.9) |
| **To iliac arteries** | 80 (49.7) | 75 (93.8) | 5 (6.3) |
| **To femoral arteries** | 53 (32.9) | 45 (84.9) | 8 (15.1) |
| **To iliac and femoral arteries** | 23 (14.3) | 21 (91.3) | 2 (8.7) |
| **Other** | 15 | 12 | 3 |

**Table 10**. The type of graft used and the result of operation.

| | Tube graft, n (%) | Bifurcated graft, n (%) | p |
|---|---|---|---|
| **Bleeding** | 5 (4.4) | 6 (3.7) | 0.772 |
| **Cardiac complications** | 6 (5.3) | 12 (7.5) | 0.481 |
| **Intestinal complications** | 4 (3.5) | 9 (5.6) | 0.432 |
| **Peripheral arterial complications** | 2 (1.8) | 12 (7.5) | **0.035** |
| **Pulmonary complications** | 4 (3.5) | 10 (6.2) | 0.323 |
| **Cerebral complications** | 1 (4.4) | 4 (2.5) | 0.330 |
| **Renal complications** | 1 (0.9) | 2 (1.2) | 0.780 |
| **Eventeration** | 1 (0.9) | 1 (0.6) | 0.801 |
| **Delirium** | 1 (0.9) | 1 (0.6) | 0.801 |
| **Total** | 25 (22.1) | 56 (36.6) | **0.024** |

**Table 11**. Technique of operation and frequency of complications.

### 5.2. Ruptured abdominal aortic aneurysm group

Fifty nine men (70.2%) and 25 women (29.8%) have been operated on for a RAAA. Of 84 patients, 43 (51.2%) died after the operation and 41 (48.8%) survived. The mean age for survivors and non-survivors was 71.8 ± 9.6 and 74.7 ± 9.7, respectively (p > 0.05). Twenty nine patients (34.5%) were younger than 70 and 55 patients (65.5%)

were at the age of 70 or older. Twelve patients out of 29 (41.4%) in the younger group and 31 patients out of 55 (56.4%) in the older group died after surgery ($p > 0.05$).

Coronary heart disease, history of MI and AH were the most striking concomitant diseases though their rate did not differ significantly in survivors and in those patients who died after the operation (Table 12).

| Risk factors, concoitant pathology | Survivors, n (%) | Non-survivors, n (%) | p |
|---|---|---|---|
| **Smoking** | 15 (36.6) | 10 (23.3) | 0.183 |
| **Chronic obstructive pulmonary disease** | 11 (26.8) | 12 (27.9) | 0.912 |
| **Arterial hypertension** | 27 (65.9) | 22 (51.2) | 0.173 |
| **Diabetes** | 1 (2.4) | 0 (0) | 0.154 |
| **Renal insufficiency** | 0 | 0 (0) | |
| **History of MI** | 16 (39.0) | 15 (34.9) | 0.695 |
| **Coronary heart disease except MI** | 31 (75.6) | 26 (60.5) | 0.137 |
| **Peripheral artery occlusive disease** | 4 (9.8) | 3 (7.0) | 0.646 |
| **Stroke in the past** | 3(7.3) | 6 (14.0) | 0.326 |
| **Renal artery stenosis determined previously** | 0 | 0 | |
| **Total** | 41 | 43 | |

**Table 12.** Prevalence and significance of comorbidities**.**

The influence of age and gender is shown in Table 13. Women were significantly older than men. Postoperative mortality in women was higher than in men. There was no significant difference in the mortality rate between patients < 70 years and patients >70 years.

By further evaluation of gender differences it is worth noting that the Detsky score was significantly higher in men as compared to women: $14.0 \pm 2.5$ and $11.7 \pm 1.8$ ($p<0.05$). The Detsky score was almost equal in survivors and in non-survivors: $13.1 \pm 5.9$ and $14.4 \pm 8.8$ ($p > 0.05$). Detsky risk factors' influence on mortality rates is reflected by the data presented in Table 14. Postoperative mortality rate did not depend on the Detsky score.

Of 41 patients who survived after the operation, theDetsky factors were present in 39 patients (95.1%). The same rate of the Detsky risk factors was among non-survivors. The incidence of MI did not differ in survivors and non-survivors. Stenocardia was even more frequent in survivors ($p<0.05$, OR 0.34 95% CI 0.13-0.86). It should be taken into

consideration that history data on stenocardia obtained from patients in shock could have been incomplete (Table 15).

| | Total | Male | Female | p | OR (95% CI) |
|---|---|---|---|---|---|
| **Survivors, n (%)** | 41 (48.8) | 33 (55.9) | 8 (32.0) | <0.05 | 2.7(1.0-7.2) |
| **Non-survivors, n (%)** | 43 (51.2) | 26 (44.1) | 17 (68.0) | <0.05 | 2.7(1.0-7.2) |
| **Mean age of survivors, yrs** | 71.8 ± 9.6 | 70.4 ± 9.2 | 77.6 ± 9.5 | 0.079 | |
| **Mean age of non-survivors, yrs** | 74.7 ± 9.8 | 71.0 ± 8.9 | 80.4 ± 8.3 | <0.05 | |
| **Younger than 70 yrs, n (%)** | 29 (34.5) | 25 (86.2) | 4 (13.8) | <0.05 | 3.9(1.2-12.7) |
| **Died, n (%)** | 12 (41.4) | 10 (40.0) | 2 (50.0) | >0.05 | |
| **70 yrs and older, n (%)** | 55 (65.5) | 34 (61.8) | 21 (38.2) | <0.05 | 3.9(1.2-12.7) |
| **Died, n (%)** | 31 (56.4) p>0.05 | 16 (47.1) | 15 (71.4) | 0.077 | |

**Table 13**. Age and gender influence to postoperative mortality.

| Detsky score, points | Total, n (%) | Non-survivors, n (%) |
|---|---|---|
| **0** | 3 (3.6) | 1 (33.3) |
| **5-10** | 29 (34.1) | 18 (62.1) |
| **15-20** | 37 (44,0) | 17 (45.9) |
| **25-40** | 15 (17.9) | 7 (46.7) |

**Table 14**. Mortality rate by the Detsky score.

The Hardman score was composed of 4 original factors, as there were no patients with renal insufficiency defined by the Hardman index. Blood pressure < 90 mm Hg was added to Hardman index variables for more complete assessment of shock but the influence of this factor was calculated separately (Table 16).

| Detsky factors | Survivors, n (%) | Non-survivors, n (%) | p |
|---|---|---|---|
| **Detsky factor present** | 39 (95.1) | 41 (95.3) | >0.05 |
| **MI within last 6 months** | 3 (7.3) | 3 (7.0) | >0.05 |
| **MI beyond 6 months** | 14 (34.1) | 12 (27.9) | >0.05 |
| **Stenocardia** | 31 (75.6) | 22 (51.2) | <0.05 |
| **Arrhythmia** | 15 (36.6) | 11 (25.6) | >0.05 |

**Table 15.** Rate of Detsky factors among survivors and nonsurvivors

| Hardman index score | Total of patients, n (%) | Mortality n (%) | Ischemia on ECG, n | HGB <90g/l, n | Age >76 yrs, n | Loss of consciousness, n | Systolic BP <90mmHg, n |
|---|---|---|---|---|---|---|---|
| **1** | 27 (32.1) | 12 (44.4) | 7 | 4 | 1 | 0 | 4 |
| **2** | 20 (23.8) | 13 (65.0) | 10 | 7 | 9 | 0 | 6 |
| **3** | 10 (11.9) | 9 (90.0) | 9 | 9 | 9 | 0 | 9 |
| **4** | 2 (2.4) | 2 (100) | 2 | 2 | 2 | 2 | 2 |

**Table 16.** Relation between the mortality rate and the Hardman score. The difference in the mortality rate between the group of patients with 1 or 2 points and the group with 3 or 4 points was statistically significant ($p<0.05$, OR 9.7 95% CI 1.2-81.3). The difference of the blood pressure level in the group of patients with 1 or 2 points and the group with 3 or 4 points was also significant ($p < 0.0001$, OR 40.7 95% CI 4.7-355.3).

There was no influence of shock on the complication rate but it increased the death rate ($p<0.05$, OR 3.2 95% CI 1.1-9.0) (Table 17).

| | Shock | No signs shock | p |
|---|---|---|---|
| **Total, n (%)** | 64 (76.2) | 20 (23.8) | |
| **Complications, n (%)** | 45 (70.3) | 13 (65.0) | >0.05 |
| **Died, n (%)** | 37 (57.8) | 6 (30.0) | <0.05 |

**Table 17**. Influence of hemorrhagic shock on the outcome surgery.

Ten patients (6 men and 4 women) died during the operation immediately after the clamping of the abdominal aorta. All these patients were in hemorrhagic shock and older than 76 years.

