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РИСКИ ТРОМБОЗА ПОСТОЯННОГО СОСУДИСТОГО ДОСТУПА

© *И.Н. Староверов[1,2], Н.С. Нощенко[1,2], Л.Б. Шубин[1]*

ФГБОУ ВО Ярославский государственный медицинский университет Минздрава России, Ярославль, Россия (1)
ГБУЗ ЯО Областная клиническая больница, Ярославль, Россия (2)

Цель. Выявить факторы, влияющие на возникновение тромбоза постоянного сосудистого доступа (ПСД), определить их значимость. ***Материалы и методы.*** Проанализированы результаты лечения 168 пациентов с нативной артериовенозной радиоцефальной фистулой. Прослежены результаты лечения в течение 1 года. Пациенты разделены на 2 группы: 1 группа – пациенты, у которых в течение 1 года гемодиализа не возникло тромбоза артериовенозной фистулы, 2 группа – пациенты, у которых в течение 1 года произошла дисфункция постоянного сосудистого доступа вследствие тромбоза. ***Результаты.*** На основании полученных данных к факторам риска тромбоза ПСД в период до 6 месяцев были отнесены: повторные операции, длительность антикоагулянтной терапии, коррекция антикоагулянтной терапии, антибиотикотерапия. К факторам риска тромбоза ПСД в период от 6 до 12 месяцев были отнесены: атеросклероз, диаметр фистульной вены, повторные операции, количество повторных операций, причина повторной операции, длительность антикоагулянтной терапии, коррекция антикоагулянтной терапии, антибиотикотерапия. ***Заключение.*** Реализация выделенных факторов риска не является единственной причиной возникновения осложнений. Для более детального рассмотрения вероятности возникновения тромбоза постоянного сосудистого доступа в разные временные промежутки целесообразно применение многомерного математического моделирования.

Ключевые слова: *постоянный сосудистый доступ; факторы риска тромбоза; гемодиализ; хроническая почечная недостаточность; артериовенозная фистула.*

THROMBOSIS RISKS OF PERMANENT VASCULAR ACCESS

I.N. Staroverov[1,2], N.S. Noshchenko[1,2], L.B. Shubin[1]

Yaroslavl State Medical University, Yaroslavl, Russia (1)
Regional Clinical Hospital, Yaroslavl, Russia (2)

Aim. To identify the factors affecting the occurrence of thrombosis of permanent vascular access and to determine their significance. ***Materials and Methods.*** The results of treatment of 168 patients with native arteriovenous radio-cephalic fistula were analyzed. The results of treatment were traced within 1 year. According to the results of treatment, patients were divided into 2 groups: the 1st group – patients who did not develop thrombosis of the arteriovenous fistula within 1 year of hemodialysis, and the 2nd group – patients with a dysfunction of permanent vascular access developed due to thrombosis within the first year. ***Results.*** On the basis of the obtained data, the risk factors for thrombosis of permanent vascular access within 6 months were: repeated operations, duration of anticoagulant therapy, correction of anticoagulant therapy, antibiotic therapy. Risk factors for thrombosis of the PVA for the period from 6 months to 12 months were: atherosclerosis, fistula vein diameter, repeated operations, the number of repeated operations, a

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reason for a repeated operation, duration of anticoagulant therapy, correction of anticoagulant therapy, antibiotic therapy. ***Conclusions.*** The results of the study suggest that the realization of the identified risk factors is not the only cause of complications. For a more detailed consideration of the probability for thrombosis of permanent vascular access in different time intervals, it seems appropriate to use multidimensional mathematical modeling.

Keywords: *permanent vascular access; thrombosis risk factors; hemodialysis; chronic renal failure; arteriovenous fistula.*

Up to the moment, causes for complication of permanent vascular access (PDA) in patients with technically correct implementation of surgical intervention remain unclear [1]. The formed native arteriovenous fistula (AVF) works on average within 3-5 years, duration or this period reduces due to development of complications (thrombosis, stenosis, fistula vein aneurysm). With time the amount of patients with functional AVF declines [2]. The most common complication on the part of PVA which happens in 60% to 90% of cases is thrombosis of AVF. At present a number of rules are elaborated for use of PVA with the aim to prevent such complications as thrombosis, hemorrhage, infection of permanent vascular access, aneurysms of fistula vein. However, no methods have been developed permitting to detect changes in the fistula vein that impair the quality of hemodialysis to the extent of appearance of clinical manifestations requiring surgical, sometimes urgent, correction. Many works have been conducted to study factors that influence the risk of thrombus formation, such as low resistance of the vessel wall [3], prolongation of antiplatelet and anticoagulant therapy in dialysis patients [4,5], stenosis of fistula vein [6], and to assess the influence of circulating complexes [7]. Nevertheless, there remain many causes and mechanisms of complications of PVA as well as factors influencing the frequency of complications, that are not yet completely studied.

