Diagnostic Value of Von Willebrand Factor on Changes in Tissue Oxygenation during Dental Implantation in Persons with Previous Coronavirus Disease

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Abstract: On the background of the wide introduction of dental implants into the dental practice, according to the data of some authors, the rate of complications at the different stages of dental rehabilitation of patients with dental implants is increasing. At present the scientists of the world pay more attention to the problem of pandemic-Covid-19. The whole population living on the Earth was exposed to a mild to moderate coronavirus infection, 58% of the Earth's population suffered from this infection in a severe form and 27% were fatal. From the implantologist's point of view, it is important that with prolonged arterial hypertension, reduced immunity with Covid-19 and regular administration of hypotensive, anticoagulant drugs, the phenomenon of "rarefaction" or "rarefaction" occurs, which is expressed in a reduction of the total surface of the exchange vessels [Jablonski D, 2014]. The von Willebrand factor (vWF) can serve as a prognostic and diagnostic marker of insufficient oxygen delivery to the tissues during recuperation and an indicator of the need to correct the ongoing therapy aimed at normalization of hemostasis disorders.

Key words: biochemical study, von Willebrand factor, dental implantation, diagnostic efficacy.

Study objective: to determine the diagnostic performance and importance of von Willebrand factor in assessing the outcome of dental implantation in patients with secondary adentia with previous coronavirus pathology.

Materials and methods of the study:

To address the aims and objectives of the study, we examined 100 patients and treated 77 patients who were operated on at the Department of Surgical Dentistry and Implantology, TGSI during the period 2018 to 2022.

The diagnosis of SARS-CoV-2 S-RDB (Covid-19) viral infection suffered by the patients was confirmed by clinical and laboratory investigation methods (ELISA and IHLA).

The patients admitted to the Department of Faculty Orthopaedic Dentistry were referred to the Department of Surgical Dentistry and Dental Implantology of Tashkent State Dental Institute, where they were diagnosed with Secondary Adentia. Condition after a previously suffered Covid-19.

An open method of dental implant management was used (with one-stage placement of gingival margin shapers).

The distribution of patients is shown in Table 1. In total 53 male and 34 female patients were examined, 87 of them were placed 491 intraosseous dental implants, Osteem and Impro systems.

Table 1. Distribution of patients according to gender and age

Gender		Age (number of years)			Total
		30-34	45-49	50-55	
Men	Number	8	34	11	53
	Percentage	9,2%	39,1%	12,6%	61%
Women	Number	4	14	16	34
	Percentage	4,6%	16,1%	18,4%	39%
Total	Number	12	48	27	87
	Percentage	13,8%	55,2%	31%	**100%**

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The patients were divided into four groups. All patients (100) were divided into 4 comparison groups depending on nosology, preoperative examination and treatment choice.

➢ Group 1 - observation group, it consisted of 30 patients with secondary adentia with a previous history of mild to moderate coronavirus pathology. This category of patients was prescribed vitamin complex CALCIVIT "Swiss energy" for restoration of calcium-phosphorus metabolism, stimulating osteomodeling and metabolism in bone tissue, as well as normalization of blood haemostasis;

➢ Comparison group 2 consisted of 25 patients with secondary adentia with a history of previous mild to moderate coronavirus pathology. This category of patients received only the traditional regimen, without prior preparation;

➢ Comparison group 3 consisted of 25 patients with secondary adentia with previous history of mild to moderate degree coronavirus pathology in the background of associated disease (cardiovascular system);

➢ Group 4 was a control group of 20 patients without Covid-19 and without concomitant pathology.

The control group consisted of practically healthy patients without background disease, whose laboratory and functional examination did not reveal general somatic pathology, but who had dental defects; they were 30 people.

During the examination of the patients at the preoperative stage, general clinical (anamnesis, examination of the intended implant site, measurement of blood pressure and pulse), radiological (aim radiography, panoramic zonography (orthopantomography) and computer tomography), functional and laboratory methods of examination (ultrasound Doppler flowmetry, ECG, total clinical blood count, blood biochemical analysis) were used.

Results of the study and discussion

Since numerous changes after coronavirus infection are observed in the circulatory organs and hemostasis system, we used rheocardiography for early diagnosis of latent hemodynamic disorders. Individual characteristics of a patient (weight, height, sex, age), as well as a number of laboratory parameters (in our case hemoglobin level) were taken into account when calculating physiological indices of vital organs. The following parameters were studied: BP, HR, central hemodynamics - myocardial contractility (SI, UI) and peripheral hemodynamics (IPSS), as well as their integral index - tissue oxygen delivery index (DO2I), which characterizes capillary blood flow and the intensity of aerobic metabolic processes in the body. These indices were analyzed in the period of recuperation in the study groups (Table 1).