The mean blood loss for survivors and non-survivors was 2175.6 ± 925 cc and 2568.4 ± 1100.1 cc, respectively ($p > 0.05$). There was no blood volume deficiency observed in patients who recovered, while in patients who died after surgery blood volume deficiency was 629.0 ± 323.4 cc ($p < 0.05$). An average time-span from patients' admission to the start of operation was 660.0 ± 1154.2 min and 222.1 ± 348.1 min for survivors and non-survivors, respectively ($p = 0.08$).

Sixteen patients were transferred urgently from the admission-room to the operating theatre because of hemorrhagic shock and unstable hemodynamics. Six of them survived after the operation. The condition of 3 patients was evaluated by 3 points according to the Hardman index. The patients had unstable hemodinamics because of hemorrhagic shock. In the rest 3 patients instability could be ascribed to the severe cardiac impairment (acute myocardial ischemia on the ECG). Of 10 deceased patients, 2 were evaluated by 4 points according to the Hardman index and were characterized by such factors as age, low hemoglobin, ischemia on the ECG and loss of consciousness. Four patients were given 3 points for age, hemoglobin < 90 g/l and myocardial ischemia. Two points in one patient reflected the age factor and the hemoglobin level < 90 g/l. In 7 out of these 10 patients low systolic blood pressure (< 90 mm Hg) was observed.

The mortality rate was compared in patients with the maximum Detsky score and with patients given maximum points according to the Hardman index. Seven patients out of 15 (46.7%) with the Detsky score of ≥ 25 died, whereas 11 patients out of 12 (91.7%) died with ≥ 3 points by the Hardman index (p = 0.01, OR 12.6 95% CI 1.3-123.9).

The most important complications that determined poor outcome of patients were bleeding, cardiac and renal function impairment. Respiratory complications were also of significance (Table 18).

| | n, (%) | Survivors, n (%) | Non-survivors, n (%) | p | OR (95% CI) |
|---|---|---|---|---|---|
| **Total of patients** | 56 (66.7) | 13 (23.2) | 43 (76.8) | **<0.00001** | 44.2(9.3-211.7) |
| **Bleeding** | 20 (35.7) | 1 (2.4) | 19 (44.2) | **<0.00001** | 31.7(4.0-252.7) |
| **Cardiac** | 18 (32.1) | 0 (0) | 18 (41.9) | **<0.00001** | 28.8(3.6-230.1) |
| **Intestinal** | 10 (17.9) | 3 (7.3) | 7 (16.3) | >0.05 | |
| **Peripheral thrombembolism** | 8 (14.3) | 4 (9.8) | 4 (9.3) | >0.05 | |
| **Respiratory** | 18 (32.1) | 5 (12.2) | 13 (30.2) | **<0.05** | 3.1(1.0-9.7) |
| **Cerebral** | 4 (7.1) | 2 (4.9) | 2 (4.7) | >0.05 | |
| **Renal insufficiency** | 5 (8.9) | 0 (0) | 5 (11.6) | **<0.05** | 7.0(1.0-66.5) |

**Table 18.** Complications rate in survivors and non-survivors.

The higher complication rate was observed in patients who received a bifurcated graft (p=0.037, OR 3.0 95% CI 1.0-8.4). This was for the account of minor impairment

of intestinal and respiratory function or peripheral thrombembolic events, which did not cause severe ischemia of the extremities and did not need surgery. They were accompanying major complications but did not play any role in determining postoperative mortality. The rate of major complications was almost the same in the two groups according to the technique used (Table 19). Therefore there was no significant difference in the mortality rate between the patients operated on by the placement of a tube graft and by aortobifemoral, aortobiiliacal or aorto-iliacal-femoral graft implantation (Table 20).

| | **Tube vascular graft group, n (%)** | **Bifurcated vascular graft group, n (%)** | **p** |
|---|---|---|---|
| **Total of patients** | 41 (48.8) | 31 (36.9) | |
| **Total of complications** | 22 (53.7) | 24 (77.4) | **0.037** |
| **Bleeding** | 5 (12.2) | 6 (19.4) | 0.409 |
| **Cardiac** | 7 (17.1) | 8 (25.8) | 0.372 |
| **Intestinal** | 6 (14.6) | 4 (12.9) | 0.833 |
| **Peripheral thrombembolism** | 3 (7.3) | 5 (16.1) | 0.246 |
| **Respiratory** | 8 (19.5) | 8 (25.8) | 0.529 |
| **Cerebral** | 2 (4.9) | 2 (6.5) | 0.775 |
| **Renal insufficiency** | 2 (4.9) | 3 (9.7) | 0.434 |
| **Eventeration** | 1 (2.4) | 1 (3.2) | 0.842 |

**Table 19.** Technique of aortic reconstruction and frequency of complications.

| | | **Bifurcated grafts** | | | | |
|---|---|---|---|---|---|---|
| | **Tube vascular graft** | **All bifurcated grafts** | **Into iliac arteries** | **Into femoral arteries** | **Into the iliac and femoral arteries** | **Axillo-femoral graft** |
| **Total, n (%)** | 41 (48.8) | 31 (36.9) | 20 (23.8) | 7 (8.3) | 4 (4.8) | 2 (2.4) |
| **Complications, n (%)** | 22 (53.7) | 24 (77.4) | 14 (70.0) | 6 (85.7) | 4 (100) | 2 (100) |
| **Died, n (%)** | **16 (39.0)** | **17 (54.8)** | 11 (55.0) | 3 (42.9) | 3 (75.0) | 2 (100) |
| | **p** | **0.092** | | | | |

**Table 20**. Complication and mortality rate in individual prosthetic groups.

In 2 patients (4.8%) ligation of the abdominal aorta was carried out and axillobifemoral bypass procedure was performed. Both patients died after surgery because of further hemorrhagic shock complications. Sixteen patients out of 41 (39.0%) died after tube graft insertion. Seventeen patients out of 31 (54.8%) died operated on by means of a bifurcated graft. The difference was insignificant ($p = 0.092$).

The mean hospital stay of survivors was $16.1 \pm 7.2$ days, whereas in the group of non-survivors the mean hospital stay was $6.3 \pm 8.8$ days ($p < 0.000001$).

### 5.3. Follow-up results

Of 373 patients who were operated for ruptured or unruptured abdominal aortic aneurysm, 302 (81.0%) were recovered. Follow-up data were obtained in 153 (50.7%) patients and information on concomitant diseases and cause of death were analyzed. One hundred and thirty-seven (89.5%) of these were men and 16 (10.5%) women. One hundred and six (69.3%) patients died during follow-up period: 95 (69.3%) males and 11 (68.8%) females. Their average survival after surgery was $75.2 \pm 4.4$ months (95%, CI 66.6 to 83.7).

According to the findings the causes of death and their frequency is shown in Table 21. The three most common causes of death were ischemic heart disease, stroke and malignancies. In other 5 patients ruptured aneurysm of other localization was diagnosed.

Follow-up period was from 0 to 144 months. The fact of death, the cause of death was recorded.

Forty-seven (30.7%) patients were invited for control to the hospital or to the outpatient clinic of VUCH by one vascular surgeon.

It was found that 40 (85.1%) patients had progressing cardiac pathology, 5 (10.6%) had had coronary bypass surgery, six (12.8%) were operated on for anastomotic pseudoaneurysm, 39 (83.0%) patients underwent surgery for advanced peripheral arterial pathology. One (2.1%) patient was operated for ruptured iliac artery aneurysm.

| Causes of death | n (%) |
|---|---|
| Cardiac | 36 (34.0) |
| Stroke | 13 (12.3) |
| Malignancies of other localization | 12 (11.3) |
| Lung cancer | 9 (8.5) |
| Ruptured aneurysm | 5 (4.7) |
| Arterial hypertension | 5 (4.7) |
| Renal insufficiency | 5 (4.7) |
| Atherosclerosis | 6 (5.7) |
| Pneumonia | 5(4.7) |
| PATE | 2 (1.9) |
| Tuberculosis | 2 (1.9) |
| Bleeding from the gastrointestinal tract | 2 (1.9) |
| Other reasons | 2 (1.9) |
| Multiple myeloma | 1 (0.9) |
| Pancreatitis | 1 (0.9) |

**Table 21**. Causes of death in follow-up period after abdominal aortic aneurysm operations.

***Gender***

During follow-up period it was found that the gender did not influence the survival of patients ($p>0.05$). Mean survival rate for men was $74.8 \pm 4.5$ months, for women it was $75.4 \pm 15.5$ months (Fig. 5).

