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Application of Test Systems in Diagnosis and Monitoring of Brucellosis Infection in Donors Blood

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Abstract Based on analysis of comparative data on peculiarities of brucellosis progression, an assertion can be made that in the latest decade brucellosis in people has been less symptomatic which impedes its diagnostics. In such cases laboratory methods of studying this infection are utterly important. This confirms the importance of improving and developing new, more sensitive and specific means of diagnostics, especially those for rapid testing and instrumental account of test results. A diagnostic test system has been developed for detection of brucellosis pathogens in indirect IFA and PCR in the course of study of human biological material, and the conditions for its application have been optimized. The results are presented to demonstrate that the test system is fairly specific and sensitive, which allows proposing it for routine diagnostics of brucellosis as a complementary or alternative test method.

Keywords Donor blood, Brucellosis infection, Heddelson reaction, Wright reaction, IFA, PCR

1. Introduction

Blood transmitted infection is the commonest cause of complications after blood transfusion. The etiological agents can be virus, bacteria or protozoa. These organisms can cause clinical sickness in recipient, can persist in him as carrier state or can cause asymptomatic infection in him. Every blood bank follows screening analyses to prevent such infections but the infective agents escape detection due to window period – a period where in the infective agent's presence cannot be detected, though it is present in donor's blood. [1]

Among the donors who have applied to the blood transfusion center of the Republic of Uzbekistan, the incidence of brucellosis infection improving inspection methods and comparing them.

2. Material and Methods

For this study, out of 128,158 donors who donated voluntary blood to the Republican blood transfusion center of the Ministry of health of the Republic of Uzbekistan in 2021-2024, 90 donors of blood serum were isolated, which at the first stage gave a positive result to the Heddelson agglutination reaction. The blood of 90 donors with isolated positive results is the Wright's agglutination reaction (Ecolab), Immunoferment method (Brucella-IgM-IFA-BEST and Brucella-IgG-IFA-BEST) and PCR ("Amplicense Brucella spp.- FL") with research was conducted using diagnostic systems. Based on the results of our study, the distribution of donors (n=90) with positive brucellosis infection by age and gender was 18–60 years. Of these, the male donors 78 (86,7%), (38,3+1,1) and woman donors 12 (13,3%), (40,5+3,8) were organized. (1-table)

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Table 1

		number of donors			
		main group (n=90)		control group (n=50)	
		abs.	%	abs.	%
Gender	M	78	86,7	49	98,0
	W	12	13,3	1	2,0
Age	M	38,3±1,1		36,9±1,2	
	W	40,5±3,8		47,0±0,0	
	general	38,6±1,1		37,1±1,2	

Comparative results of the effectiveness of the test using ECOlab and Single Brucellosis Antigen Reagents according to the Heddelson method (abs/%) (Table 2)

Table 2

Heddelson reaction	ECOlab (n=90)		Single Brucellosis Antigen (n=90)		P
	abs.	%	abs.	%	
0,04 suspicious	10	9,0+0,0	10	9,0+0,0	>0,05
0,02 positive	15	13,5+3,3	13	11,7+3,3	>0,05
0,01 positive	65	72,2+4,7	67	74,4+4,6	>0,05

In the first stage, the blood of 90 donors was studied using the Heddelson reaction method Ecolab and Single Brucellosis antigen reagents, in the blood of 90 donors taken for research, 10 donors have a titer of 0.04 (9,0%) suspicious, 15 donors had positive results with a titer of 0.02 (13,5+3.3%), and 65 donors had positive results with a titer of 0.01 (72.2+4.7%) and 90 donors taken for research, 10 donors have a titer of 0.04 (9,0%) suspicious, 13 donors had positive results with a titer of 0.02 (11,7+3.3%), and 65 donors had positive results with a titer of 0.01 (74.4+4.6%).

The Heddleson reaction has a relative specificity of $p<0.05$ compared to the Wright reaction, and a relative specificity of $p<0.001$ compared to the IFA and PCR methods. [2]

Results of Wright's reaction for brucellosis infection in donor blood (abs/%), (1-Figure).