Aim – to carry out a complex analysis of factors influencing initiation of thrombosis of permanent vascular access and to determine their significance.

Materials and Methods

The results of surgical treatment of 168 patients with terminal stage of chronic kidney disease were monitored. Of them 73 (43%) were women and 95 (57%) were men. The mean age was 56±14 years. The results of treatment of the diseases were traced within 1 year (from September 2016 to September 2017).

In all patients PVA was performed in the lower third of the forearm by a modified technique proposed by M.J. Brescia и J.E. Cimino (1966): under local anesthesia from transverse access in the lower third of forearm with formation of anastomose of the type ‘end of cephalic vein into the side of radial artery’ by microsurgery methods using general surgical and microvascular kits. In all patients in the postoperative period a distinct systolic-diastolic thrill of the anastomosed vein was noted.

According to the results of treatment patients were divided into 2 groups: the 1st group – with no thrombosis of AVF within the first year of hemodialysis (n=126), the 2nd group included patients with dysfunction of PVA within the first year due to thrombosis (n=42).

In all patients included into the study, the history of the main disease that led to the terminal stage of CKD and a related pathology were evaluated, and preoperative examination was conducted with the aim to determine localization of access depending on the condition of arterial and venous bed in the scope of US examination using the Philips Envisor C HD apparatus (the Netherland) before and after tourniquet test.

Parameters of the initial condition of the patient before surgical intervention were ana-

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lyzed (gender, age, the main diagnosis, existence of essential hypertension, diabetes mellitus, hypotension, atherosclerosis,, ischemic heart disease, characteristics of the radial artery and of cephalic vein).

In pre- and postoperative period, parameters of CBC, of biochemical blood test, of formation of the aneurysm of the fistula vein during its use, speed characteristics of blood in the fistula, infections of vascular access were analyzed; in postoperative period – anticoagulant and antiplatelet therapy, antibiotic therapy.

Statistical processing was carried out using Statistica 12.0 (StatSoft Inc., USA), MedCalc® 18.2.1 (MedCalc Software, Belgium) programs. Basic descriptive characteristics, comparisons of differences between the groups, extended statistical methods including calculation of relative risk (RR) and odds ratio (OR), elements of multivariate statistics were used. The level of statistical significance was taken to be $p<0.05$.

Interpretation of the RR value was conducted in the following way. The relative risk parameter was compared to 1 (unity) to determine the character of relationship between the factor and outcome: if RR equaled 1, it was concluded that the studied factor did not influence the probability of outcome (absence of relationship between the factor and outcome); at the values >1 the factor increased the incidence of outcomes (feed-forward); the values <1 meant a reduction of the probability of outcome under influence of the factor (feedback).

Besides, the limits of 95% confidence interval (CI) were evaluated. If both values – of the lower and upper limits were located on the same side from 1, or, in other words, CI did not include 1, the conclusion was made about statistical significance of the identified link between the factor and outcome with the probability of error $p\leq0.05$.

Results and Discussion

The analysis of the data obtained demonstrated an increase in the quantity of complications with the time of functioning of PVA, and in this context the patients' data were analyzed in different periods of observation. In result, the patients were divided into groups depending on the time of development of thrombosis, and, accordingly, on the increase in the amount of these complications [8,9] with the critical point 6 and 12 months (Tables 1, 2).

Table 1

Relative Risk and Odds Ratio for Initiation of Thrombosis with Critical Point of 6 Months of Functioning

	Value	**CI -95%**	**CI +95%**	**Significance Level, p**
RR	4.75	2.06	10.93	0.0002
OR	5.77	2.35	14.17	0.0001

Table 2

Relative Risk and Odds Ratio for Initiation of Thrombosis with Critical Point of 12 Months of Functioning

	Value	**CI -95%**	**CI +95%**	**Significance Level, p**
RR	1.20	0.24	5.89	0.0080
OR	1.63	1.22	2.17	0.0070

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For evaluation of probable risk factors for thrombosis of PVA, relative risks were calculated in different critical intervals, namely before 6 months and after 6 months (Tables 3, 4).

Table 3

Relative Risks for Development of Thrombosis of Permanent Vascular Access before 6 Months

Factor	RR	CI -95%	CI +95%	Significance Level, p
Atherosclerosis	2.18	0.85	5.60	0.1000
Urea level before operation	0.90	0.51	1.60	0.7200
Blood flow velocity through fistula	0.62	0.27	1.41	0.2500
Stenosis of fistula vain	3.75	0.59	23.66	0.1600
Sepsis	10.50	0.44	252.56	0.1500
Repeated operations	2.57	1.77	3.72	<0.0001
Quantity of repeated operations	0.24	0.09	0.66	0.0050
Reason for repeated operation	0.18	0.03	1.23	0.0800
Duration of anticoagulant therapy	8.79	3.68	20.95	<0.0001
Correction of anticoagulant therapy	5.06	2.56	10.02	<0.0001
Antibiotic treatment	2.51	1.74	3.63	<0.0001
Urea level after operation	1.47	0.60	3.57	0.4000