***Age***

The comparison of survival rate during follow-up period for all age groups showed that patient survival rate was directly proportional to the patient's age. The survival rate for older groups compared to the younger age group was significantly lower ($p<0.05$). The data are shown in Tables 22 – 23 and in Figures 6 and 7.

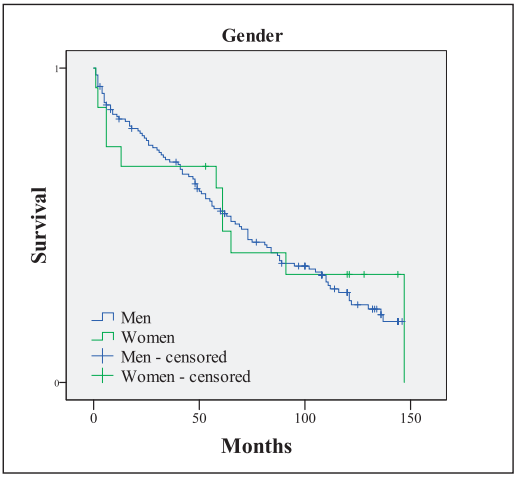


**Figure 5**. Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for men and women (p>0.05 Log Rank test).

| Age groups, yrs | Total, n (%) | Non-survivors, n (%) |
|---|---|---|
| **<60** | 21 (13.7) | 13 (61.9) |
| **60 – 69** | 70 (45.8) | 42 (60.0) |
| **70 – 79** | 46 (30.1) | 36 (78.3) |
| **≥80** | 16 (10.5) | 15 (93.8) |
| | | |
| **<70** | 92 (60.1) | 55 (59.8) |
| **≥70** | 61 (39.9) | 51 (83.6) |

**Table 22.** Mortality rate in age groups of patients during follow-up period.

| Age groups, yrs. | Average, months |
|---|---|
| **<60** | 85.1 ± 11.3 |
| **60 – 69** | 87.4 ± 6.4 |
| **70 – 79** | 64.2 ± 7.8 |
| **≥80** | 37.2 ± 7.7 |
| | |
| **<70** | 87.7 ± 5.5 |
| **≥70** | 55.6 ± 6.2 |

**Table 23**. Survival rate for different age groups of patients who died during follow-up period.

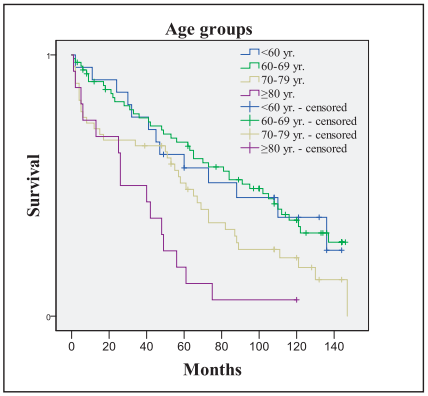


**Figure 6**. Cumulative survival rate of patients by Kaplan-Meier method after abdominal aortic aneurysm operations for different age groups (p<0.05 Log Rank test).

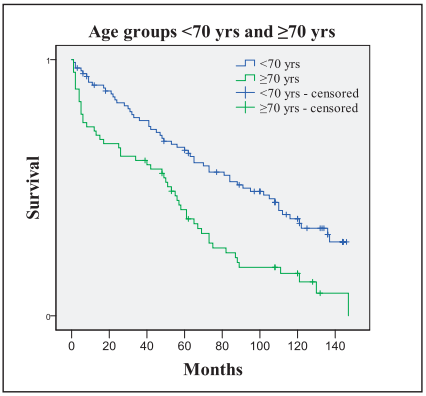


**Figure 7.** Cumulative survival rate of patients by Kaplan-Meier method after abdominal aortic aneurysm operations for age groups <70 years and ≥70 years (p<0.05 Log Rank test).

***Detsky risk factors***

The comparison of mortality rate during follow-up according to Detsky score before surgery, showed that the presence of concomitant diseases very important factor in determining patient mortality during follow-up period. Patients without concomitant pathology or with fewer diseases had higher survival rates compared to groups of patients with more points by Detsky (p<0.05). The assessment of patients groups are given in Table 24 and Figure 8.

In patients who had no risk factors the mortality rate was lower in these who had one or more risk factors and survival rate after surgery was higher (p<0.05). The results of this comparison are illustrated in Tables 25 – 26 and Figure 9.

| Detsky score | Average, month |
|---|---|
| **0** | 110.6±10.8 |
| **5** | 89.8±8.2 |
| **10** | 53.6±10.5 |
| **15** | 81.4±10.8 |
| **20** | 57.3±8.6 |
| **25** | 60.9±14.1 |
| **30** | 72.6±22.9 |
| **35** | 46.0±24.8 |
| **Total** | 75.2±4.4 |

**Table 24**. Detsky score and survival rate of patients.

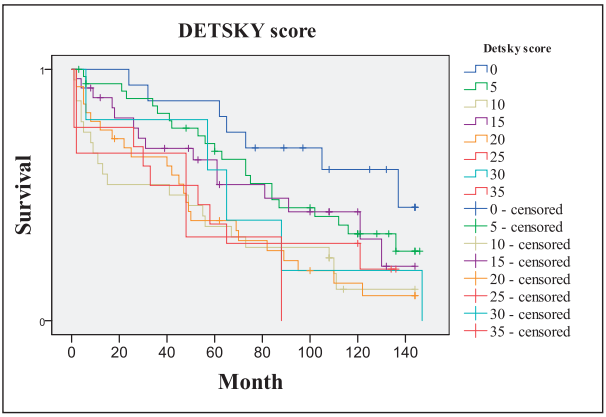


**Figure 8**. Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for different Detsky score ($p<0.05$ Log Rank test).

| Detsky risk factors | Total, n (%) | Non-survivors, n (%) |
|---|---|---|
| **No risk factor** | 20 (13.1) | 7 (35.0) |
| **One or more risk factor** | 133 (86.9) | 99 (74.4) |

**Table 25.** Mortality of patients with no risk factor and one or more risk factor according to Detsky during follow-up period.

| Detsky risk factors | Survival, month |
|---|---|
| **No risk factor** | 117.1±9.2 |
| **One or more risk factor** | 68.4±4.5 |

**Table 26**. Survival rate of patients with no risk factor and one or more risk factor according to Detsky during follow-up period.

***Smoking***

Smoking as a risk factor didn't have any higher impact on patient survival and mortality rates during follow-up period. From 63 (41.2%) patients who didn't smoke before surgery, 41 (65.1%) died and from 90 (58.8 %) smokers, 65 (72.2%) patients died ($p>0.05$). Mean survival rate for patients who didn't smoke before surgery was 76.8 ± 7.5 months and for smokers – 73.7 ± 5.3 months. Comparison of these two patient groups is presented in Figure 10.

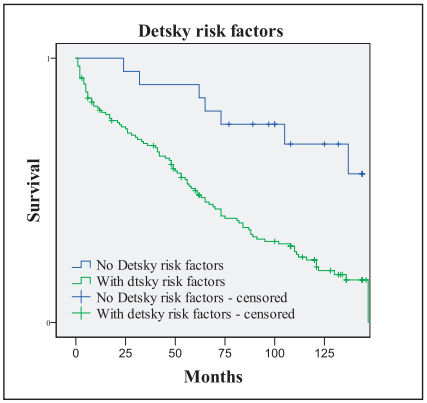


**Figure 9.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with one or more risk factors by Detsky during follow-up period ($p<0.05$ Log Rank test).

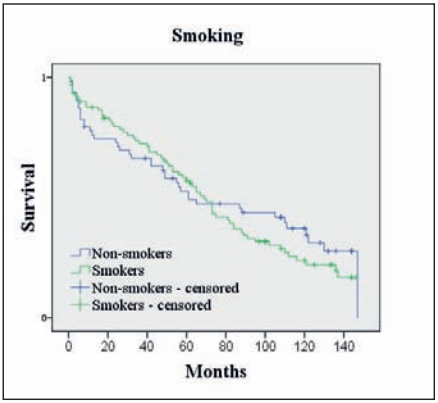


**Figure 10.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for smokers and nonsmokers during follow-up period ($p>0.05$ Log Rank test).

***Myocardial infarction***

Fifty-five (35.9%) patients had history of myocardial infarction before aortic aneurysm surgery, 42 (76.4%) of them died during follow-up period. Mean survival rate of these patients was $62.9 \pm 7.3$ months.