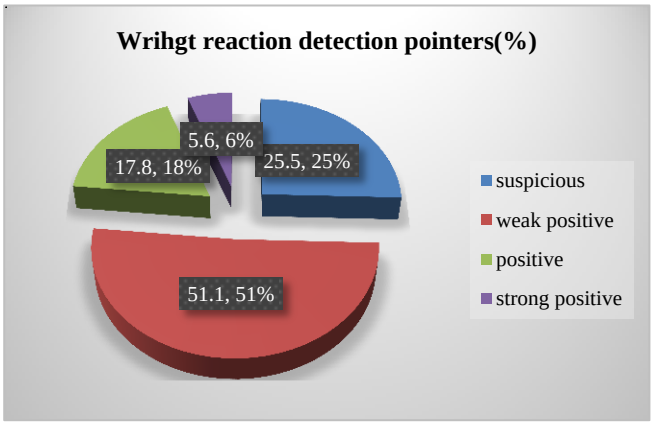

Figure 1

In the second stage, the blood of 90 donors with positive results was tested using the Wright reaction method. Of the 90 donors taken for the study, 23 donors (25.5%) showed doubtful results, 46 donors (51.1%) showed weak positive results, 16 donors (17.8%) showed positive results and 5 donors (5.6%) showed strong positive results. [3]

The Wright reaction the relatively comparative detection pointer to the Heddleson reaction was ($p<0.05$), compared to the IFA and PCR methods the comparative detection pointers were ($p<0.01$).

Results of testing donor blood for brucellosis infection using the IFA method (abs,%), (2-Figure).

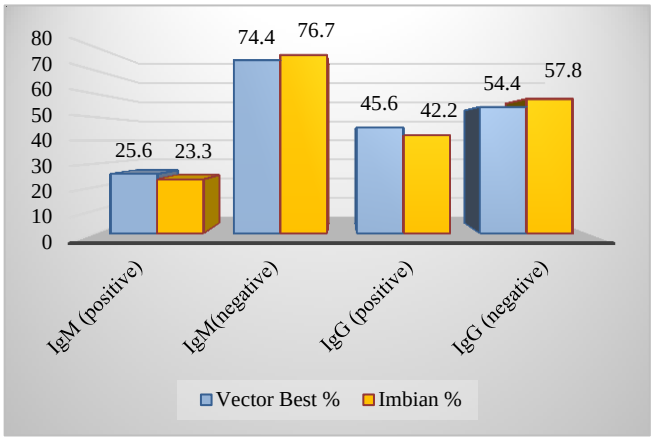

Figure 2

In the third stage, a study was carried out using the IFA method, which identified specific serum antibodies IgM and IgG, and examined whether or not there is immunity to brucellosis. Specific antibodies in donor blood using the IFA method (Vector Best) IgM positive results in 23 donors (25.6%) and in 67 donors (74,4%), (0,749±0,10) showed negative results, moreover, specific antibodies in the blood of donors IgG positive results in 41 donors (45.6%) and in 49 donors (54,4%), (1,581±0,17) showed negative results. Specific antibodies in donor blood using the IFA method (Imbian) IgM positive results in 21 donors (23.3%) and in 69 donors (79,9%), (0,749±0,10) showed negative results, moreover, specific antibodies in the blood of donors IgG positive results in 38 donors (42.2%) and in 52 donors (57,8%), (1,581±0,17) showed negative results. The IFA method the relatively comparative detection pointer to the Heddleson reaction was ($p<0,001$), the compared to the Wright reaction ($p<0.05$), and the relatively comparative detection pointer to the PCR method was ($p>0.05$) showed results. [4]

Comparative determination of the efficiency of positive results when tested using the Vector Best and Imbian reagents by the IFA method (abs/%) (Table-3).