Table 1 – Haemodynamic parameters in patients in vWF groups during the period of recuperation after COVID-19

Indicator	Control group (n=20)	Group I (n=30)	Group III (n=25)	P
HR, beats per minute	68,60 [63,25; 73,75]	74,0 [62,0; 83,0]	68,5 [61,0; 74,0]	0,16
BPc, mmHg.	111,80[107,75; 127,0]	114,0 [110,0; 124,0]	126,0* [115,0; 136,0]	0,06
Std.	72,20 [65,75; 92,0]	76,0 [74,0; 86,0]	79,0 [74,0; 89,0]	0,39
BPd, mm Hg.	3,55 [2,80; 3,80]	2,8 [2,2; 3,7]	2,4* [1,8; 3,1]	**0,04**
std.	52,10 [43,50; 56,75]	43,0 [31,0; 52,0]	34,0* [24,0; 45,0]	0,05
SI, l/min/m2	2124,5 [1636,0; 2326,0]	2439,0 [1940,0; 3443,0]	3389,0* [2338,0; 4278,0]	**0,03**
UI, ml/m2	669,0 [537,0; 724,0]	533,0 [380,0; 692,0]	437,0* [307,0; 560,0]	**0,02**

*Notes: p - statistical significance of differences in values between groups, Mann-Whitney test; * - statistical significance of differences in values compared with the control group, Mann-Whitney test.*

There were no differences in BP and HR between the studied groups, and the data corresponded to age-related norms. The median UI in group II was 34 [24; 45] ml/m2 versus 43 [31; 52] ml/m2 in group I (p=0.05), suggesting a decrease in patients' exercise capacity and endurance during recuperation. The UI value was correlated with a decrease in the quality of performance of daily activities against a background of emotional state (RE) (y=0.21; p=0.031). SI was also decreased in group II (p=0.04) and was 2.4 [1.8; 3.1] l/min/m2, indicating a lower heart rate. There was a correlation between SI and vital activity (VT) (y=0.21;p=0.03) and role functioning due to emotional state (y=0.22; p=0.047) in group III patients. The EPSS, as a rule, reflects the degree of peripheral vasoconstriction. There was an increase in its value in Group III patients (p=0.03) and a significant difference from the control group (p=0.006).

The main interest was to study the effect of vWF changes on tissue oxygenation. A negative correlation between vWF level and DO2I was found (y= -0.37; p=0.005). Every second patient (62%) of those included in the study had a decreased DO2I (p=0.02) during the period of recuperation. According to A.A. Antonov, the developer of Simon 111 integral monitoring system, DO2I in a healthy person (not an athlete) is 600±100 ml/min/m2 [20]. In our study in the control group, DO2I=669±168 ml/min/m2. In group II, DO21 was 437.0 ml/min/m2 [307.0; 560.0], which was significantly lower than in group I and control group, respectively (p=0.02 and p=0.003). The lower DO2I, the worse the process of oxygen transport to organs and tissues, which is clinically manifested by reduced role functioning due to both physical (y=0.18; p=0.038) and emotional (y=0.21; p=0.034) conditions.

Significant values of sensitivity and diagnostic efficiency at low specificity allow to use vWF in the postvoid period as a screening marker of tissue oxygenation disorders in the period of recuperation.

In addition to the use of vWF value as a prognostic marker of the risk of developing hypoxic conditions, the determination of this value during the recuperation period and its impact on oxygenation can be used as a diagnostic marker in order to decide on the appropriateness of the ongoing therapy (including anticoagulant therapy) correction.

The method of logistic regression revealed the possibility of using the vWF index during the period of recuperation in the diagnosis of insufficient tissue oxygenation (Table 2).

Table 2. Odds ratio and probability of DO2I reduction when vWF is increased in patients during COVID-19 recuperation

Value	P+	OR (95% CI)	Bi	B0	x^2	p
vWF >187,9%	0,77	3,39 (1,06-10,9)	1,22 p=0,049	0,57 p=0,043	4,6	0,03

Here: OR - odds ratio; 95% CI - 95% confidence interval; P+ - probability of DO2I reduction; Bi - regression coefficient of independent factor "risk" i; B0 - free term in regression equation; %2 - Pearson test; p - statistical significance level of regression equation.

As follows from the table, at vWF value >187,9% or 1,3 and more times higher than the upper limit of the reference interval in 1,5 months after the coronavirus infection, the probability of DO2I reduction in the returnees is 0,77 (x2=4,6; p=0,03).

Conclusions:

1. vWF can thus serve as a prognostic and diagnostic marker of inadequate oxygen delivery to the tissues during the recuperation period and an indicator of the need for correction of the ongoing therapy aimed at normalizing hemostasis disorders, which is particularly important to consider when performing dental implantation.

2. Significant values of the indicators of sensitivity and diagnostic efficiency with low specificity allow the use of vWF in the postvoid period as a screening marker of tissue oxygenation disorders in the period of recovalescence.

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