Of 98 (64.1%) patients without history of MI, 64 (65.3%) died during follow-up period and their mean survival rate was $81.2 \pm 5.2$ months.

Although mortality of patients with MI during follow-up period was higher and the average survival was shorter, myocardial infarction as a risk factor was not significant ($p=0.059$). Comparison of these two patient groups is shown in Figure 11.

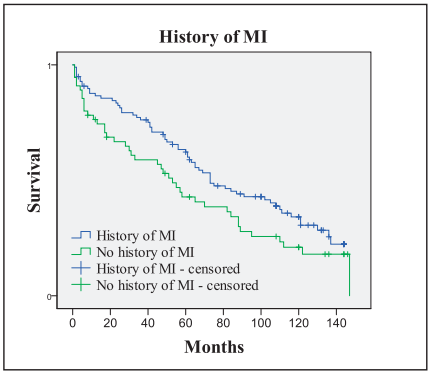


**Figure 11.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with history of MI during follow-up period (p=0.059 Log Rank test).

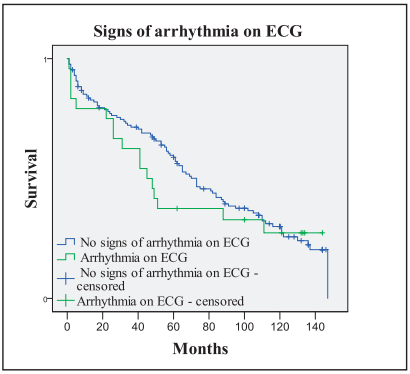


**Figure 12.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with signs of arrhythmia on ECG during follow-up period (p>0.05 Log Rank test).

***Arrhythmia***

The impact of heart rhythm disturbances didn't have noticeable impact on follow-up results (p>0.05). In 24 (15.7%) patients chronic cardiac arhythmia was diagnosed before surgery, 17 (70.8%) of these died during follow-up period. Their average survival was 65.9 ± 11.3 months.

Of 129 (84.3%) patients who had no cardiac arrhythmias during follow-up period, 89 died (69.0%) and their average survival was 76.8 ± 4.7 months (Figure 12).

***Myocardial ischemia***

Fifty-seven (37.3%) patients had signs of myocardial ischemia on ECG, 43 (75.4%) of them died during follow-up period. The mean survival rate of these patients was 75.0 ± 6.7 months.

Of 96 (62.7%) patients who had no signs of cardiac ischemia on ECG before surgery, 63 (65.6%) died during follow-up period and mean survival rate after surgery was 74.5 ± 5.6 months.

Differences in these groups were insignificant (p>0.05) (Figure 13).

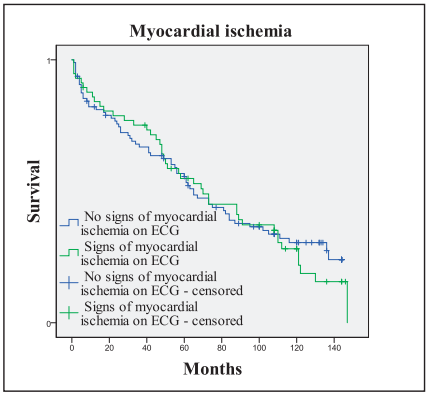


**Figure 13.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with signs myocardial ischemia on ECG during follow-up period (p>0.05 Log Rank test).

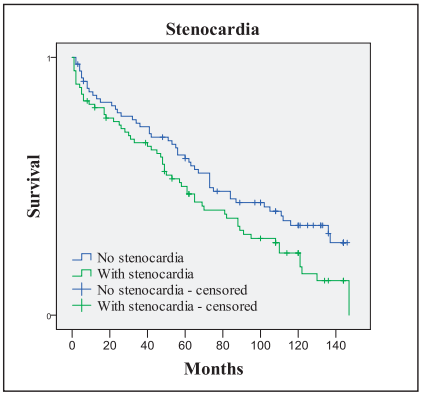


**Figure 14.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with stenocardia during follow-up period (p<0.05 Log Rank test).

***Stenocardia***

In 77 (50.3%) patients had symptoms of stenocardia, 58 (75.3%) of them have died during follow-up period. The mean survival of these patients was 67.2 ± 5.8 months.

In 76 (49.7%) cases symptoms of stenocardia were not found, and mortality rate among them was lower – 48 (63.2%) patients died. The mean survival of these patients after surgery was higher – 82.6 ± 6.2 months (p <0.05) (Fig. 14).

***Cardiac risk factors***

From 55 (35.9%) patients without cardiac risk factors 33 (60.0%) patients died. Meanwhile, from 98 (64.1%) patients who had these risk factors 73 (74.5%) patients died.

Average survival during follow-up period of patients who had no cardiac risk factors was 86.3 ± 7.1 months, while the mean survival rate after surgery for patients who had cardiac risk factors was significantly lower – 68.6 ± 5.4 months (p<0.05).

Those differences between the two groups are shown in Figure 15.

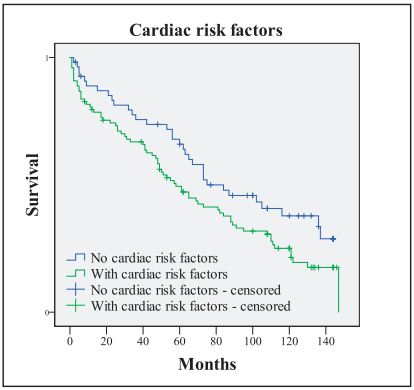


**Figure 15.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with cardiac risk factors by Detsky during follow-up period ($p<0.05$ Log Rank test).

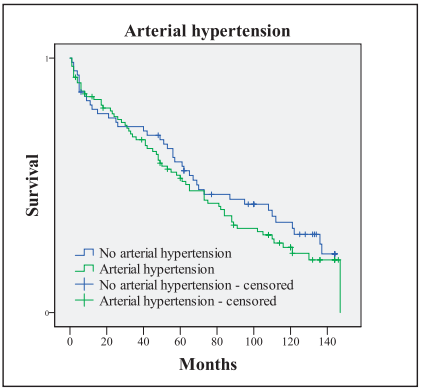


**Figure 16.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with arterial hypertension during follow-up period ($p>0.05$ Log Rank test).

***Arterial hypertension***

Ninety-three (60.8%) patients had arterial hypertension diagnosed before surgery, 66 (71%) of them died during follow-up period. The average survival of these patients was 72.3 ± 5.5 months.

Of 60 (39.2%) patients without arterial hypertension, 40 died (66.7%). Their average survival was 79.0 ± 7.0 months.

The differences between the two groups were insignificant ($p>0.05$). A comparison of groups is presented in Figure 16.

***Chronic obstructive pulmonary disease***

In 61 (39.9%) patient COPD was diagnosed before the abdominal aortic aneurysm resection, 49 (80.3%) of them died during follow-up period. Average survival of these patients was 59.5 ± 6.0 months.

Meanwhile, of 92 (60.1%) patients who had no signs of COPD prior to surgery, 57 (62.0%) died during follow-up period. The mean survival rate after surgery was

significantly higher – 85.1 ± 5.8 months (p<0.05). These two groups of patients are compared in Figure 17.

***Diabetes mellitus***

Eight (5.2%) patients had type II diabetes mellitus before the operation. They were treated with oral medications or insulin. Seven (87.5%) patients of them died during follow-up period. Their average survival after surgery was 50.1 ± 12.5 months.

From 145 (94.8%) patients without DM, 99 (68.3%) patients died. Their survival rate after surgery was 76.5 ± 4.5 months.

There was no difference between these two groups (p>0.05) (Figure 18).

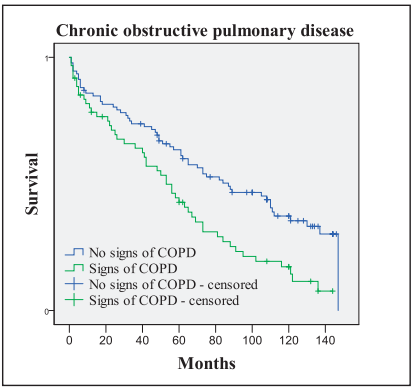


**Figure 17.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with COPD during follow-up period (p<0.05 Log Rank test).

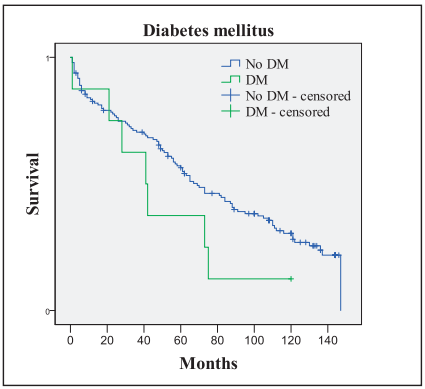


**Figure 18.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with Diabetes mellitus during follow-up period (p>0.05 Log Rank test).