Table 4

Relative Risks for Development of Thrombosis of Permanent Vascular Access in Period from 6 to 12 Months

Factor	RR	CI -95%	CI +95%	Significance Level, p
Hypotension	9.00	0.96	84.21	0.0541
Atherosclerosis	3.07	1.23	7.67	0.0161
Fistula vein diameter	1.50	1.02	2.22	0.0418
Urea level before operation	0.85	0.48	1.48	0.5583
Repeated operations	2.87	1.97	4.18	<0.0001
Quantity of repeated operations	4.61	1.37	15.54	0.0137
Reason for repeated operation	0.25	0.08	0.77	0.0155
Antiplatelet therapy	1.39	0.57	3.387	0.4713
Anticoagulant therapy	2.95	0.19	46.037	0.4405
Duration of anticoagulant therapy	10.37	4.10	26.28	<0.0001
Correction of anticoagulant therapy	5.90	2.86	12.19	<0.0001
Antibiotic therapy	0.44	0.29	0.69	0.0003
Urea level after operation	1.39	0.57	3.39	0.4644

On the basis of the obtained data, risk factor for thrombosis of PVA in 6-month period included: repeated operations, duration of anticoagulant therapy, correction of anticoagulant therapy, antibiotic therapy. Risk factor for thrombosis of PVA in the period from 6 to 12 months included: atherosclerosis, fistula vein diameter, repeated operations,

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quantity of repeated operations, reason for a repeated operation, duration of anticoagulant therapy, correction of anticoagulant therapy, antibiotic therapy.

Thus, calculation of risk factors in two critical periods permitted to determine a set of parameters that influence development of thrombosis of the permanent vascular access with a high chance of realization that should be taken into consideration.

In the world literature much attention is given to search for dependence of thrombosis on mutations of thrombophilic genes [10,11], to analysis of blood flow types for development of stenosis [6], and also to monitoring of intraluminal pressure during hemodialysis procedure. All these goals are resource-consuming from the point of view of both labor and money. In the given study for the first time a search for interrelations of thrombosis of permanent vascular access was undertaken using routine diagnostic methods.

Conclusion

The main risk factors promoting thrombosis of permanent access within the first year irrespective of the analyzed period (before 6 months and after 6 months) are atherosclerosis, duration of anticoagulant therapy, correction of anticoagulant therapy, antibiotic therapy, fistula vein diameter, multiple operations, reasons for a repeated operation.

Realization of the stated risk factors is probably not the only reason for development of complications. To consider the probability for development of thrombosis of vascular access in different periods of time it would be reasonable to continue the work with use of multidimensional mathematical modeling.

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Дополнительная информация [Additional Info]

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Информация об авторах [Authors Info]

Староверов Илья Николаевич – д.м.н., доцент, зав. кафедрой хирургии Института постдипломного образования, ФБГОУ ВО Ярославский государственный медицинский университет Минздрава России, Ярославль, Россия; зав. отделением сосудистой хирургии, ГБУЗ ЯО Областная клиническая больница, Ярославль, Россия. [**Ilya N. Staroverov** – MD, PhD, Associate Professor, Head of the Surgery Department of Postgraduate Education Institute, Yaroslavl State Medical University, Yaroslavl, Russia; Head of the Department of Vascular Surgery, Regional Clinical Hospital, Yaroslavl, Russia.]
SPIN: 8011-7176, ORCID ID: 0000-0001-9855-9467, Researcher ID: M-8174-2014.

***Нощенко Никита Сергеевич** – аспирант кафедры хирургии Института постдипломного образования, ФБГОУ ВО Ярославский государственный медицинский университет Минздрава России, Ярославль, Россия.; врач сердечно-сосудистый хирург отделения сосудистой хирургии, ГБУЗ ЯО Областная клиническая больница, Ярославль, Россия. [**Nikita S. Noshchenko** – PhD-Student of the Surgery Department of Postgraduate Education Institute, Yaroslavl State Medical University, Yaroslavl, Russia; Cardiovascular surgeon of the Department of Vascular Surgery, Regional Clinical Hospital, Yaroslavl, Russia.]
SPIN: 4755-6307, ORCID ID: 0000-0001-7770-4370, Researcher ID: A-7229-2019. E-mail: noschenko.ns@gmail.com

Шубин Леонид Борисович – к.м.н., доцент кафедры патологической анатомии ФБГОУ ВО Ярославский государственный медицинский университет Минздрава России, Ярославль, Россия. [**Leonid B. Shubin** – MD, PhD, Associate Professor of the Department of Pathological Anatomy, Yaroslavl State Medical University, Yaroslavl, Russia.]
SPIN: 8021-7289, ORCID: 0000-0003-4562-7731, Researcher ID: A-9339-2019.

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