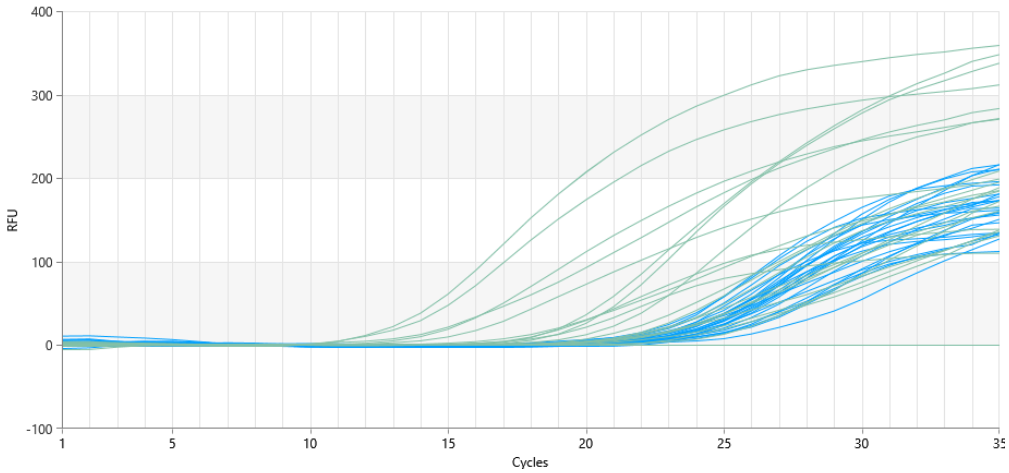

Figure 3

Table 3

IFA	Vector Best (n=90)		Imbian (n=90)		P
	abs.	%	abs.	%	
IgM	23	25,6+4,6	21	23,3+4,5	>0,05
IgG	41	45,6+5,3	38	42,2+5,2	>0,05

3. Results and Discussions

In our study, testing of brucellosis infection in the blood of donors by the IFA method showed almost the same results when tested using the Vector best and Imbian reagents. [5]

Results of PCR testing of brucellosis infection in donor blood (abs/%) (4-Table).

Table 4

PCR (n=90)	abs.	%
negative	51	56,7
weak positive	18	20
positive	21	23,3

In the fourth step, a study using the PCR method was performed, showing weak positive results in 18 donors (20%), positive results in 21 donors (23.3%) and negative results in 51 donors (56.7%). [6]

Comparative results of testing donor blood for brucellosis infection using Heddelson, Wright reactions, IFA and PCR methods (abs/%) (5-Table).

Table 5

(n=90)		Negative		Postive	
		abs.	%	abs.	%
1	PCR	51	56,7	39	43,3
2	IFA(Vector Best) IgM	67	74,4	23	23,5
	IFA(Vector Best) IgG	49	54,4	41	45,6
	IFA(Imbian) IgM	69	76,7	21	23,3
	IFA(Imbian) IgG	52	57,8	38	42,2
	χ^2	1,5			
	P_{1-2}	>0,05			
3	Heddelson	11	12,2	79	87,8
	χ^2	39,4			
	P_{1-3}	<0,001			
	χ^2	53,9			
	P_{2-3}	<0,001			
4	Wright reaction	23	25,6	67	74,4
	χ^2	18,0			
	P_{1-4}	<0,01			
	χ^2	29,0			
	P_{2-4}	<0,01			
	χ^2	5,2			
	P_{3-4}	<0,05			

The conducted studies showed that, PCR method compared to Heddelson reaction $p<0.001$, $\chi2$ -39.4, compared to Wright reaction, $p<0.01$, $\chi2$ -18.0, compared to IFA method, $p>0.05$, $\chi2$ -1.5, IFA method compared to Heddelson reaction $p<0.001$, $\chi2$ -53.9, compared to Wright reaction, $p<0.05$, $\chi2$ -29, Heddelson reaction compered to Wright reaction, $p<0.05$, $\chi2$ -5.2 comparative pointers showed. [7]

4. Conclusions

The use of IFA and PCR methods in the diagnosis and monitoring of Brussels infections in the blood of donors plays a key role in ensuring transfusion safety. Regular screening of blood donors using these methods reduces the risk of infection and helps protect the health of blood recipients.

Thus, the use of IFA and PCR methods in the diagnosis and monitoring of brucellosis infection in donor blood is a necessary element of modern tranfusiology, ensuring a high level of safety and effectiveness of transfusion processes.

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