***History of stroke***

Seven (4.6%) patients had history of stroke before surgery, four (57.1%) of them have died during follow-up period. Mean survival rate of these patients after surgery was 84.6 ± 17.9 months.

Of 146 (95.4%) patients who had no history of stroke, 102 (69.9%) died during follow-up period. Mean survival rate of them after surgery was 74.5 ± 4.5 months).

These two groups of patients had no significant difference (p>0.05) (Figure 19).

***Technique of operation***

Patients were divided into three groups according to technique of surgery – tube graft, bifurcated aortic prosthesis and other reconstructive surgery. The comparison of mortality and survival of these three groups of patients during follow-up period didn't show any significant differences (p>0.05). Comparison of these groups is presented in Table 27 and Figure 20.

| Technique of operation | Total, n (%) | Non-survivors, n (%) | Survival, months |
|---|---|---|---|
| **Tube graft** | 63 (41.2) | 46 (73.0) | 72.3±6.8 |
| **Bifurcated graft** | 85 (55.6) | 56 (65.9) | 77.7±5.9 |
| **Other** | 5 (3.3) | 4 (80.0) | 60.2±22.2 |

**Table 27**. Comparison of mortality and survival rate in groups of different technique during follow-up period.

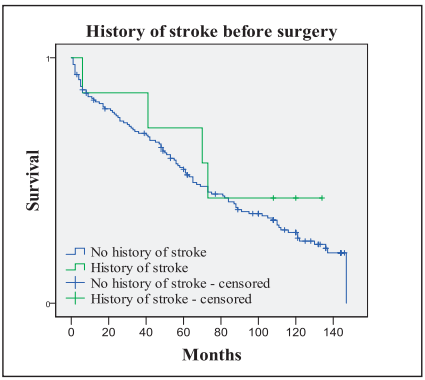


**Figure 19.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for patients without and with history of stroke during follow-up period (p>0.05 Log Rank test).

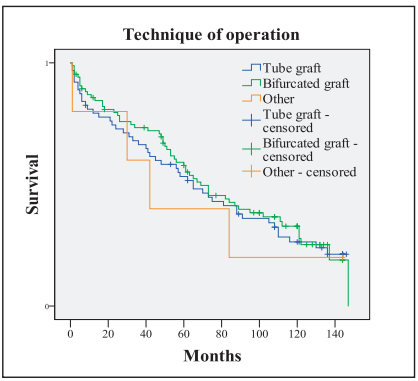


**Figure 20.** Cumulative survival rate by Kaplan-Meier method after abdominal aortic aneurysm operations for different surgery technique groups during follow-up period (p>0.05 Log Rank test).

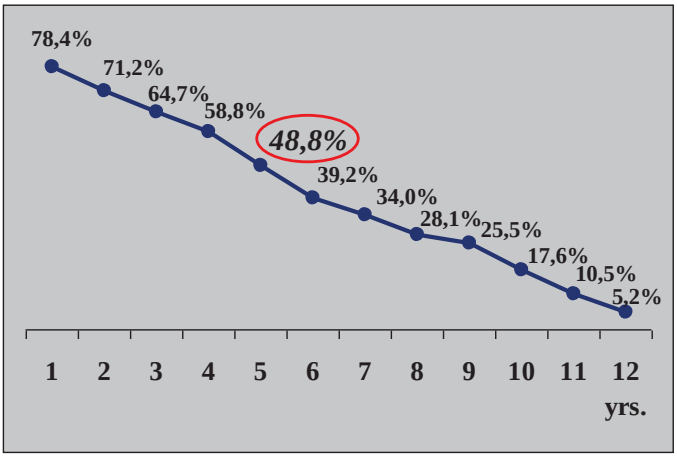


**Figure 21.** Survival rate after abdominal aortic aneurysm operations.

Of all patients 78.4% survived one year after abdominal aortic aneurysm operations. Twelve years survival rate was only 5.2%. Five years survival rate after abdominal aortic aneurysm surgery was 48.8% (Fig. 21).

## 6. Conclusions

1. Age is a risk factor for postoperative mortality of patients operated for nonruptured aortic aneurysm.
2. Ischemic heart disease reduces survival rate after elective aortic aneurysm surgery.
3. Chronic obstructive pulmonary disease as an indipendant risk factor which increases mortality of men after surgery for non-ruptured aneurysm.
4. Aortobifemoral grafting is related to higher incidence of peripheral arterial complications than aortic repair with a tube graft.
5. Shock and blood volume deficiency are more significant risk factors than chronic heart pathology.

6. There are no reliable factors predicting postoperative death of patients operated for ruptured aortic aneurysm and therefore the criteria for depriving patients of the operation do not exist.
7. Age, female gender and concomitant heart disease are the most negative predictors of outcome after ruptured abdominal aortic aneurysm surgery.
8. Advanced age and pronounced heart pathology as well as chronic obstructive pulmonary disease are the factors decreasing long-term survival rate after abdominal aortic aneurysm operations.
9. Five year survival rate after aortic aneurysm resection was 48,4 %. The most frequent causes of death were chronic heart disease, stroke and malignancies.

## 7. Practical recommendations

1. In spite of high probability of rupture which is determined by the size of an aneurysm the elective surgery should be declined in cases of age >70 years, myocardial infarction and chronic obstructive pulmonary disease.
2. All patients presented with ruptured abdominal aortic aneurysm should be operated in spite of their critical condition.
3. Patients operated for the abdominal aortic aneurysm should undergo periodical postoperative control for cardiovascular, respiratory and other systems in an out-patient clinic.

## 8. Santrauka lietuvių kalba

### *Įvadas*

Progresuojantis arterijos plėtimasis gali sukelti aneurizmos plyšimą, ir jo padariniai dažniausiai yra katastrofiški visam organizmui. Plyšusi pilvinės aortos aneurizma (PPAA) išlieka viena dažnesnių mirties priežasčių Vakarų šalyse ir Lietuvoje (Carrioccio A 2004, Heather LH 2004, Triponis V 2001, Urbonavičius S 2002). Mirtingumas po pilvinės aortos aneurizmos planinio operacinio gydymo, įvairių centrų duomenimis, tesiekia 3–5 %, o plyšus pilvinės aortos aneurizmai mirtingumas siekia 30–80 %. Tobulėjant diagnostikos ir gydymo metodams, didėjant šios patologijos gydymo patirčiai, daugėjant planinių operacijų skaičiui ir gerėjant gydymo rezultatams, plyšusių pilvinės aortos aneurizmos atvejų nemažėja, o mirtingumas po plyšusios pilvinės aortos aneurizmos išlieka labai didelis (Bown MJ 2002, Hoornweg LL 2008, Kniemeyer HW 2000, Noel AA 2001, Peppelenbosch AG 2010).

Šios patologijos diagnostika pagerėjo, kai buvo pradėtos tam tikro amžiaus pacientų grupių tikslinio sveikatos patikrinimo programos (*screening*). Šių programų tikslas – kuo anksčiau nustatyti pilvinės aortos patologiją ir ją gydyti planine tvarka. 2003 metais buvo baigti du didelės imties tyrimai: Jungtinėse Amerikos Valstijose – „Aneurizmos nustatymas ir gydymas“ (ADAM) ir Didžiojoje Britanijoje – „Mažos aneurizmos“ (UKSAT). Apibendrinus šių tyrimų rezultatus buvo suformuluotos ir pateiktos pilvinės aortos aneurizmos gydymo rekomendacijos (Brewster DC 2003).

Daug veiksnių, pavyzdžiui, amžius, gretutinės ligos, nestabili hemodinamika, daro įtaką PPAA pooperacinių komplikacijų dažniui ir mirtingumui (Axelrod DA 2001, Halpern VJ 1997, Hultgren R 2007, Katz DJ 1997, Lindblad B 2005). Iš literatūros šaltinių neaišku, kurie veiksniai sudaro didžiausią grėsmę ir lemia plyšusios pilvinės aortos aneurizmos pooperacines komplikacijas bei mirtingumą. Kai kuriuose šaltiniuose pažymima, kad užsitęsusio šoko būsenos ligoniai, turintys inkstų funkcijos nepakankamumo požymių, neoperuotini. Literatūroje pateikiamos tik santykinės PPAA operacinio gydymo kontraindikacijos, kurias apibendrina Hardmano indeksas (Carrioccio A 2004, Acosta S 2006, Hardman DT 1996).

***Darbo tikslas***

Nustatyti ir įvertinti rizikos veiksnių įtaką pilvinės aortos aneurizmos operacijų rezultatams.

***Darbo uždaviniai***

1. Įvertinti paciento amžiaus įtaką pooperaciniam mirtingumui po neplyšusios pilvinės aortos aneurizmos operacijų.
2. Įvertinti paciento gretutinės širdies patologijos įtaką pooperaciniam mirtingumui po neplyšusios pilvinės aortos aneurizmos operacijų.
3. Įvertinti obstrukcinės plaučių ligos įtaką pooperaciniam mirtingumui po neplyšusios pilvinės aortos aneurizmos operacijų.
4. Įvertinti operacijų apimties įtaką pilvinės aortos aneurizmos chirurginio gydymo rezultatams.
5. Įvertinti šoko, nukraujavimo bei lėtinės gretutinės patologijos poveikį mirtingumui po plyšusios pilvinės aortos aneurizmos operacijų.
6. Nustatyti rizikos veiksnius, lemiančius mažiausią išgyvenamumo tikimybę po plyšusios aortos aneurizmos operacijų.
7. Įvertinti paciento lyties, amžiaus bei gretutinės patologijos įtaką plyšusios pilvinės aortos aneurizmos chirurginio gydymo rezultatams.
8. Nustatyti svarbiausius rizikos veiksnius, lemiančius blogesnį išgyvenamumą vėlyvuoju pooperaciniu laikotarpiu.
9. Nustatyti pacientų penkerių metų išgyvenamumą vėlyvuoju pooperaciniu laikotarpiu po pilvinės aortos aneurizmos operacijų bei dažniausias pacientų mirties priežastis.

***Darbo naujumas***

Širdies ir kraujagyslių ligų paplitimas, šių ligų ankstyvos komplikacijos ir mirtingumas priklauso nuo socialinių – ekonominės bei kultūrinės visuomenės būklės. Vertinant širdies ir kraujagyslių ligų rizikos veiksnius pastebėta, kad Lietuvoje ir kitose pokomunistinėse šalyse jie išaiškinami jaunesniems individams nei išsivysčiusios Vakarų šalyse. Apie aortos ir periferinių ligų paplitimą Lietuvoje, rizikos veiksnių reikšmę šių ligų gydymo rezultatams turime labai mažai duomenų. Pilvo aortos

aneurizmos gydymo rezultatai, įvairių rizikos veiksnių poveikis jiems visai nenagrinėtas. Tokie tyrimai neatlikti ir kaimyninėse šalyse Latvijoje, Estijoje bei Lenkijoje. Taip pat laisvai pasiekiamoje mokslinėje spaudoje neradome jokių duomenų apie panašius tyrimus, kurie būtų atlikti Baltarusijoje ar Rusijos Federacijoje.

***Darbo metodika***

Tyrimas buvo atliktas Vilniaus universiteto Medicinos fakulteto Širdies ir kraujagyslių ligų klinikos Kraujagyslių chirurgijos centre, esančiame Vilniaus miesto universitetinėje ligoninėje (VMUL).

Tirti pacientai, kurie buvo operuoti dėl plyšusios ir neplyšusios subrenalinės pilvinės aortos ir/ar bendrųjų klubo arterijų aneurizmos VMUL Pirmajame ir Antrajame kraujagyslių chirurgijos skyriuose nuo 1997 m. sausio 1 d. iki 2006 m. gruodžio 31 d.

Duomenys rinkti nuo 2007 m. spalio 1 d. iki 2011 m. sausio 31 d.

Pirmame tyrimo etape iš VMUL archyvo buvo paimtos ir retrospektyviai išanalizuotos 1997–2006 m. operuotų dėl pilvinės aortos ir/ar klubo arterijų aneurizmos pacientų gydymo stacionare ligos istorijos.

Registruoti pacientų demografiniai duomenys, rizikos veiksniai, apatinių galūnių arterinės kraujotakos būklė, gretutinė visų organų sistemų patologija, atliktų bendro ir biocheminio kraujo tyrimų, elektrokardiogramos, pilvinės aortos ir klubo arterijų ultragarsinio bei kompiuterinės tomografijos tyrimų rezultatai, operacijos apimtis bei įsiūto kraujagyslės protezo tipas, operacijos metu ir pooperaciniu laikotarpiu kilusios komplikacijos, pakartotinės intervencijos, mirties priežastys.

Į tyrimą įtraukti visi pacientai, kurie buvo operuoti dėl plyšusios ir neplyšusios pilvinės aortos ir/ar bendrųjų klubo arterijų aneurizmos. Įtraukti ir tie pacientai, kurie mirė operacijos metu tik pradėjus chirurgines manipuliacijas. Į tyrimą neįtraukti pacientai, kurie buvo tiriami ar gydomi angiochirurgijos skyriuose, bet dėl įvairių priežasčių aneurizmos rezekcijos operacija jiems neatlikta.

Iš viso į tyrimą įtraukti 373 pacientai, 84 (22,5 % ) iš jų operuoti dėl plyšusios pilvinės aortos ir/ar klubo arterijų aneurizmos. Po operacijos pasveiko 302 pacientai.

Išanalizuoti ankstyvieji gydymo rezultatai. Ankstyvuoju pooperaciniu laikotarpiu laikytas laikas iki paciento hospitalizacijos pabaigos.

Antrame tyrimo etape pagal turimus pacientų kontaktinius duomenis išsiųsti laiškai su kvietimais visiems po PAA operacinio gydymo pasveikusiems pacientams atvykti į VMUL išsitirti. Iš viso gauta informacijos apie 153 (50,7 % ) pacientus. Į kitus laiškus negauta jokio atsakymo. Iš gautų atsakymų sužinojome, kad 106 (69,7 % ) pacientai jau yra mirę.

Kai kurių jų mirties priežastis buvo nurodyta paciento artimųjų atsiųstuose atsakymuose. Visų mirusių pacientų mirties priežastys (pagal TLK-10) bei datos buvo patikslintos raštu kreipiantis į Statistikos departamentą.

Papildomai duomenų apie buvusiems pacientams vėlesniu laikotarpiu atliktas kitas kraujagyslines operacijas gauta peržiūrėjus VMUL Kraujagyslių chirurgijos centre veikiančią operacijos protokolų elektroninę duomenų bazę.

Paciento tyrimo pradžia laikyta operacijos data, o pabaiga – paciento mirties arba apžiūros data, arba paskutinės fiksuotos operacijos data.

Likę 47 (30,3 % ) pacientai atvyko stacionariniam arba ambulatoriniam ištyrimui. Jiems buvo surašyti anamnezės duomenys apie ligas ir operacijas, kurios buvo laikotarpiu nuo pilvinės aortos rekonstrukcinės operacijos iki kontrolinio tyrimo, įvertinta ir fiksuota galūnių arterinė kraujotaka bei jos patologija, atliktas ultragarsinis pilvinės aortos protezo bei klubo arterijų tyrimas, užrašyta ir aprašyta elektrokardiograma, pacientas konsultuotas kardiologo ir įvertinta gretutinė visų organų sistemų patologija.

Analizuojant gautus duomenis apie ankstyvąjį pooperacinį laikotarpį, pacientai buvo suskirstyti į dvi grupes – plyšusios ir neplyšusios pilvinės aortos ir/ar klubo arterijų aneurizmos.

Visų pacientų bendra būklė buvo vertinama pagal anamnezės duomenis ir objektyvių tyrimų rezultatus, fiksuojami žalingi įpročiai (rūkymas), gretutinė patologija – cukrinis diabetas, inkstų funkcijos sutrikimai, arterinė hipertenzija.

Gretutinė širdies patologija ir pooperacinių komplikacijų rizika buvo vertinama balais pagal Detsky modifikuotą širdies rizikos indeksą (Detsky AS 1986, Wong T 1992).

Visiems pacientams pilvinės aortos ir klubo arterijų aneurizmos dydis buvo vertinamas atliekant ultragarso KT tyrimą.

Pacientų, gydytų dėl plyšusios pilvinės aortos aneurizmos, bendra būklė ir pooperacinių komplikacijų rizika vertinta dar ir pagal Hardmano indeksą.

Pacientams, gydytiems dėl plyšusios PAA, hemoraginis šokas buvo nustatomas iškart atvykus į gydymo įstaigą, t. y. vertinamas širdies susitraukimų dažnis, sistolinis arterinis kraujospūdis, kvėpavimo dažnis, inkstų funkcija, sąmonės lygis, hemoglobino (Hb) kiekis ir hematokritas. Šie ligoniai suskirstyti į dvi grupes – atvykę šoko būsenos ir stabilios būklės. Jei UG metodu randama laisvo skysčio pilvo ertmėje ir sistolinis AKS <90 mm Hg, tokie pacientai iš karto buvo vežami į operacinę ir papildomi tyrimai neatliekami.

Kraujo tūrio deficitas buvo vertinamas lyginant netekto kraujo kiekį operacijos metu ir perpiltą kristaloidų tirpalų bei kraujo komponentų kiekį operacijos metu ir po operacijos.

Statistika. Diskretūs nominalieji kintamieji buvo analizuojami panaudojant Pirsono $\chi^2$ nepriklausomumo kriterijų arba Fišerio tikslusis testas.

Daugiamatė analizė atlikta panaudojant binarinę logistinę regresiją. Bendras modelio statistinis patikimumas buvo įvertintas remiantis Determinacijos koeficientu (angl. Nagelkerke R Square).

Įvairių veiksnių įtaka įvertinta šansų santykiu, jo statistinis reikšmingumas įvertintas panaudojant 95 proc. pasikliautinus intervalus.

Atskirų rizikos veiksnių įtakos išgyvenamumui vertinimui naudotas Kaplan-Meier metodas. Gauti rezultatai atvaizduoti grafiškai, kreivės palygintos Log Rank testu. Skirtumo statistinis reikšmingumas laikytas patikimas, kai $p<0,05$.

Nepriklausomų grupių kiekybinių duomenų analizei taikytas Stjudento T testas. Reikšmingumo lygmeniu pasirinkta, kuomet $\alpha=0,05$, t.y. skirtumo statistinis reikšmingumas laikytas patikimas, kai $p<0,05$.

Visi vidurkiai pateikti su standartiniu nuokrypiu (SD).

Duomenys apdoroti naudojant Microsoft Office Excel 2007, statistinio duomenų apdorojimo programomis WinPepi v11.4 (2011) bei SPSS Statistics 17.0 (2008).

***Rezultatai***

Iš viso 1997–2006 metais VMUL Pirmajame ir Antrajame kraujagyslių chirurgijos skyriuose dėl pilvinės aortos aneurizmos buvo operuoti 373 pacientai. Iš jų 289 (77,5 %) operuoti dėl neplyšusios PAA, o kiti 84 (22,5 %) pacientai – dėl plyšusios PAA.

Neplyšusios PAA. Dėl neplyšusios pilvinės aortos aneurizmos operuoti 238 (82,4 %) vyrai ir 51 (17,6 %) moteris. Vyrų ir moterų santykis 4,6:1. Moterų amžiaus vidurkis buvo 72,1 ± 8,1 metų, o vyrų – 67,6 ± 8,5 metų ($p<0,0001$). Daugiausia pacientų buvo amžiaus grupėse nuo 60 iki 79 metų, jose vyrų ir moterų skaičius reikšmingai nesiskyrė. Amžiaus grupėje iki 60 metų gerokai daugiau buvo vyrų, o vyresnių kaip 80 metų amžiaus grupėje – moterų ($p<0,05$).

Po operacijos iš viso mirė 28 (9,7 % ) pacientai – 21 (8,8 % ) vyras ir 7 (13,7 % ) moterys. Bendras mirtingumas vyrų ir moterų nesiskyrė ($p>0,05$). Palyginus mirtingumą pagal amžiaus grupes, reikšmingo skirtumo tarp vyrų ir moterų, tačiau bendras mirtingumas pacientų, jaunesnių nei 60 metų, buvo daug mažesnis nei 80 metų ir vyresnių (2 (4,5%) ir 7 (23,3%), $p<0,05$).

Padalijus pacientus į dvi amžiaus grupes – iki 70 metų ir ≥70 metų, nustatyta, kad tarp jaunesnių pacientų vyrų buvo daugiau nei moterų (141 (59,.2%) ir 18 (35,3%)), o vyresniųjų grupėje daugumą sudarė moterys (97 (40,8%) ir 33 (64,7%), $p<0,05$).

Įvertinus gydytus pacientus pagal Detsky pooperacinių komplikacijų rizikos skalę mirę vyrai turėjo daugiau gretutinės patologijos negu pasveikusieji (13,1 ± 9,4 ir 19,3 ± 9,5, $p<0,05$). Palyginus bendrai pasveikusių ir mirusių pacientų gretutinės patologijos rizikos įvertinimo rezultatus rasta, kad mirusiųjų Detsky balų vidurkis buvo gerokai didesnis (13,1 ± 9,5 ir 19,6 ± 9,1, $p<0,05$). Visų pacientų amžiaus grupėje <70 metų gretutinės patologijos rizika pagal Detsky buvo įvertinta 10,6 ± 9,3 balų, o ≥70 metų amžiaus grupės pacientų ta pati rizika buvo daug didesnė – sudarė 17,6 ± 8,6 ($p<0,05$). Amžiaus grupėje ≥70 metų pasveikusių vyrų, moterų bei visų pasveikusių pacientų gretutinės patologijos rizika buvo didesnė nei jaunesnių pasveikusių pacientų ($p<0,05$). Vyresnių mirusių moterų Detsky balų vidurkis buvo gerokai didesnis nei jaunesnių mirusių moterų ($p<0,05$). Amžiaus grupėje <70 metų mirusių vyrų ir visų mirusių pacientų gretutinės patologijos buvo daugiau, nei pasveikusių vyrų ir visų pasveikusiųjų ($p<0,05$). Amžiaus grupėje ≥70 metų mirusios moterys turėjo daugiau gretutinės patologijos pagal Detsky skalę nei pasveikusios ($p<0,05$). Pacientų, turėjusių Detsky

balų sumą 0–15, mirtingumas po operacijos buvo žymiai mažesnis nei 20 ir daugiau balų (10 (5,3%) ir 18 (18,2%), p<0,05).

Persirgtas miokardo infarktas anamnezės duomenimis, bent vienas Detsky rizikos veiksnių – šie veiksniai atskirai buvo reikšmingi pacientų mirtingumui (p<0,05). Palyginus gretutinės patologijos paplitimą vyrų ir moterų grupėse bei jos atskirų veiksnių dažnį mirusiųjų grupėse, pastebėta, kad tik LOPL kaip atskiras veiksnys buvo gerokai dažnesnis tarp mirusių vyrų (p<0,05).

Rūkymo kaip rizikos veiksnio mirtingumui reikšmingo poveikio nerasta, tačiau jis lėmė vyrams dažnesnes pooperacines komplikacijas nei moterims (p<0,05).

Bifurkacinio protezo grupėje buvo didesnis bendras komplikacijų skaičius palyginus su vienvamzdžio protezo grupe (56 (36,6%) ir 25 (22,1%), p=0,010). Šioje grupėje periferinių arterijų trombembolinių komplikacijų buvo gerokai daugiau (12 (7,5%) ir 2 (1,8%), p=0.035), o kitų komplikacijų dažnis buvo panašus.

Plyšusios PAA. Dėl plyšusios pilvinės aortos aneurizmos operuoti 59 (70,2 %) vyrai ir 25 (29,8 %) moterys. Operuotų pacientų amžiaus vidurkis buvo 73,3 ± 9,7 m.

Po operacijos 41 (48,8 %) pacientai pasveiko, o 43 (51,2 %) mirė ankstyvuoju pooperaciniu laikotarpiu. Pasveikusiųjų po operacijos pacientų amžiaus vidurkis buvo 71,8 ± 9,6 m., o mirusiųjų ligonių – 74,7 ± 9,7 metai (p>0,05). Moterų pooperacinis mirtingumas buvo didesnis (p<0,05). Mirusiųjų grupėje moterys buvo daug vyresnės nei vyrai (p<0,05). Pasveikusių vyrų ir moterų amžiaus reikšmingo skirtumo nenustatyta.

Palyginus gretutinės patologijos paplitimą pasveikusiųjų ir mirusiųjų ligonių grupėse rasti skirtumai nebuvo statistikai reikšmingi. Vertinant vyrų ir moterų skirtumus pagal Detsky pooperacinių širdies komplikacijų rizikos skalę nustatyta, kad vyrų balų vidurkis buvo 14,0 ± 2,5, o moterų – 11,7 ± 1,8 (p<0,05). Iš keturiasdešimt vieno paciento, pasveikusio po operacijos, 39 (95,1 %) turėjo daugiau ar mažiau Detsky širdies rizikos veiksnių. Mirusių ligonių grupėje iš 43 tokių buvo 41 (95,3 %) (p>0,05).

Iš viso buvo paplitę keturi iš penkių Hardmano rizikos veiksnių, nes nė vienas gydytas pacientas iki pilvinės aortos aneurizmos plyšimo nesirgo lėtiniu inkstų funkcijos nepakankamumu. Sistolinis arterinis kraujo spaudimas <90 mmHg buvo pridėtas prie kitų Hardmano indekso veiksnių išsamesniam šoko įvertinimui, tačiau šio veiksnio įtaka vertinta atskirai. Pacientų, turėjusių vieną ar du Hardmano indekso balus, mirtingumas buvo mažesnis nei tų, kurie turėjo tris ar keturis balus (25 (53,2%) ir 11 (91,7%),

p<0,05). Šiose dviejose pacientų grupėse žemo sistolinio arterinio kraujo spaudimo paplitimas buvo taip pat labai reikšmingai skirtingas (10 (21,3%) ir 11 (91,7%), p<0,0001).

Iš penkiolikos pacientų, turėjusių ≥25 balus pagal Detsky skalę, septyni (46,7 %) mirė po operacijos, o iš dvylikos ligonių, turėjusių ≥3 balus pagal Hardmano indeksą, mirė 11 (91,7 %) (p=0,01).

Iš visų dėl plyšusios pilvinės aortos aneurizmos operuotų pacientų net 64 (76,2 %) buvo hemoraginio šoko būsenos, 45 (70,3%) jų mirė (p<0,05).

Pasveikusiųjų grupėje kraujo tūrio deficito nenustatyta, tačiau mirusiųjų grupėje tūrio deficitas buvo vidutiniškai 629,0 ± 323,4 ml (p<0,05).

Pasveikusių pacientų grupėje vidutinė laiko trukmė nuo atvykimo iki operacijos pradžios buvo 660,0 ± 1154,2 min., o mirusiųjų grupėje – 222,1 ± 348,1 min (p=0,08).

Keturiasdešimt vienam (48,8 %) pacientui po aneurizmos rezekcijos pilvinė aorta rekonstruota vienvamzdžiu kraujagyslės protezu. Iš jų 16 (39,0 %) pacientų mirė ankstyvuoju pooperaciniu laikotarpiu. Trisdešimt vienam (36,9 %) pacientui pilvinė aorta rekonstruota bifurkaciniu protezu, iš jų 17 (54,8 %) mirė po operacijos. Mirtingumo skirtumas šiose grupėse buvo nepatikimas (p>0,05), tačiau komplikacijos dažnesnės buvo bifurkacinio protezo grupėje (22 (53,7%) ir 24 (77,4), p=0,035).

Vėlyvieji rezultatai. Duomenų gauta apie 153 (50,7%) pacientų ligos eigą, gretutines ligas ar mirtį bei mirties priežastį, 106 (69,3%) jų jau buvo mirę. Trys dažniausios mirties priežastys – širdies patologija, galvos smegenų insultas ir onkologinės ligos. Penkis metus po operacijos išgyveno 48,4 % pacientų. Mažesnį išgyvenamumą vėlyvuoju pooperaciniu laikotarpiu lėmė vyresnis paciento amžius operacijos metu, gausesnė gretutinė širdies patologija, lėtiniai obstrukciniai plaučių pakitimai (Log Rank testas p<0,05).

***Išvados:***

1. Ligonio amžius turi įtakos pooperaciniam mirtingumui.
2. Mirtingumą po neplyšusios pilvinės aortos aneurizmos operacijos lemia išeminė širdies patologija.

3. Po aortos bifurkacinio protezavimo operacijų dažniau pasitaiko periferinės kraujotakos sutrikimų, todėl ši operacija yra rizikingesnė nei aortos protezavimas vienvamzdžiu kraujagyslės protezu.
4. Obstrukcinė plaučių liga kaip atskiras rizikos veiksnys turi įtakos vyrų mirtingumui po neplyšusios pilvinės aortos aneurizmos operacijų.
5. Mirtingumui po plyšusios pilvinės aortos aneurizmos operacijos nukraujavimas ir šokas buvo reikšmingesni nei lėtinė širdies liga.
6. Nė vienas iš vertinimo kriterijų negali būti lemiamas atsisakant operacinio plyšusios pilvinės aortos aneurizmos gydymo.
7. Amžius, moteriškoji lytis ir gretutinė širdies patologija – tai rizikos veiksniai, kurie lemia blogą plyšusios pilvinės aortos aneurizmos operacijos baigtį.
8. Vyresnis paciento amžius operacijos metu, gretutinės širdies patologijos gausa ir lėtiniai obstrukciniai plaučių pakitimai – tai veiksniai, lemiantys blogesnį išgyvenamumą vėlyvuoju pooperaciniu laikotarpiu.
9. Penkerių metų išgyvenamumas po pilvo aortos aneurizmos operacijų buvo 48,4 %. Dažniausios mirties priežastys buvo širdies patologija, insultas ir piktybiniai augliai.

***Praktinės rekomendacijos:***

1. Nepaisant didelės aneurizmos plyšimo tikimybės, nustatomos pagal aneurizmos skersmenį, rekomenduojame susilaikyti nuo planinės aneurizmos rezekcijos, kai pacientas turi šiuos rizikos veiksnius: amžius >70 m., persirgtas MI, obstrukcinė plaučių liga.

2. Plyšus pilvinės aortos aneurizmai turi būti operuojami visi pacientai, nepaisant kokios sunkios būklės jie būtų atvežti į gydymo įstaigą.

3. Po pilvinės aortos aneurizmos operacijos pacientai turi būti periodiškai tiriami dėl širdies, plaučių bei kitų organų sistemų patologijos progresavimo, gydoma ši patologija.

## 9. List of publications


1. Janušauskas T, Janušauskas E, Kazlauskas V, Triponienė D, Triponis V. Ruptured iliac artery aneurysm after abdominal aortic aneurysm resection: a case report. Medicinos teorija ir praktika 2010;16(4):464-466. ISSN 1392-1312.
2. Janušauskas T, Vaitkevičiūtė L, Triponis V. Analysis of risk factors as outcome predictors after open aortic repair in patients with a ruptured abdominal aortic aneurysm. Seminars in Cardiovascular Medicine 2011;17:5. e-ISSN 1822-7767


## 10. Brief information about the author


Name and Surname: **Tomas Janušauskas**

Date and place of birth: 25th of January, 1976, Vilnius, Lithuania

Office: Vilnius University City Hospital,
Antakalnio st. 57, LT-10207 Vilnius
Phone No.: +370 5 239 14 68

E-mail: janusauskas.t@gmail.com


Education:

1994 – 2000 Vilnius University Faculty of Medicine, graduated as Medical Doctor

2006 – License of vascular surgeon issued the ministry of Health of the Republic of Lithuania.

2007 – 2011 Doctorial student at Clinic of Heart and Vascular Diseases, Vilnius University Faculty of medicine.

Professional experience:

Since 2006 vascular surgeon at Vilnius City University Hospital Center of Vascular Surgery.

Scientific activities:

Published 2 articles and delivered 11 presentations with co-authors at conferences in Lithuania, Norway, France and Germany.

He is a member of Lithuanian Society of vascular surgery and European Society for Vascular Surgery.

**Trumpa informacija apie autorių**


| | |
|---|---|
| Vardas ir pavardė: | **Tomas Janušauskas** |
| Gimimo data ir vieta: | 1976 m. sausio mėn. 25 d., Vilnius, Lietuva. |
| Darbo vieta: | Vilniaus miesto universitetinė ligoninė |
| | Antakalnio g. 57, LT-10207 Vilnius |
| El. paštas: | janusauskas.t@gmail.com |


Išsilavinimas

1994 – 2000 Vilniaus Universitetas, Medicinos Fakultetas, gydytojo diplomas.

2006 – LR SAM Gydytojo kraujagyslių chirurgo licenzija.

2007 – 2011 Vilniaus Universitetas, Medicinos Fakultetas, Širdies ir kraujagyslių ligų klinika, doktorantas.

Darbo patirtis:

Nuo 2006 m. gydytojas kraujagyslių chirurgas Vilniaus miesto universitetinėje ligoninėje.

Mokslinė veikla:

Paskelbti 2 spausdinti darbai, pristatyti 11 pranešimų kartu su bendraautoriais konferencijose Lietuvoje, Norvegijoje, Prancūzijoje ir Vokietijoje.

Tomas Janušauskas yra Lietuvos Kraujagyslių Chirurgijos Draugijos bei Europos Kraujagyslių Chirurgijos Draugijos (European Society for Vascular Surgery) narys.